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REGIONAL ISSUE IDENTIFICATION AND ASSESSMENT

FIRST ANNUAL REPORT

SEPTEMBER 1979

U.S. DEPARTMENT OF ENERGY
OFFICE OF THE ASSISTANT SECRETARY FOR ENVIRONMENT
OFFICE OF TECHNOLOGY IMPACTS
REGIONAL ASSESSMENTS DIVISION

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FOREWORD

This regional assessment report portrays the major regional environmental, human health and safety, socioeconomic and institutional effects that might result from the implementation of one of a set of national energy supply and demand projections developed by the Department of Energy in 1978. General problem areas are identified and assessed on a regional and state basis that could either constrain or significantly modify the realization of the energy projections. Many of the issues identified are of a long-standing nature and would continue to exist, in spite of the particular energy projection used.

We believe this assessment to be innovative, that is, it is the first time the Federal Government has attempted to examine comprehensively and in detail the impacts of national policy at the state and sub-state level. It provides the type of insight that should make it a valuable and important tool for the formulation of energy policy at all levels of government.

The research and assessments reflected in this document were performed by the following national laboratories:

Argonne National Laboratory
Brookhaven National Laboratory
Lawrence Berkeley Laboratory
Los Alamos Scientific Laboratory
Oak Ridge National Laboratory
Pacific Northwest Laboratory

It is a compilation of individual reports prepared by Federal regions and available separately. The project was managed by the Regional Assessments Division, Office of Technology Impacts, Office of Environment.

This regional assessment activity is continuing with an examination of a more recent energy supply/demand projection. Since this is the first report--a report which breaks new ground--we would appreciate your comments and suggestions on how we might make future regional assessments more useful. Comments, questions, and suggestions should be directed to Dr. Joan Hock, Director, Regional Assessments Division, Office of Environment, U.S. Department of Energy, Washington DC 20545, telephone: (301) 353-4258.

Ruth C. Clusen
Assistant Secretary for Environment

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DEPARTMENT OF ENERGY

Arthur Katz - RIIA Program Manager
Theodore Harris - Deputy Director,
Regional Assessment Division

NATIONAL LABORATORY PROGRAM MANAGERS

Stephen Ballou - Argonne
Richard Davis - Oak Ridge
Darryl Hessel - Pacific Northwest
Peter Meier - Brookhaven
Donald Morris - Los Alamos
William Siri - Lawrence Berkeley

SYSTEMS CONSULTANTS, INC.

Cameron McDonald
Craig Williams

All of the above made major contributions to
the continuing operation of the RIIA program

Proofreading, typing, art and production by:

Donna Baden
Judy Bremmerman
Douglas Canete
Lawrence Krupnak
Janet Mitchell
Marie Pecarro
Keith Schools
Fred Sparks
Maxian Wells

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INTRODUCTION

This report represents an initial step in developing a technical basis for understanding the potential regional implications of proposed energy policies.

The Department of Energy Regional Issue Identification and Assessment Program (RIIA) is conducted by the Regional Assessments Division of the Office of Technology Impacts (OTI), Office of Environment. It is one of several ongoing activities of OTI designed to provide detailed information on the environmental, socioeconomic, and health and safety impacts of various energy alternatives. Studies of this kind are designed to permit an analysis of the energy, economic, and environmental trade-offs presented by proposed policies. RIIA specifically provides the Department and other energy policymakers a regional framework for decisionmaking.

STUDY DESCRIPTION

The approach taken by the RIIA program for this study is shown in Figure A-1. In the first step a basic Department of Energy mid-term (through 1990) national projection (scenario) of future energy development was chosen. This scenario, referred to as the Projection Series C, is one of six developed for the Department's Annual Report to Congress published in April, 1978.* It assumes medium energy demand and fuel supply through 1990 as projected prior to the passage of the National Energy Act.

The next step utilized the fuel mix predicted by the scenario (i.e., the proportions of coal, oil, geothermal, etc.) In 1985 and 1990 power plants, major fuel burning industrial plants, and mines were located throughout the United States for these years based on the projected Federal regional fuel mix. Energy sources included in the scenario were coal, nuclear, oil, gas, oil shale, geothermal, hydroelectric, and solar. Assumptions regarding control technologies are shown in Table A-1. One caveat, because 1985 and 1990 energy use represents a forecast, these predicted energy patterns may deviate from other currently available regional plans.

After the location of the projected energy facilities was completed, each participating laboratory then performed two major, distinct tasks. First, each laboratory (Figure A-2) determined the impact of future energy development on one or more environment impact areas (e.g., air quality, water quality, etc.) for the Nation. This exercise was referred to as the "lead impact analysis" and the appointment of a laboratory to a specific analysis was made on the basis of that laboratory's demonstrated expertise, shown in Figure A-2.

Secondly, each laboratory utilized these "lead analyses" to support their own intensive regional assessment. These assessments focused on the specific problems unique to the particular region(s) for which the laboratories were responsible (Figure A-3). This report is a compilation of these efforts.

*Energy Information Administration, Annual Report to Congress, 1977, DOE/EIA-0036/2 (Executive Summary).

Figure A-1
MAJOR STEPS IN THE RIIA METHODOLOGY

Figure A-2

"LEAD LABORATORY" ASSIGNMENTS FOR RIIA I

- ORNL - Utilities siting
Industrial siting
Water availability
- BNL - Industrial siting
Emissions
Eastern long-range transport of air pollutants
Public and occupational health and safety
Solid waste
- ANL - Water quality
Local air quality
Ecology/Land use
Local socioeconomics
- LASL - Visibility
- PNL - Western long-range transport of air pollutants
- LBL - National economics

Table A-1
CONTROL TECHNOLOGY ASSUMPTIONS

	UTILITY	INDUSTRY	MINING																		
AIR	<p>EMISSIONS AND LOCAL AIR QUALITY:</p> <p><u>COAL</u></p> <ul style="list-style-type: none">EXISTING PLANTS - UNCONTROLLED EMISSIONS BASED ON FPC COAL CHARACTERISTICS FOR ASH, HEAT AND SULFUR (1976)PLANTS WITH STARTUP DATES PRIOR TO 1983 - SIPS OR NSPS REQUIREMENTSPLANTS WITH STARTUP DATES AFTER 1983 - BACT, 85% AND 90% CONTROL OR REMOVAL OF SO₂ CONSIDERED <p><u>OIL</u></p> <ul style="list-style-type: none">SIPS REQUIREMENTS <p><u>GAS AND METALLURGICAL COAL</u></p> <ul style="list-style-type: none">UNCONTROLLED	<p>EMISSIONS AND LOCAL AIR QUALITY:</p> <p><u>COAL</u></p> <ul style="list-style-type: none">NEW LARGE SOURCES (250 X 10⁶ BTU/HR) BACT, 80% REMOVALNEW SMALL SOURCES (100-250 X 10⁶ BTU/HR) 1.5 LB/10⁶ BTUNEW NON-MFBI PLANTS (100 X 10⁶ BTU/HR) SIPS WITH PHYSICAL CLEANINGEXISTING LARGE SOURCES (250 X 10⁶ BTU) SIPS FOR MFBIEXISTING SMALL SOURCES (100-250 X 10⁶ BTU/HR) SIPS FOR MFBIEXISTING NON-MFBI PLANTS (100 X 10⁶ BTU/HR) SIPS USING LOCALLY AVAILABLE COAL <p><u>OIL AND GAS</u></p> <ul style="list-style-type: none">SIPS LIMITATIONS ON SULFUR CONTENT OF FUEL, AS A WEIGHT FRACTION.EMISSIONS FACTORS IN USEPA "COMPILATION OF AIR POLLUTANT FACTORS". <p><u>PARTICULATES</u></p> <ul style="list-style-type: none">BACT, 99% REMOVAL0.05 LB/10⁶ BTUSIPS, CYCLONESSIPS FOR MFBISIPS FOR MFBISIPS USING SETTLING CHAMBER/EXPANDED CHIMNEY & CYCLONES	<p>NO ASSUMPTIONS MADE. AIR POLLUTANTS FROM MINING ACTIVITIES NOT CONSIDERED.</p>																		
WATER QUALITY	<p>BPCT, EFFECTIVE JULY 1977</p> <p>BACTEA, EFFECTIVE JULY 1984</p> <p>NSPS, EFFECTIVE JULY 1977</p> <p>UTILITY GENERATING LOAD FACTOR - 55%</p>	<p>BPCT, EFFECTIVE JULY 1977</p> <p>BACTEA, EFFECTIVE JULY 1984</p> <p>NSPS, EFFECTIVE JULY 1977</p>	<p>MINE DRAINAGE: "COAL SUPPLY REGION" (CSR) DRAINAGE DATABASE - COMPLIANCE WITH EFFLUENT LIMITATIONS ASSUMED.</p> <p>COAL WASHING: ASSUME 50% OF COAL IS CLEANED, 95% OF THAT BY WET METHODS. ALL FACILITIES HAVE ZERO DISCHARGE IN CSRs 7 - 10, 60% OF FACILITIES HAVE ZERO DISCHARGE IN CSRs 1 - 6, CSR 11 AND CSR 12. 40% OF FACILITIES IN THOSE CSRs PRODUCE 2,150 LITERS/METRIC TON OF COAL WASHED.</p> <p>COAL REFUSE FILL: 40% OF ANNUAL PRECIPITATION IN EACH CSR RESULTS IN EFFLUENT RUNOFF: 7.06 X 10⁶ HECTARES/METRIC TON OF COAL CLEANED ARE EXPOSED TO RAIN FOR ONE YEAR.</p> <p>RECLAMATION: SEDIMENTATION CAN ACHIEVE 30% CONTROL EFFICIENCY. OTHER RUNOFF RATES ARE FROM EPA NATIONAL ASSESSMENT OF NON-POINT SOURCE POLLUTION.</p>																		
WATER AVAILABILITY	<p>COOLING OPTION:</p> <table><thead><tr><th></th><th>NUCLEAR (1000 MW)</th><th>FOSSIL (1000 MW)</th></tr><tr><th></th><th>WITH- DRAWAL (MGD)</th><th>WITH- DRAWAL (MGD)</th></tr></thead><tbody><tr><td>ONCE THROUGH</td><td>1400</td><td>230</td></tr><tr><td>POND OR CANAL</td><td>42</td><td>25</td></tr><tr><td>WET COOLING TOWER</td><td>28</td><td>17</td></tr><tr><td>DRY COOLING TOWER</td><td>0.3</td><td>0.2</td></tr></tbody></table>		NUCLEAR (1000 MW)	FOSSIL (1000 MW)		WITH- DRAWAL (MGD)	WITH- DRAWAL (MGD)	ONCE THROUGH	1400	230	POND OR CANAL	42	25	WET COOLING TOWER	28	17	DRY COOLING TOWER	0.3	0.2	<p>DATA BASE:</p> <ul style="list-style-type: none">WATER CONSUMPTION DATA DEVELOPED FOR THE WATER RESOURCES COUNCIL.	<p>WATER REQUIREMENTS FOR COAL EXTRACTION AND WASHING, DUST CONTROL AND REVEGETATION ARE ASSUMED TO BE NEGLIGIBLE.</p>
	NUCLEAR (1000 MW)	FOSSIL (1000 MW)																			
	WITH- DRAWAL (MGD)	WITH- DRAWAL (MGD)																			
ONCE THROUGH	1400	230																			
POND OR CANAL	42	25																			
WET COOLING TOWER	28	17																			
DRY COOLING TOWER	0.3	0.2																			
SOLID WASTE	<ul style="list-style-type: none">COAL CHARACTERISTICS IN 1985 AND 1990 ARE THE SAME AS IN 1976. DATA FROM FPC TAPES.USE OF ELECTROSTATIC PRECIPITATORS AND FLUE GAS DESULFURIZATION WITH LIME/LIMESTONE SLURRIES ASSUMED FOR 1985 AND 1990.	<ul style="list-style-type: none">NSPS AND SIPS REQUIREMENTS USED TO DETERMINE ASH AND FGD SLUDGE PRODUCTION AND LAND REQUIREMENTS.	<ul style="list-style-type: none">CONVERSION FACTORS FOR COAL MINING RANGED FROM 0.0818 ACRES/1000 TONS (COAL MINED) IN DEEP MINING IN EASTERN KENTUCKY TO 0.235 ACRES/1000 TONS IN STRIP MINING IN ARKANSASPAST BUREAU OF MINES DATA AND MINRES PROGRAM WERE USED TO DETERMINE MINING RESIDUALS.																		

ABBREVIATIONS:

BACTEA	BEST AVAILABLE CONTROL TECHNOLOGY ECONOMICALLY ACHIEVABLE
BEA	BUREAU OF ECONOMIC ACTIVITY AREA
BPCT	BEST PRACTICABLE CONTROL TECHNOLOGY
BTU	BRITISH THERMAL UNIT
FGD	FLUE GAS DESULFURIZATION
FPC	FEDERAL POWER COMMISSION
MFBI	MAJOR FUEL BURNING INSTALLATIONS
MGD	MILLION GALLONS PER DAY
MW	MEGAWATTS
NSPS	NEW SOURCE PERFORMANCE STANDARDS
SIPS	STATE IMPLEMENTATION PLANS

NATIONAL SCENARIO

The Projection Series C or Mid-Mid Scenario represents a mid-range projection (i.e., through 1990) of energy development based on assumptions of medium supply, medium demand, and constant world oil prices. It projects the future on the basis of the continuation of policies existing prior to the implementation of the National Energy Act (NEA). Basic assumptions for the scenario on the national level include the following:

- o Slight increase in domestic oil production due to Alaskan oil field and outer continental shelf (OCS) development.
- o Continued decline of natural gas production in the lower 48 states.
- o Dramatic increase in coal production, particularly in the western states, due to increasing demand coupled with rising oil and gas prices.
- o Decrease in the growth rate of electricity sales from the historic 7% to 4.5% per year, representing saturation of the market for air conditioning and other major appliances that appeared during the 1960s. The projected growth is consistent with 5% growth from 1970 to 1976 and 4.2% from 1976 to 1977.
- o Shift in the industrial sector from gas to oil and to a lesser extent to electricity, indicated by fuel shares in the industrial sector.
- o Constant world oil price of \$15.32/barrel.

Table A-2 shows the national Mid-Mid scenario projection for energy supply and demand for 1985 and 1990, and the status in 1975. Total supply is projected to increase from 72.6 quadrillion Btus (quads) in 1975 to 96.9 quads in 1985 and 110.9 quads in 1990 (see Figure A-4). Total electricity generation in 1975 was 2036 billion kilowatt hours; the scenario projects increases to 3045 in 1985 and 3692 in 1990. The fuel mix for electrical generation (Figure A-5) changes with increased use of nuclear power, and decreases in oil and gas.

Figure A-6 compares energy use in 1975 and 1990 by fuel type. The growth of energy derived from coal, uranium, and imported oil are the most significant changes. Since the scenario is only projected to 1990, alternate energy sources are not an important part of the predicted energy mix.

Per capita energy use is shown in Figure A-7. The largest area of energy growth is projected to be industrial. Figures A-8, A-9, and A-10 display the regional growth rates through 1985 assumed by this scenario for population, employment, and energy. As one might expect, the strongest growth areas are found in the Southwest, and parts of the South Central and South Eastern regions.

A PERSPECTIVE ON REGIONAL ISSUES

The discussion by each laboratory focuses on region specific issues. However, it is important that the material developed at the state and Federal

Table A-2 National 1975, 1985 and 1990 Energy Supply/Consumption Balance (Quadrillion Btu Per Year)

<u>Projection Series(a)</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
<u>DOMESTIC PRODUCTION</u>			
Crude Oil	17.9	19.0	18.0
LNG and Butane	2.6	2.0	1.8
Shale Oil	0.0	.1	.3
Natural Gas	19.0	17.2	16.7
Coal	14.6	23.1	27.5
Nuclear	1.8	6.2	10.3
Hydro and Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC PRODUCTION	59.1	71.8	79.6
<u>IMPORTS</u>			
Crude Oil	8.7	16.5	20.9
Petroleum Products	3.8	6.7	7.8
Natural Gas	1.0	1.9	2.6
TOTAL IMPORTS	13.5	25.1	31.3
TOTAL SUPPLY	72.6	96.9	110.9
<u>DOMESTIC CONSUMPTION</u>			
Oil	32.8	43.9	48.5
Natural Gas	20.0	19.1	19.3
Coal	12.8	21.2	25.4
Nuclear	1.8	6.2	10.3
Hydro and Geothermal	3.2	4.2	5.0
TOTAL DOMESTIC CONSUMPTION	70.6	94.6	108.5
<u>EXPORTS</u>			
Coal	1.8	1.9	2.1
Refinery Loss	.2	.4	.3
TOTAL CONSUMPTION AND EXPORT	72.6	96.9	110.9
<u>DOMESTIC CONSUMPTION BY SECTOR</u>			
Residential	14.7	19.0	21.2
Commercial	11.3	13.5	15.0
Industrial	26.0	40.7	49.0
Transportation	18.6	21.4	23.3
TOTAL DOMESTIC CONSUMPTION	70.6	94.6	108.5

(a) For the EIA TRENDLONG MID-MID Scenario.

Figure A-2

"LEAD LABORATORY" ASSIGNMENTS FOR RIIA I

CAK RIDGE NATIONAL LABORATORY (ORNL)	– UTILITIES SITING INDUSTRIAL SITING WATER AVAILABILITY
BROOKHAVEN NATIONAL LABORATORY (BNL)	– INDUSTRIAL SITING EMISSIONS EASTERN LONG RANGE TRANSPORT PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY SOLID WASTE
ARGONNE NATIONAL LABORATORY (ANL)	– WATER QUALITY LOCAL AIR QUALITY ECOLOGY/LAND USE LOCAL SOCIOECONOMICS
LOS ALAMOS SCIENTIFIC LABORATORY (LASL)	– VISIBILITY
PACIFIC NORTHWEST LABORATORIES (PNL)	– WESTERN LONG RANGE TRANSPORT
LAWRENCE BERKELEY LABORATORY (LBL)	– NATIONAL ECONOMICS

DEPARTMENT OF ENERGY FEDERAL REGIONS

A-7

Figure A-3 Federal regions assigned to each national laboratory.

Figure A-4

TOTAL ENERGY CONSUMPTION AND EXPORT

Figure A-5

ELECTRIC GENERATION BY FUEL TYPE (PERCENTAGE)

1976

1990

Figure A-6

A-10

Figure A-7

U.S. ENERGY USE PER CAPITA BY END-USE SECTOR

Figure A-8

ORNL DWG 79-14610

POPULATION GROWTH 1975 TO 1990
MID-RANGE PROJECTION SERIES C SCENARIO
Average Annual Percentage Growth Rates by BEA

Legend: Negative: < 0 Low: 0 - .12 Medium: .13 - 1.92 High: 1.93 - 2.67 Very High: > 2.67

regional level is also viewed in terms of the larger picture. There are a number of instances where impacts are created by problems that transcend regional boundaries. Useful and interesting similarities and contrasts between regions can be seen. Some observations about a limited number of issues of this type are discussed below. These comments are not intended to be exhaustive, but they do provide some insight into this larger perspective.

Air

Among the air-related issues, of particular importance is the long-range transport of pollutants. This problem clearly illustrates the inter-relationship of energy development activities occurring in one state or region and affecting others. For example, emission of sulfur oxides and sulfates in one part of the country can expose other regions to potential environmental impacts such as acid rain and health risks. Figure A-11 reflects long-range transport calculations developed by the Brookhaven National Laboratory.* Note that sulfate (SO_4) imported from other regions is particularly high in the Northeast (Regions 1, 2, and 3) while much lower in the West (Regions 9 and 10). This illustrates the type of differences between various parts of the Nation that has significance for policy makers.

Visibility impairment is another air issue which is receiving increasing attention and concern at the national level. The 1977 Clean Air Act Amendments established a national goal to improve existing visibility and prevent future visibility impairment in certain national parks and wilderness areas (designated Class I areas). The Los Alamos Scientific Laboratory has attempted, possibly for the first time, to make an initial comprehensive estimate of visibility effects in the U.S. for this study. A projection of the visual range, the farthest distance that an object can be seen, is shown for 1975 in Figure A-12 and in 1990 in Figure A-13. The contour lines represent the visual range. The West, especially the Southwest, (the 75 mile contour), in general has good visibility. Figure A-14 shows a map of changes between 1975-1990. A negative sign represents a reduction of visual range, in terms of percent change.

Water

In the East, the problems of water availability are most often tied to periodic droughts resulting in low stream and river flow (Figure A-15). Under the legal doctrine of riparian rights existing in the East, landowners adjacent to a body of water have coequal water rights, as long as their use does not unreasonably interfere with use by persons either upstream or downstream. Therefore, an energy facility must guarantee that other water users will not be adversely affected during these low flow periods. To do this, they must have access to supplementary water, a process known as low flow augmentation and usually requiring construction of a dam. However, because of the unacceptable environmental impacts of dams, there

*P. Meier, et al., "A Methodology for Estimating County Level Air and Solid Waste Residuals". Policy Analysis Division, Brookhaven National Laboratory, Forthcoming Report.

Figure A-9

ORNL DWG 79-14608

EMPLOYMENT GROWTH 1975 TO 1990
MID-RANGE PROJECTION SERIES C SCENARIO
Average Annual Percentage Growth Rates by BEA

Legend:
Negative: < 0
Low: 0 - .75
Medium: .77 - 2.57
High: 2.58 - 3.72
Very High: > 3.72

Figure A-10

ORNL DWG 79-14609

ENERGY GROWTH 1975 TO 1990
MID-RANGE PROJECTION SERIES C SCENARIO
Average Annual Percentage Growth Rates by BEA

■ Negative: < 0 ▨ Low: 0 - 1.23 □ Medium: 1.23 - 3.35 ▩ High: 3.37 - 4.24 ■ Very High: > 4.24

Federal regional level is also viewed in terms of the larger picture. There are a number of instances where impacts are created by problems that transcend regional boundaries. Useful and interesting similarities and contrasts between regions can be seen. Some observations about a limited number of issues of this type are discussed below. These comments are not intended to be exhaustive, but they do provide some insight into this larger perspective.

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Water

In the East, the problems of water availability are most often tied to periodic droughts resulting in low stream and river flow (Figure A-11). Under the legal doctrine of riparian rights existing in the East, landowners adjacent to a body of water have coequal water rights, as long as their use does not unreasonably interfere with use by persons either upstream or downstream. Therefore, an energy facility must guarantee that other water users will not be adversely affected during these low flow periods. To do this, they must have access to supplementary water, a process known as low flow augmentation and usually requiring construction of a dam. However, because of the unacceptable environmental impacts of dams, there has been little success in developing adequate augmentation. This has constrained energy development.

Further, eastern rivers receive significant quantities of municipal and industrial waste. When their flows are subjected to consumptive water uses (such as evaporation from cooling towers), concentrations of pollutants above acceptable levels may result without the facility itself contributing any significant pollution. This situation will lead to an increase in facility siting problems.

Figure A-11

IMPORTED VS LOCAL SULFATE (SO_4) BY FEDERAL REGION - 1990

CALCULATED VISUAL RANGE (1975) (MILES)

Figure A-15

1990 WATER-FOR-ENERGY PROBLEM AREAS
BY AGGREGATED SUBAREA
ENERGY WATER-USE FOR MIDRANGE TRENDLONG SCENERIO
BASED ON MAXIMUM BASE LOAD GENERATION

SEVERE, LOW-ENERGY SEVERE, HIGH-ENERGY LOW FLOW PROBLEMS

Figure A-13

CALCULATED VISUAL RANGE (1990)
PROJECTION SERIES C NATIONAL ENERGY SCENARIO

A-20

Figure A-14

PER CENT CHANGE IN VISUAL RANGE (1975-1990)
PROJECTION SERIES C NATIONAL ENERGY SCENARIO

has been little success in developing adequate augmentation. This has constrained energy development.

Further, eastern rivers receive significant quantities of municipal and industrial waste. When their flows are subjected to consumptive water uses (such as evaporation from cooling towers), concentrations of pollutants above acceptable levels may result without the facility itself contributing any significant pollution. This situation will lead to an increase in facility siting problems.

In contrast, the West suffers a continuous high demand for water. In some cases, energy facilities use high proportions of the available water; in other cases, they utilize a relatively low proportion. In either case additional energy-related water use will have to compete with existing users. Under the Appropriation Doctrine, followed in the West, water rights can be bought. This has the effect of denying access to water to other beneficial uses such as agriculture. Therefore, the question of the trade-offs between beneficial uses is a major concern in the region.

Issues such as those discussed above illustrate a way by which the results of the RIA program can be utilized to describe situations which, while identified on a regional basis, may also be transregional or national in scope. We encourage the reader to keep this in mind as he or she examines this document.

SIGNIFICANT FINDINGS AND CONCLUSIONS

FEDERAL REGION 1

FINDINGS

- o The widespread public opposition to nuclear power in the region is likely to constrain realization of the nuclear goals of the scenario (51% of regional capacity by 1990 versus 25% nationwide). The need for federal action to solve the radioactive waste disposal problem cannot be overemphasized.
- o Half of the local coal conversions in the scenario, under the Energy Supply and Environmental Coordination Act, will be constrained by local air quality and solid waste concerns.
- o About a 30% improvement in sulfur oxides air quality is projected for the region, based on emissions reductions both within the region and in upwind states. These reductions are premised on the assumptions that current State Implementation Plans will be met by 1985 in all areas of the country and that, for new facilities, the proposed New Source Performance Standards will be implemented. Nitrogen oxides air quality, however, will not show comparable improvements.
- o Maine is the only state showing significant increase in SO_2 concentrations, due primarily to the 1100 MW of coal capacity shown for Waldo County. Acadia National Park (one of our mandatory Class I PSD areas in the region) is close enough to this plant to warrant a detailed analysis of compliance with Class I PSD increments for SO_2 .

o Several important institutional issues will affect realization of scenario goals, including construction work in progress, conflict over consumptive water use and the riparian water rights doctrine, and the issue of federal preemption in regulating the transport of radioactive materials.

o With the improvement in sulfur oxides air quality, health effects related to sulfate exposure are expected to decrease by some 40%, although impacts due to other pollutants were not qualified. Radiation-induced cancers due to nuclear power plant operation are projected to increase, but, because their absolute levels are small, they are likely to constrain the scenario as a result of public perception of risk rather than actual risk.

DISCUSSION

Nuclear

The scenario postulates five major new nuclear facilities in the region, corresponding to the utility planned Montague 1, Millstone 3, Pilgrim 1, Seabrook 1, and NEP 1 units. This would result in some 51% of electric energy generated by nuclear power in the region by 1990, versus 25% nationwide. Every one of these facilities must be expected to encounter significant licensing delays as a result of widespread opposition present even before the Three Mile Island accident. The most tangible issue, one seized upon by many public figures and environmental agencies, is the radioactive waste disposal problem, which is perceived as being a federal responsibility. Already a flood of municipal ordinances preclude shipment of radioactive wastes through the areas of their jurisdiction — some 50% of all Vermont towns have such regulations — and, even if they do not stand the test of the federal preemption doctrine in nuclear regulation matters, they remain a good indicator of widespread public concern. The urgency of federal action to resolve the radioactive waste management problem cannot be overemphasized.

Coal

Only one major new coal plant is postulated by the scenario for the region, an 1100 MW plant in Waldo County, ME, corresponding to the utility-planned Sears Island unit. Its location happens to be close to one of four Mandatory Class I areas in the region (Acadia National Park) and our analysis indicates that this area may be expected to incur a Class I PSD SO₂ increment exceedance by 1990.

The level of coal conversions under the Energy Supply and Environmental Coordination Act is also highly problematic. Of the 2.49 GW of such conversions postulated in the scenario, only 1.11 GW at Brayton Point in Somerset County, MA, is likely to occur. The others are likely to be constrained on a variety of grounds, especially those in Middletown and Norwalk Harbor, in southeastern Connecticut, that are located in TSP non-attainment areas, and the Mt. Tom facility in Hamden County, MA, where land use encroachments during the years that the plant has burned oil have foreclosed likely solid-waste disposal areas. Note, however, that the parties in the Brayton Point conversion agreement have displayed considerable innovation in resolving trade-off issues; the plant will be allowed to burn coal without sulfur controls in exchange for installing new particulate control equipment, and the Massachusetts Department of Environmental

Protection has guaranteed at least a 15-year period of unchanged emissions requirements.

Air Quality

Sulfur oxides air quality in all states of the region except Maine is expected to show considerable improvement as a result of improved emissions controls both in the region and in the major industrial areas upwind. The region-wide average concentration of sulfur dioxide is expected to fall from $5.8 \mu\text{g}/\text{m}^3$ in 1975 to $5.3 \mu\text{g}/\text{m}^3$ in 1990, and that of suspended sulfate to drop from $6.1 \mu\text{g}/\text{m}^3$ to $3.7 \mu\text{g}/\text{m}^3$. These improvements are particularly dependent on improved emissions controls on existing coal-burning facilities in the Ohio Valley and TVA areas to the west since 85% of the 1990 sulfate concentration in the region is due to emissions from upwind regions. The increase in SO_2 levels in Maine is attributable in large part to the emissions interstate being very low.

It should be noted, however, that emissions of nitrogen oxides are not likely to be as well controlled as those of sulfur oxides, and thus the impact of these species and of photochemical oxidants may actually worsen for both 1985 and 1990 depending on the efficiency of the EPA control strategies. In light of much of the southern part of the region being in non-attainment for these pollutants, these represent important concerns even if the postulated sulfur oxides emissions are achieved.

Water Quality and Availability

No major water-related issue should significantly constrain the technology mix postulated in the scenario. Most of the water problems (e.g., release of PCBs from harbor dredging operations needed to support OCS development activity; concentration effects in cooling tower blowdown at the Montague plant), are highly local in scope and should be amenable to site specific solutions and safeguards. Thermal discharge issues, especially in relation to Section 316 of the Water Pollution Control Act, may, however, be raised at most new plants. The most serious water problems are likely to be institutional, related primarily to the emerging conflict between increasing levels of consumptive use and the riparian rights doctrine. The combination of planned diversions of Connecticut River water in Massachusetts to supply Boston's drinking water need and the consumptive use at the Montague plants in Franklin County, Massachusetts, is likely to rekindle Connecticut's riparian rights concerns that reached the Supreme Court in the 1930's.

Socioeconomic Impacts

The proximity of postulated utility construction projects to the major metropolitan area and the historical willingness of New England construction laborers to commute long distances results in very few construction and operation phase personnel relocations: from a high of 300 to 100 workers, respectively, for Sears Island in Waldo County, ME, to 75 and 30, respectively, for Millstone 3 in southern Connecticut. These levels are generally well within the infrastructure capacity of the affected counties. Because in New England the property tax revenues on utility plants accrue

to the town level of government, however, the benefits of the considerable tax revenues involved will accrue to only a small percentage of those who may feel they bear the environmental impact of the plant's operation.

Institutional Issues

The unique powers of town government in the region and the strong traditions of public involvement make energy facility proposals of all kinds subject to extremely parochial pressures that are difficult to balance against state, regional, and even federal priorities. Proposals for refineries are much more likely to be defeated by town level votes on zoning ordinance variances than by an analysis of costs and benefits to the region as a whole by a state agency. The proliferation of ordinances regulating radioactive materials transport, in the face of clear legal precedents that give the federal government preemptive powers over nuclear materials regulation, similarly mirror local attitudes and concerns. Indeed, the difficulties of siting have resulted in the situation that Public Service Company of New Hampshire, in financial trouble over Seabrook but now with an approved site, has had no difficulty in finding buyers for the bulk of its interest in the plant — this despite the continuing problems over financing and the Construction Work in Progress issues. It must be expected, therefore, that federal energy objectives for the region, however well-intentioned in terms of alternatives that will lessen the region's dependence on imported oil, will continue to be complicated by conflicting regional interests.

Health and Safety

Regarding several issues there is considerable divergence between the current public perception of their importance and the computed levels of impact of the scenario as derived in this analysis. For example, there is widespread concern over the effects of low-level radiation at nuclear power plants in the region, yet our analysis indicates that the expected total number of cancers due to radiation from nuclear power plant operation in the region, including not only occupational and general public exposure, but also the annualized effect of catastrophic accidents, will increase from 1 per year in 1975 to only 2.5 per year by 1990.

The health effects of fossil fuel combustion in terms of excess mortality due to population exposure to sulfates are projected to decline parallel to overall regional decreases in ambient SO_4 concentrations. Thus anticipated deaths related to sulfate exposure will decrease from a range of up to 5% of all deaths in 1975 (5900 deaths) to up to 3% of all deaths in 1990 (4000 deaths). Since these effects are postulated to be chronic, the improvements may not actually be realized until some future year.

It should also be recognized that the calculations for excess mortality involve larger uncertainties, including whether or not the sulfur oxides are actually the damaging agent, whether the damage is linear or whether a "no-effect" threshold exists, whether present-day or historical concentration levels are the most important, and whether smoking habits or occupational exposures play an important role.

FEDERAL REGION 2

FINDINGS

- o The widespread public opposition to nuclear power in the region is likely to constrain realization of the nuclear goals of the scenario (38% of regional capacity by 1990 versus 25% nationwide). Public opposition has focused on the inadequacy of evacuation plans (particularly in the New York City and Long Island areas) and on the issue of radioactive waste disposal. The need for federal action to solve the latter problem cannot be overemphasized.
- o The scenario assumption that the West Valley facility will reopen and provide a third of the nation's reprocessing capacity runs contrary to the trend of the current debate regarding its continued closure and eventual decommissioning.
- o About a 40% improvement in sulfur oxides air quality is projected for the region, based on emissions reductions both within the region and in upwind states. These reductions are premised on the assumptions that current State Implementation Plans will be met by 1985 in all areas of the country and that, for new facilities, the proposed New Source Performance Standards will be implemented. Nitrogen oxides air quality, however, will not show comparable improvements.
- o With the decrease in ambient sulfate concentrations, visibility improvements can be expected through the region.

o The scenario-postulated levels of oil and gas production from the Baltimore Canyon area may be constrained by continuing opposition on environmental grounds, particularly from the recreation industry on Long Island.

o Limited water availability in the Delaware River Basin may significantly constrain thermal capacity postulated by the scenario in New Jersey. As evidenced by the demise of the Tocks Island and Trexler Dam proposals, the scenario requirement of an additional 176 cubic feet per second of low flow augmentation for power generation in the Basin by 1990, equivalent to 12% of the present low flow, must be viewed as extremely unlikely.

o Local air quality problems are projected to constrain energy facilities only in the Buffalo and New York City metropolitan areas currently in nonattainment for both SO₂ and particulates. Efforts to address non-attainment problems for oxidants in the New York metropolitan area could affect postulated transportation energy consumption.

o With the improvement in sulfur oxides air quality, health effects attributable to sulfate exposure are also expected to decrease by some 40%, although impacts due to other pollutants were not quantified. Radiation-induced cancers due to nuclear power plant operation are projected to increase, but because their absolute levels are small, they are likely to constrain the scenario as a result of public perception of risk rather than actual risk. The estimated health impacts of a reprocessing facility, however, are an order of magnitude greater than those associated with nuclear power plant operation and may significantly constrain the scenario expectation of reopening of such a facility in New York.

DISCUSSION

Nuclear

Since 47% of the electric generation facilities added between 1976 and 1990 in the scenario are nuclear, the dependence on nuclear power is 13% greater than the national average. Each of these facilities must be expected to encounter significant licensing delays as a result of opposition present even before the Three Mile Island incident. The most tangible issue, radioactive waste disposal, is perceived as a federal responsibility and has particular overtones for Region 2. The West Valley, New York, reprocessing and disposal facility (which in the scenario is assumed to supply 30% of the national reprocessing capacity) is the subject of a debate focusing on its continued closure and eventual decommissioning. While this debate continues, existing storage capacity at operating facilities is being used, and in some cases may be exhausted as early as 1981. A second generic problem, which has surfaced since the Three Mile Island incident, concerns the adequacy of evacuation plans, particularly for areas with large seasonal population fluctuations and limited access such as Long Island and the barrier island beaches of New Jersey.

Water Quality and Availability

In some areas of the region, available water supplies are simply insufficient to meet projected demand from all sectors, and proposed augmentation projects have met severe opposition. In light of the demise of the Tocks Island and Drexler Dam proposals, the requirement for 176 cubic feet per second of low flow augmentation in the scenario for power plant development in the Delaware River Basin seems unlikely to be met, or, at the least, apt to result in a prolonged delay in the development of thermal capacity additions in the Basin. Any proposed augmentation project may be marked by institutional conflicts regarding priorities among consumptive uses and also conflicts between priorities of use and the prevalent riparian rights doctrine. Such conflicts have always resulted in complicated, tedious, and time-consuming litigation.

Air Quality

Sulfur oxides quality in the region is expected to show considerable improvement as a result of improved emissions controls. The concentration of sulfur dioxide is expected to fall from $20 \mu\text{g}/\text{m}^3$ in 1975 to $10.5 \mu\text{g}/\text{m}^3$ in 1990, and that of suspended sulfate to drop from $9.5 \mu\text{g}/\text{m}^3$ to $4.9 \mu\text{g}/\text{m}^3$. These improvements are particularly dependent on improved emission controls on existing coal-burning facilities in the Ohio Valley and TVA areas to the west and southwest, since 73% of the 1990 sulfate concentration in the region is due to emissions from upwind regions.

Local air quality issues are likely to constrain the scenario only in the Buffalo metropolitan area, currently in nonattainment for both SO_2 and particulates, and in the New York City area, where the 700 MW coal-fired facility proposed for the Bronx may encounter severe delay. Important international problems may arise over air quality attainment in the Buffalo area because the Nanticoke coal plant in Ontario, some 50 miles upwind, is currently being expanded to 3000 MW and is not anticipated to have scrubbers.

It should be noted, however, that emissions of nitrogen oxides are not likely to be as well controlled as those of sulfur oxides, and thus the impact of these species and of photochemical oxidants may actually worsen for both 1985 and 1990 depending on the efficacy of the EPA control strategies. In light of much of the region being in nonattainment for these pollutants, these represent important concerns even if the postulated sulfur oxides emissions are achieved.

Visibility

Since sulfate aerosols comprise the single most important contributor to haze in the Northeast, the decrease in ambient sulfate concentrations noted above should result in visibility improvements in the region. In particular, visibility improvements are projected for the Brigantine National Wilderness Area in New Jersey (the only Class I PSD area in the region) and for portions of the Catskill and Adirondack State Parks in New York that are prime candidates for Class I designations initiated by the state.

Institutional

One of the dominant political concerns of the region relates to the coastal environmental impacts of petroleum exploration and development in the Baltimore Canyon Area, and levels of offshore production in the scenario may be constrained by environmental opposition, especially in New York. To the extent that current drilling has failed to result in commercial quantities of oil or natural gas, such issues may be moot. Nonetheless, continuation of the leasing program has resulted in concern on the part of state governments and private groups; in particular, the recreation industry and commercial fishing interests on Long Island remain adamantly opposed.

The ability of the institutional framework in New York to deal adequately with the number of major new electric generation facilities assumed in the scenario must be questioned. The creation of a one-stop energy facility licensing Board, rather than facilitating licensing procedures, has been a source of further delay, and up until Dec. 1978, not a single uncontested permit has been granted by the Board, despite numerous submissions. In Dec. 1978, the Board did grant a permit for the Somerset coal plant. Not a single application has been granted by the Board over the past 5 years despite numerous submissions.

Socioeconomic Impacts

There are three areas of New York State where labor availability, local socioeconomic issues, and low productivity could delay power plant siting schedules necessary to meet scenario goals: Chautauqua, Erie, and Niagara counties, which lack artisans in specific crafts; Oswego and Cayuga counties, which lack both labor and infrastructure; and Green and Schoharie counties, which lack the revenue and infrastructure necessary to accommodate the predicted 14 to 20% construction force immigration.

Health and Safety

Regarding several issues, there is considerable divergence between the current public perception of their importance and the computed levels of impact of the scenario as derived in this analysis. For example, there is widespread concern over the effects of low level radiation at nuclear power plants in the region; yet our analysis indicates that the expected total number of cancers due to radiation from nuclear power plant operation in the region, including not only occupational and general public exposure, but also the annualized effect of catastrophic accidents, will increase from 0.5 per year in 1975 only to 3.0 per year by 1990. On the other hand, radiation-induced cancers among the general public due to the scenario-postulated reprocessing facility at West Valley are estimated to reach 15 per year by 1990.

The health effects of fossil fuel combustion in terms of excess mortality due to population exposure to sulfates are projected to decline parallel to overall regional decreases in ambient SO_4 concentrations. Thus, anticipated deaths related to sulfate exposure will decrease from a range of up to 8% of all deaths in 1975 (19,700 deaths) to up to 5% of all deaths in 1990 (13,000 deaths). Since these effects are postulated to be chronic, the improvements may not actually be realized until some future year.

It should also be recognized that the calculations for excess mortality involve large uncertainties, including whether or not the sulfur oxides are actually the damaging agent, whether the damage is linear or whether a "no-effect" threshold exists, whether present-day or historical concentration levels are the most important, and whether smoking habits or occupational exposures play an important role.

FEDERAL REGION 3

FINDINGS

- o The widespread public opposition to nuclear power in the region is likely to impede realization of the nuclear goals of the scenario (6900 MW for Pennsylvania and 3700 MW for Virginia). The need for federal action to solve the radioactive waste disposal problem cannot be overemphasized.
- o About 50% improvement in sulfur oxides air quality is projected for the region (all states), based on emissions reduction both within the region and in neighboring regions. This improvement is highly dependent on clean-up of existing major fuel burning sources as well as implementation of new performance standards. Nitrogen oxides air quality may be less well controlled.
- o Even though strip mine production is projected to decrease by 1990, coal production levels hypothesized by the scenario may be significantly constrained by the impact of new Federal regulations on reclamation (Pennsylvania, Virginia, and West Virginia).
- o In the event that offshore oil and gas exploration becomes successful, development may be constrained by continuing opposition on

environmental grounds in Maryland and Delaware, relating to protection of coastal environmental resources.

- o Given the abandonment of several recent dam projects in Delaware, water availability constraints may be important for inland sites where low flow augmentation is required.

- o The health and safety impacts of the scenario are dominated by the coal fuel cycle. By 1990, mining related injuries and deaths are projected to increase by about 25% over current levels, while public health impacts due to sulfur oxides air pollution are projected to decrease by about 40%. Impacts due to other air pollutants, however, were not quantified. Although health and safety impacts due to nuclear power plants in Pennsylvania and Virginia are projected to increase, the numbers are quite small and are likely to constrain the scenario only because of public perception rather than actual risk.

- o Pennsylvania has nonattainment areas (areas where ambient air pollution standards have not been met) which may constrain the siting of new energy-related facilities; one new coal-fired power plant may be affected.

DISCUSSION

Nuclear

A severe constraint on the energy future postulated by the Mid-Mid scenario is the widespread opposition to nuclear power in the region. Although many of the specific environmental concerns are local in nature and amenable to local solutions (such as water related issues), timely licensing, especially where political forces can be mobilized at the state level, is extremely unlikely in the present climate. Especially in Pennsylvania, the Three Mile Island incident is likely to create severe licensing delays for the seven additional nuclear units postulated in the state by 1990. Moreover, in all of the Northeast, concern over radioactive waste management issues remains a prominent issue, and the need for federal action cannot be over-emphasized.

Coal

The Mid-Mid scenario hypothesizes an increase in underground mining in the region from 256 million tons in 1975 to 200 million tons per year in 1990, and a decrease in strip mined coal production from 80 to 71 million tons per year by 1990. Nevertheless, the impact of new regulations under the 1977 Surface Mining Control and Reclamation Act on the coal industry, especially on smaller mining concerns, has been fiercely debated in the coal producing states of the region (Maryland, Pennsylvania, Virginia, West Virginia). A total of 174,000 acres will have been disturbed for surface mining (reclaimed or not) by 1990, a 40% increase over the estimated area disturbed in 1977.

Water Quality and Availability

Energy-water conflicts in the region rank as one of the more important constraints to realization of the future embodied in the Mid-Mid scenario.

Both in the coastal zone acts in the nation, and in inland areas, where consumptive use for evaporative cooling requires low flow augmentation to meet river basin commission policies, severe constraints on energy facility siting must be expected. For example, 176 cubic feet per second (CFS) of low flow augmentation (which represents 12% of the present low flow) must be provided in the Delaware River Basin to accommodate postulated thermal plants in Pennsylvania, New Jersey, and Delaware portions of the basin. In light of the demise of the Tocks Island and Trexler dam proposals, this may be extremely difficult to achieve.

Many of the water quality problems in the region stem from past coal mining activity, especially in Pennsylvania and West Virginia. Unfortunately, much of the pollution comes from abandoned mines which cannot be readily controlled by current statutes, and thus, even with stringent application of new regulations (under NPDES or new Strip Mine regulations) to operating and new facilities, realization of water quality goals may be decades distant.

Solid Waste

Despite significant coal mining and a number of new coal-fired electric plants fitted with flue gas desulfurization systems, solid waste disposal is not anticipated to be a significant constraint to energy development in the region. Adequate disposal sites are expected to be found, although costs could be significantly affected by implementation of the Resource Conservation and Recovery Act.

Air Quality

Region 3 is heavily industrialized, and its sulfur oxides emissions (1975) are 3rd highest among those in the ten federal regions (2nd highest on the basis of emissions per square mile). Even so, in 1975, 58% of the ambient sulfate resulted from emissions from outside the region. Thus, local air pollution controls have only limited usefulness in improving air quality in Region 3. For all the time periods analyzed, Region 3 was the region with the highest regional average sulfate concentration, because of its relatively high population density and its location just downwind from other large industrialized regions. It is estimated that the regionwide average concentration of sulfur dioxides will decrease from $24.9 \mu\text{g}/\text{m}^3$ in 1975 to $12.9 \mu\text{g}/\text{m}^3$ in 1990, and that of suspended sulfate from $14.9 \mu\text{g}/\text{m}^3$ in 1975 to $8.0 \mu\text{g}/\text{m}^3$. Achievement of these levels is dependent on emissions reductions both within the region and in neighboring regions, especially the Ohio Valley and TVA areas to the west.

It should be noted, however, that emissions of nitrogen oxides are not likely to be as well controlled as those of sulfur oxides, and thus the impact of these species and of photochemical oxidants may actually worsen for both 1985 and 1990 depending on the efficacy of the EPA control strategies. Since much of the region is nonattainment for oxidants, these represent important concerns even if the postulated sulfur oxides emissions are achieved.

Institutional

One of the dominant political concerns of the mid-Atlantic region relates to the coastal environmental impacts of petroleum exploration and development in the Baltimore Canyon area. To the extent that current drilling has failed to result in commercial quantities of oil or natural gas, such issues may be moot. Nonetheless, continuation of the leasing program has resulted in concern on the part of state government and private groups. Although all the coastal states of the Northeast have enacted some form of coastal zone environmental legislation in response to both the federal mandates and to ongoing Outer Continental Shelf oil exploration, the legislatures of the coastal states of Federal Region 3 — particularly those of Delaware and Maryland — have been especially sensitive to energy related threats to their coastal resources. Delaware's Coastal Zone Act, as noted, is the most stringent coastal environmental legislation in the Northeast. The provisions of Maryland's Coastal Facilities Review Act, although not as restrictive as those of neighboring Delaware, apply to an area comprising approximately 65 percent of the state's land area. Yet most new major energy facilities postulated by the scenario in either state would necessarily have to be sited in the areas covered by these acts.

Health and Safety

There is considerable divergence between the current public perception of the importance of several issues and the computed levels of impact of the scenario as derived in this analysis. For example, there is widespread concern over the effects of low level radiation at nuclear facilities in the region, yet our analysis indicates the expected number of radiation-induced cancers from nuclear power plant operation in the region, including occupation and general public exposure, will only be 0.5 per year in 1975 and 1.5 per year by 1990.

Annual total accidental injuries in coal mining are expected to increase from 3810 - 14,500 in 1975 to 4900 - 21,500 in 1990, in parallel with increases in coal production in the region. These levels reflect current accident rates and should be viewed as an upper bound in light of possible future improvements in mine safety.

The health effects of fossil fuel combustion, in terms of excess mortality due to population exposure to sulfates, are projected to decline parallel to overall regional decreases in ambient SO_4 concentrations. Thus, anticipated deaths from SO_4 exposure decrease from a range of up to 13% of all deaths in 1975 (29,000 deaths) to up to 7% in 1990 (18,000 deaths). These effects are postulated to be chronic, and thus the improvement may not actually be realized until some future year.

It should also be recognized that the calculations for excess mortality involve large uncertainties, including whether or not the sulfur oxides are actually the damaging agent, whether the damage is linear or whether a "no-effect" threshold exists, whether present-day or historical concentration levels are the most important, and whether smoking habits or occupations exposures play an important role.

FEDERAL REGION 4

FINDINGS

- o In the Southeast, institutional and political issues are not expected to restrain electric energy development. Much of the region's future electrical energy production is projected to come from nuclear power (approximately 20 percent) and the effect of the accident at Three-Mile Island on future nuclear construction in the region is unknown.
- o Southern Florida is projected to have severe water shortages during low-flow periods by 1985, because of extensive irrigation and urban uses. Any further increase in water consumption is likely to conflict with current needs.
- o The Southeast may be constrained in its energy development as a result of potential shortages of skilled manpower (36% increase by 1990). The region may also face problems with capital availability (30% increase by 1990).
- o The risk to human health from exposure to fossil fuel combustion products will be significant in Kentucky, Tennessee, Alabama, North Carolina and Georgia. This exposure will be aggravated by increased combustion of coal to the west, and upwind of Region 4.
- o Deaths from underground coal mining will increase significantly, particularly in Kentucky by 1990 (possibly as high as 4000/year).
- o Problems of solid waste management (from surface mining and scrubber sludges) are not expected to restrain energy development in the Southeast by 1990.

DISCUSSION

The Regional Issue

The underlying issue concerning energy growth and development in the Southeast is the perceived relationship between energy and economic growth. The region is concerned with more than just the availability of energy, as addressed by the Mid-Range Projection Series C Scenario; it is also concerned with the region's economic competitiveness and its share of the national economy. The economy of the Southeast still lags behind the nation. Thus, any energy or environmental policy that reduces the region's potential for closing this economic gap is of major importance.

For example, projections for increased use of coal, as specified under the scenario, will make compliance with the Air Quality Amendments of 1977 and the Resource Conservation and Recovery Act more difficult for industry and utilities. Many believe that the PSD and nonattainment provisions of the amendments could seriously stifle much future economic growth in sections of the Southeast that already have high pollution levels. As another example, the scenario reflects the provisions of the Energy Supply and Environmental Coordination Act of 1976. These provisions call for major switch of fuel use in utilities and industry from oil and gas to coal by 1985. Because the Southeast is significantly dependent on oil and gas, major capital and infrastructure investments will be required to comply with this fuel switching policy. The cost of installing coal-fired boilers in these utilities and industries and the cost of establishing adequate coal transportation and distribution lines into the region will raise the cost of operating business in the region. This increased cost is likely to be borne disproportionately by the Southeast and may make the region's economy less competitive with the rest of the nation. These and other coal-related issues already exist in the region. However, the energy fuel mix patterns specified in the scenario are likely to increase the severity of these issues in the future.

State and Local Issues

In the discussion for individual states, the majority of issues identified in the region are long-standing and would exist regardless of any particular energy future. However, a few of the issues, particularly those related to the coal fuel cycle, will probably be aggravated by the Mid-Range Scenario because of its projections for increased use of coal in the future. For example, the state of the region's coal transportation system has been of concern in several coal mining states for some time. Many air quality problems projected for the region's urban areas under the scenario assumptions exist now and will merely persist in the future. Other major issues identified in each state are summarized as follows.

- o Increased combustion of coal in Alabama will have adverse effects on public health, and possibly vegetation in some parts of the state. The projected switch from surface mining to deep mining of coal will increase coal mining injuries and deaths (from 170 in 1975 to 620 annually in 1990). With these exceptions, Alabama should have few problems in accommodating the changes projected by the Mid-Range Scenario.

o The availability of water may limit the energy developments projected by the scenario in southern Florida and along the Gulf coast of the peninsula unless ocean/cooling is used. The increased use of coal in Florida may strain the state's transportation system, increase the risk of groundwater contamination and, in central Florida, reduce yields of fruit and vegetables.

o New utility construction in southern Georgia will have significant socioeconomic impact upon five rural counties. Water availability in the headwater streams near Atlanta may limit water consumption for urban and energy uses in the Atlanta area. Otherwise, the scenario will have little significant impact on Georgia.

o The increased coal mining and combustion projected for Region 4 will have the greatest impact on Kentucky, the nation's leading coal producer. While other states in the region may suffer severe impacts in most categories, current problems in the transportation of coal by truck will become worse. Five rural counties will experience significant socioeconomic impacts from the construction of new coal-fired power plants. Surface mining of coal will cause at least local water quality problems in parts of the upper Ohio basin. Air quality problems will persist in much of the state, and these problems will have severe impacts on crops in western Kentucky. Mining accidents and diseases will claim more lives in Kentucky than in any other state in the region.

o Two counties in Mississippi are likely to suffer high socioeconomic impacts from power plant construction, and vegetation in one county may be affected adversely by SO_2 emissions. Increased coal use in the state will raise the risk of groundwater contamination. With these exceptions, the scenario should have only low or moderate impacts on Mississippi.

o Eastern North Carolina may experience low-flow supply problems under the conditions of the scenario, and local water shortages are possible elsewhere in the state. One county is expected to experience significant socioeconomic impacts. Air quality will be a problem in the western and Piedmont areas, and it may affect vegetation there.

o South Carolina should experience little difficulty under the scenario's conditions. One county will experience high socioeconomic impacts from nuclear plant construction, and the uncertainty over nuclear power may delay construction of the nuclear generating stations projected for the state.

o Tennessee's coal transportation system may be strained by projected increases in coal production, and four rural counties in the state should experience significant socioeconomic impacts from power plant construction. Coal mining has and will continue to affect water quality in some local areas. Air quality will continue to be a problem in the state's metropolitan areas, despite increased reliance on nuclear power, and exposure to the products of fossil fuel combustion may cause 230 to 4800 deaths per year.

FEDERAL REGION 5

FINDINGS

o In nonattainment areas in eastern Michigan and southeastern and central Wisconsin, utility coal growth will have limited opportunities for mitigation through offsets or improved control efficiencies. In Ohio, 30% of utility coal growth could be restricted. Illinois, Indiana, and Ohio may also experience problems with oil-fired utilities in nonattainment areas, but fuel purchasing practices could reduce the air quality impacts.

o Utility and industrial siting along Lake Erie may require extensive effluent pretreatment before discharging into the Lake. Allocation of water from Lake Michigan for new facilities may become an issue in Wisconsin and Illinois where large water-for-energy demands conflict with other water users.

o Surface mining activities in Illinois, Indiana, and Ohio are projected to disturb approximately 197,000 acres in the period 1975-1990 causing temporary or permanent shifts in productivity and land use. Much of the land in the mining area is presently in forest and crops.

o Regional occupational-related deaths and illness from deep mining may increase 30 to 40% over 1975 levels.

DISCUSSION

Air

The states in Region 5 currently have over 80,000 MW of installed coal burning utility capacity. This represents the greatest use of utility coal in the nation. Industrial coal use is also the highest in the nation. The nonattainment of sulfur dioxide standards remains an issue in each of the Region 5 states. SO₂ problems are most persistent in the north central portion of Ohio and Wisconsin. Illinois, Indiana, and Ohio have significant coal reserves; however, expansion of the coal economies in these areas is difficult in a climate of restrictive sulfur dioxide regulations and unproven SO₂ control technology.

Particulate standards are also an issue in every Region 5 state. Although Region 5 states have persistent SO₂ and TSP attainment problems, the proposed siting scenario does not impose significant air quality problems in Illinois, Indiana, or Minnesota. Lower Michigan and Wisconsin, however, have over 50% of proposed coal growth in areas with persistent TSP standards violations. Ohio has approximately 30% of its coal siting proposed in nonattainment areas. As expected, urban industrial centers constitute areas having the greatest air quality problems.

Minnesota, Wisconsin, and Michigan all have PSD Class I, visibility protected areas. Designated areas in these states could restrict development of major coal installations. PSD areas include northeastern Minnesota, northwestern Wisconsin, and northwestern Michigan.

Water

Utility increase projections in the region are identified to have the most certain impact on water resources in the region. However, projected growth of coal-use by industrial activity in areas adjacent to the Great Lakes is high in some states and the effluents discharged from these facilities may require extensive pretreatment if they are destined for discharge to the Great Lakes. Areas of particular concern in the scenario lie in Ohio, Michigan, and Wisconsin. Transport of expected gas stack emissions from utilities located long distances from the Great Lakes can eventually be deposited onto the surface of the lakes and affect the water quality. As a result, issues of interregional and international nature could result because of the policy of the Great Lakes Basin Commission and the international Joint Commission to improve the lakes' quality.

Solid Waste

The disposal of all kinds of wastes, including ash and sludge from utility and industrial coal combustion, will be more difficult in the future.

The land requirements for industrial disposal will increase by nearly 400% due, in part, to application of FGD systems. However, the total acreage required is still only 350 acres/year for the entire region. In spite of the relatively small number of acres required, there is a problem finding sites close enough to an industry so that transportation costs are not prohibitive. Even when a suitable site can be found, institutional factors constrain siting. Under the best of circumstances, landfills are not popular.

The effect of regulations proposed under the Resource Conservation and Recovery Act (RCRA) will be significant. Historically, regulations governing waste disposal have often been limited or nonexistent. RCRA will make finding new disposal sites more difficult and expensive, and existing sites that cannot meet RCRA standards will have to close. In addition, uncertainties surrounding certain aspects of RCRA, including the designation of ash and sludge as special wastes, could have a significant effect on disposal. Utilities, too, will be affected by new and more stringent disposal regulations. New plants should not be constrained by solid waste disposal problems although new regulations and increased public opposition will make it more difficult and expensive. The difficulty and expense of disposal may promote increased utilization or resource recovery of these materials. Existing plants will face problems similar to those industries face when they need more disposal room. The utilities will have to transport the waste off-site, and in crowded urban areas, these distances may significantly increase costs.

Ecology/Land Use

The major ecological and land use impacts in Region 5 are likely to be associated with coal extraction activities, which are projected to occur in southern areas with an almost equal mix of forest and agricultural land uses. Current Federal regulations require that surfaced-mined land be restored to its premining productivity after the coal has been removed. Reclamation costs in Region 5 may be high; reclamation has been difficult in some areas in the past due to extremely acidic conditions, and restoration of cropland or forest would require extensive soil manipulation. Restoration of the original forest ecosystem will probably not occur quickly, if at all.

Construction of a number of major new power plants projected by the scenario and the new residential development required for the local increases in population induced by these developments (see discussion of socioeconomic impacts) may remove thousands of acres from agricultural uses outside the region's major urban areas. Large utilities projected for the Ohio River Valley may affect either croplands or natural forested habitats, with attendant impacts on local wild life populations.

A major ecological concern related to coal combustion by utilities and industry is the effect of SO_2 emissions on crops and natural vegetation. Exposure to high levels of SO_2 can cause visible damage and decreases in productivity and yield in sensitive plant species. Though coal combustion is projected to increase in Region 5, SO_2 -related problems are generally projected to decrease during the scenario time-frame. However, the projected 1990 SO_2 levels would still be high enough to potentially cause damage to regionally important crops such as soybeans, wheat, hay, and fruit grown in these areas, and to exposed pine forest in the northern counties.

Socioeconomic

Socioeconomic impacts are expected to occur in every county where the scenario sites a new energy development, but will only potentially inflict severe and unmanageable impacts in seven counties. These counties, in Indiana, Illinois, Wisconsin and Ohio, are expected to incur more of the negative adverse consequences of resource development since their existing work force and infrastructure are insufficient to satisfy the excessive demands inherent during the construction phase.

These severe impacts are projected in counties where 25% of the region's proposed coal capacity, 23% of the nuclear, 7% of the oil-steam, 21% of the combined cycle and 20% of the new mine workers are sited. These technology-specific impacts will affect the more than 70,000 MW of new generating capacity, sited within Region 5, by between 1 and 8% (depending on technology). Besides experiencing downfalls in facilities and services, the counties may encounter an overburdened social infrastructure, out-migrating, frustration, social dissolution and deterioration occurring from the regional population increase of 30,000 permanent individuals by 1990. This corresponds to only 0.07% of the current regional population, but on a site-specific analysis (county level) the percentage ranges from zero to greater than 40 percent.

Health and Safety

Coal extraction is projected to be the primary source of occupational injuries and illnesses related to energy activities in Region 5. Major reserves of coal are found in Ohio, Indiana, and Illinois. The percentage of this coal recoverable by relatively low risk surface mining techniques is declining. Deep mine extraction, one of the most dangerous occupations in the U.S., presents higher risk to workers than does surface mine extraction due to dust exposure and the potential for physical trauma. Under the Mid-Mid Scenario, as demand grows and surface mining decreases, cases of Chronic Respiratory Disease and accidental deaths due to coal extraction may increase from 20% to 40%. Other energy-related activities (i.e., oil and gas extraction and refining, electricity generation and distribution) will have a minimal impact on occupational population compared to coal extraction.

Currently, quantifiable public health impacts from energy-related activities in Region 5 will result primarily from atmospheric emission during fossil-fuel combustion by both electric utilities and industries. The combustion of coal and oil releases sulfur oxides into the atmosphere along with hydrocarbons, particulates, and trace elements. Although the number of deaths resulting from exposure to sulfur oxides in Region 5 are projected to decrease approximately 35% under Mid-Mid Scenario, the magnitude of sulfur oxide related deaths will be significant, approaching the number of homicides in the total U.S. in 1975.

FEDERAL REGION 6

FINDINGS

- o The major switch of fuel in utilities and industry from oil and gas to coal called for in the scenario will be strongly resisted by most states in Region 6, particularly Texas and Oklahoma.
- o Texas will be particularly hard hit by impacts resulting from the scenario (2300 MW in 1975 vs 23,000 MW in 1990 for coal-fired electric) not only from the economic burdens of switching to coal but also from the environmental costs associated with increased air emissions (and violations); the socioeconomic burdens on rural counties selected for major energy developments; and the potential impacts on water quantity and quality.
- o Solid waste sludge generated as a result of conversions to burn coal (approximately one million tons per year) or waste from increased lignite mining (approximately 9500 acres per year in 1990) is not expected to create serious problems in Region 6 except for the possibility of local groundwater contamination. If EPA should designate scrubber sludge as a hazardous waste, this problem will be eased but public opposition may increase.
- o New Mexico has been identified as a highly desirable site for a potential atomic waste isolation pilot plant (WIPP). Health hazards — real and imagined — at both ends of the fuel cycle are becoming increasingly important factors in state political activity (as much as 80% of the state's residents have reservations).

DISCUSSION

The Regional Issue

Region 6 supplies 55% of the nation's energy (not including uranium ore) and produces over 44% of the gasoline consumed in the U.S. Obviously the political and economic forces of the region will be greatly concerned about any federal policy that might adversely redistribute dominance. The south-central region is not greatly concerned with the availability of energy but rather how its energy resources will be distributed internally and to the rest of the nation. There is opposition to the idea of being required to sell energy resources to the other regions at prices below those prevailing within the originating states. There is also resentment that other parts of the country want energy but are unwilling to take the environmental risks associated with developing their own gas and oil reserves. Over the past three decades numerous industries have been attracted to the region because of abundant, cheap energy. Any policy change that will seriously decrease the region's competitiveness or its share of the national economy will be met with opposition.

Several provisions in the Mid-Range Scenario have created concern for the region. For example, projections for increased use of coal, as specified under the scenario, will make compliance with the Air Quality Amendments of 1977 and the Resource Conservation and Recovery Act more difficult for industry and utilities in Region 6. Many believe that the PSD and nonattainment provisions of the amendments could seriously stifle much future economic growth in sections of Region 6 that already have high pollution levels. As another example, the scenario reflects the provisions of the Energy Supply and Environmental Coordination Act of 1976. These provisions call for major switch of fuel use in utilities and industry from oil and gas to coal by 1985. Because of the heavy dependence on oil and gas in Region 6, major capital and infrastructure investments will be required to comply with this fuel switching policy. The cost of installing coal-fired boilers in these utilities and industries and the cost of establishing adequate coal transportation and distribution lines into the region will raise the cost of operating business in the region. This increased cost is likely to be borne disproportionately by Region 6 and may make the region's economy less competitive with the rest of the nation. These and other coal-related issues already exist in the region. However, the energy fuel mix patterns specified in the scenario are likely to increase the severity of these issues in the future, particularly in Texas.

State and Local Issues

In the discussions for individual states, the majority of issues identified in the region are long-standing and would exist regardless of any particular energy future. However, a few of the issues, particularly those related to the coal fuel cycle, will probably be aggravated by the Mid-Range Projection Series C scenario because of its projections for increased use of coal in

the future. For example, many states in the region doubt the present transportation system can handle the increased volumes of coal (nearly double by 1990 compared to 1975) that may be transported to and within the region. Of course, mine-mouth power plants in the lignite fields will help but many air quality problems projected for the regions's urban areas will become worse, particularly in the easternmost states. It should be remembered that much of the information discussed within ORNL's Region was based on data provided by the "lead analysis". Use of the information does not constitute approval of its validity. Other major issues identified in each state are summarized below:

- o Arkansas is expected to be moderately impacted by fuel use switching (principally coal) found in the scenario. The most significant environment impact areas are air (acid rainfall) and water quality. By 1990, several drainage basins will be significantly impacted in terms of water availability and water quality (most significantly impacted are the Red-Sulphur Rivers and the Lower Arkansas). Health impacts from increased coal use are also expected to be significant (increasing from 20-310 in 1975 to 35-560 deaths/year by 1990) and seven counties will receive moderate socioeconomic impacts from proposed energy-related developments.

- o Louisiana, like Texas and Oklahoma, is concerned with the deregulation of natural gas and the effect of new industry location within the state. Air and water quality and public health and safety problems are among the most significant environmental concerns. Some problems with acid rainfall have been noted and these problems may be enhanced with the increased coal burning proposed in the scenario. Water availability appears not to be a problem for the state although water quality could be affected in southern and western Louisiana.

- o Water availability problems based on surface stream analysis are currently serious within some drainage basins in New Mexico and will probably worsen by 1990 without development of alternate sources such as groundwater or additional impoundments. The scenario probably underestimates the effects of energy development on water quality degradation. The proposed nuclear waste isolation pilot plant is considered a serious controversy for the state and is yet to be resolved. Mining development in the state will have to consider the fragile environment as far as reclamation and potential damage to the ecosystem.

- o Selected counties in the Tulsa metropolitan region of Oklahoma should be carefully monitored for potential adverse socioeconomic impacts if energy development occurs as reflected in the scenario. Otherwise, Oklahoma can expect only moderate impact in terms of the changes reflected in the scenario.

- o Texas is projected to be significantly impacted by the energy developments required by the scenario. Potential negative impacts may occur to air quality (ten counties will exceed TSP levels by 1990), water quality and availability, groundwater, and terrestrial ecology. As many as 10 counties may experience significant socioeconomic impacts from the construction of new energy facilities or expanding mining activity. The financial infrastructure of most utilities will be taxed significantly if the forced conversion to coal occurs. Industries will be similarly affected and new industry may choose not to locate in the state because of the new energy policies.

FEDERAL REGION 7

FINDINGS

- o Projected coal-fired utility expansion could be constrained in several areas due to projected TSP and SO₂ violations. Problems will be most pronounced in Iowa and Kansas, but could be incurred in all four areas.
- o Large coal and nuclear facilities projected for parts of Region 7 may experience water availability problems. The Smokey Hill River in Kansas, the Skunk River in Iowa, and the Platte River in Nebraska may have limited water supplies for operating the projected increases in fossil fuel and nuclear generating facilities.
- o Coal surface mining in Missouri (21,000 acres may be disturbed from 1975-1990) may create land use conflicts.

o Region 7 may not have the facilities or legal framework for mitigating the negative socioeconomic impacts that are projected to occur from the proposed energy development. Therefore, the potential for severe and pervasive socioeconomic impacts is great.

DISCUSSION

Air

High ambient levels of particulates remain the most persistent air quality problem in Region 7. Industrial emissions from urban industrial centers contribute to the particulate nonattainment problem in Nebraska, Missouri, and Iowa. The introduction of over 11,600 MW of coal capacity in this region could present potential siting impediments for slightly over 52% of the proposed coal scenario.

Kansas has the greatest concentration of proposed growth in coal use in areas with questionable air quality. Eighty-four percent of the increase in coal use in Kansas occurs in areas which may have difficulty maintaining Federal SO₂ and TSP air quality standards. Almost 37% of the proposed oil growth is sited in nonattainment SO₂ areas. The Kansas City/Topeka area is the area with the greatest air quality impact. Although these areas should be in compliance by 1990, nonattainment provisions will be enforced.

Kansas and Missouri are the two states with over 4000 MW of new proposed coal capacity and may also experience problems with attainment of Federal SO₂ air quality standards. In Missouri, approximately 27% of the proposed coal capacity and only 5.5% of the oil capacity is likely to interfere with maintenance of air quality standards. Approximately 65% of the proposed coal capacity is spread throughout the east central portion of the state.

Projected growth in industrial capacity throughout Region 7 will continue to impede attainment and maintenance of Federal air quality standards. Region-wide, over 72% of industrial growth will occur in nonattainment areas. Major sources in these areas will be required to obtain "emission offsets," install the "lowest achievable emission rate control equipment (LAER)," and demonstrate "net air quality improvement."

Missouri has two national parks totaling over 20,000 acres which will receive visibility protection from major combustion sources. Development of coal facilities in these areas on the southern border of the state may be restricted.

Water

Many tributaries of the Missouri and Mississippi Rivers are characterized by the occurrence of extreme low flow periods with concomitant low water quality. In these rivers, construction of additional utility capacity will be difficult without securing more water storage capacity for the low flow periods. The additional storage may originate from surface water during high flow and/or from groundwater. In extreme cases, the evaporative cooling water system could be replaced by dry cooling which would have the effect of reducing water consumption from the basin while increasing the cost of energy production. The majority of projected utility increase is located in areas along the Missouri and Mississippi Rivers, however, and

water resources issues were not identified for this site. Indian, Federal, and state water policy issues in upstream states could significantly affect the eventual availability of water in these rivers. Thus, the institutional aspects of water resources are as important to energy development as the physical availability of water.

Solid Water

The disposal of all kinds of waste, including ash and sludge from industrial and utility coal combustion, will be more difficult in the future.

Region 7 does not generate a large quantity of industrial ash and sludge. Total land requirements for disposal are estimated at only 26 acres/year in 1990. However, local opposition and institutional constraints can still make finding a suitable site a problem.

The effect of regulations proposed under the Resource Conservation and Recovery Act (RCRA) will be significant. Historically, regulations governing waste disposal have been limited or nonexistent. RCRA will make finding and maintaining sites more difficult and expensive; however, the smaller quantities of waste and the greater degree of open space should make disposal less of a problem than in more urbanized and industrialized regions.

Utilities in the region should not be constrained by solid waste disposal problems. Older plants that are forced to find off-site disposal can usually do so within a reasonable distance. New plants should be able to plan for on-site disposal. Increasing difficulty and expense of disposal may promote utilization or resource recovery of these materials.

Ecology/Land Use

The major land use impacts in Region 7 are likely to be related to coal mining activities. There is a high probability that farmland will be affected by mining activities, since crops cover 45% - 65% of the land area in counties where extraction is projected to occur. The destruction of croplands by mining will cause at least a short-term loss of agricultural productivity, a value replaced by the value of the coal being extracted. Reclamation costs in Region 7 may be high, since the restoration of croplands to their original productivity, as required by the Office of Surface Mining regulations, requires extensive soil manipulation and amendments.

Construction of the projected power plants is not likely to cause major land use impacts in the region, since proposed increases in electrical generating capacity are generally small. Rarely would more than 500 acres be required in any one area.

A major ecological concern related to coal combustion by utilities and industry is the effect of SO_2 emissions on crops and natural vegetation. Exposure to high levels of SO_2 can cause visible damage and decreases in productivity and yield in sensitive plant species. Coal combustion is projected to increase in Region 7 and many of the region's major crops, including soybeans, wheat, and hay, are SO_2 -sensitive. The analysis used in this evaluation flagged nine counties in the regions where the potential for local

effects on SO₂-sensitive vegetation may be high in 1990. SO₂ concentrations were projected to increase from 1975 levels in six of these counties. Sensitive communities of natural vegetation cover as much as 50% of the area in at least one of the nine counties.

Socioeconomic

The states of Iowa, Missouri, Nebraska, and Kansas are the potential inhabitants of more than 25,000 MW of new energy developments. These developments are principally energy generating facilities and are sited in several of the low and extra low assimilative capacity counties which are predominant within the region. Because of their characteristics, these counties are associated with a high potential for adverse socioeconomic impacts.

There are seven counties within Region 7 assessed to receive adverse socioeconomic impact from the present scenario siting pattern. For example, the existing societal and social infrastructures established within these counties are expected to be incapable of serving the more than 26,000 people projected to temporarily inhabit the region during the time period 1975-1990. The result of the divergent social and economic characteristics of the indigenous and immigrant populations is expected to cause severe negative effects within the counties encountering them.

Health and Safety

Coal extraction will be the primary source of energy-related occupational health impacts in Region 7, despite the fact that only moderate amounts of coal reserves are found in Missouri, Iowa, and Kansas, and that 90% of the coal extracted will be via relatively low risk surface mining techniques. Insufficient levels of other energy cycle activities, such as oil production and refining, natural gas extraction, and electricity generation, will occur to result in occupational health impacts on a magnitude with those from coal extraction.

The primary energy-related public health impacts in Region 7 that are currently quantifiable will result from sulfur oxides emitted during fossil fuel combustion for electricity generation and for industrial heating and process use. Impacts from other energy technologies are either of minimal impact compared to sulfur oxides, or are not quantified due to a deficiency in dose-response and/or emission data.

FEDERAL REGION 8

FINDINGS

Visibility

- o Region 8's very good visual air quality, or visibility, is very sensitive to degradation by air pollution. Historical records indicate a deterioration in Federal Region 8's visual air quality over the past 20 years. This trend could be continued with increased coal production and use.
- o Medium to high regional haze is projected in 15 Class I areas located in Colorado and the Dakotas.
- o Medium to high plume blight impacts could adversely affect four Class I areas in Colorado and Wyoming.

Local Air Quality

- o In 1985 and 1990, Region 8's major source of air pollution will be fossil fuel power generation. As projected by the scenario, Prevention of Significant Deterioration (PSD) increments in Class I or Class II areas will be exceeded in Utah, Montana, Wyoming, and North Dakota.
- o Nonanthropogenic sources of windblown dust will contribute to violations of Total Suspended Particulate (TSP) standards throughout the region.

Water

o Water availability need not act as a physical constraint on development. In the most severe conditions of water scarcity, use of the most effective conservation technologies (especially dry cooling) can greatly reduce the water requirements of energy conversion technologies at a small increase in product prices.

o While water use for energy production, even assuming use of conventional cooling systems, is a small proportion of total projected use, conflicts with other users (especially of irrigated agriculture) can be expected. Groundwater development and water transfers threaten the rights of existing users. In most States, instream uses — recreation, fisheries, aesthetics — receive little protection under State statutes.

o Strip coal mining and oil shale development pose the greatest potential for degrading water quality in Region 8. Aside from possible increases in salinity, however, the effects should be localized. Water quality impacts of coal conversion technologies in Region 8 should be negligible, because zero discharge or waste water containment is becoming standard practice for industry.

Ecology and Land Use

o Coal surface mining in the arid environments of Region 8 presents special problems of reclamation due to steep terrain and the necessity of irrigating mine spoils in order to reestablish vegetative cover.

o Habitat for endangered fish species and riparian ecosystems may be expected to be adversely affected by increased salts and sediments in runoff from surface-mined areas.

Socioeconomic

o The rapid population increases that accompany energy development will place severe economic burdens on 22 of 23 impacted counties. The threatened change of lifestyle will slow local accommodation to impact mitigation measures.

o Shortages in construction capital, skilled manpower, machinery, and equipment will pose a constraint on the timely implementation of the Mid-Mid Scenario.

Health and Safety

o Total risk to public health from airborne sulfates is projected to double under the scenario, although the overall effects on public health will be minimal.

o The projected ten-fold increase in coal production over a 15-year period will cause increased safety hazards to the public as a result of coal transportation, and increased occupational hazards as a result of coal mining.

Solid Waste

o In areas where land forms are extreme and energy projects numerous, the urban, mining, and industrial wastes will need to be transported considerable distances to find disposal sites that meet Federal and state standards.

o Adequate waste disposal facilities have not been required in the past, resulting in major problems. Part of the current local objections to new energy projects is based on the past effects of unprotected tailings, boomtown-related typhoid epidemics, and trash scattered for miles when a flash flood distributes the contents of an informal boomtown dump. Such objections have already had an effect on permits for projects in Colstrip, Montana; Craig, Colorado; and Emery County, Utah.

Institutional

o Except for Montana, institutional issues that characterize this region will not significantly constrain growth as projected by the Mid-Mid Scenario.

o Protection of Class I area airsheds will constrain projected utility expansion in Rosebud County, Montana.

DISCUSSION

Visibility

In comparison with the other Federal regions, Region 8 has an abundance of energy resources, scenic vistas, clean air, and mandatory Class I Federal areas. In 1977, Congress declared as a national goal the protection of visual air quality from impairment in these Class I areas (Public Law 95-95, Subpart 2, Section 169A).

Under the Mid-Mid Scenario, conflicts will arise between the siting of fossil fuel combustion facilities (coal-burning facilities, in particular) and the maintenance of very good visual air quality. The substantial projected growth in emissions of sulfur dioxide (a precursor to particulate sulfates) from utility and industrial sources and the long-range transport of light-scattering aerosols (sulfates, in particular) are key factors contributing to the medium to high visibility impacts projected for the region.

Local Air Quality

PSD protection of Region 8's large number of Class I areas may restrict siting and expansion of fossil-fueled power generation facilities; in some cases, this constraint could be overcome by application of highly efficient emissions control technology.

Control technology required by state and Federal air pollution regulations for new and existing point sources should reduce ambient levels of SO₂ and TSP in metropolitan nonattainment areas to meet ambient air quality standards by 1985.

Water

Water use for energy production is a small fraction of total supply and projected use. Moreover, conservation technologies exist to reduce this amount, at a price. But energy is a relatively new participant in the scene, in line behind established users. This factor is the crux of the western water for energy issue.

The regional assessment concludes that western water problems are site specific. However, at least two issues are region-wide. One issue is the potential of the energy industry to modify streamflow, which can alter valued endangered species and sports fishery habitats and wild and scenic river systems. Affected reaches may be far downstream or across state lines. The other issue is stream sedimentation during surface mine strip-ping and reclamation. Sediment loading curtails food chain productivity.

Federal and state environmental legislation protecting stream and drainage system integrity have yet to be adequately tested. Additionally, dewatering and possible aquifer contamination from oil shale and uranium production are issues in Colorado, Wyoming, and Utah. State groundwater regulations to control this are generally inadequate, unclear, and in flux. Downstream water quality commitment is important in the Upper Colorado River Basin states of Colorado, Utah and Wyoming. Energy's influence here as a new user is undetermined.

Ecology and Land Use

Competition for land and water use will be a major public issue. The perceived value of wilderness and critical habits, increasing Indian assertiveness, Indian reservations, and the importance of agricultural industry may limit areas in which energy development can take place. Environmental quality issues have been used as a basis for litigation, resulting in the postponement of some energy development projects in the region.

Socioeconomic

Local sociology, local economics, and regional economics, as described in the scenario, will provide major constraints to scenario achievement. In some cases, the projected concentrations of new population in a few counties in five western states will create unacceptable demands upon local governments and the general public. The provision of funding grants and fiscal devices, designed to relieve the existing permanent population of potential tax burdens or public debt in the event of project closedown, would need to be essential elements of any impact mitigation program. Nevertheless, financial relief alone will not remove political barriers and local resistance to change.

The massive capital construction costs by a few major companies in the western states will require significant investment incentives sufficient to overcome competition in capital markets. Similarly, the need to concentrate the necessary labor supply in a timely manner will require manpower training programs clearly designed to focus on the specific skill requirements of the energy companies. Finally, anticipated shortages in mining equipment, electrical generation, and transmission components need to be minimized in order to achieve the Mid-Mid Scenario goals.

Health and Safety

Total risks to health and safety in Federal Region 8 resulting from the projections in the Mid-Mid Scenario are not expected to constrain energy development in the area.

Solid Waste

Because a majority of the population lives either in very small towns or many miles from other people, solid waste disposal facilities consist of informal landfill operations and an occasional septic tank. As of 1975, five of the six states in the region had no state laws concerning waste disposal. Mining and milling waste problems were overlooked until the early 1970s.

This legal situation changed with the passage of the Federal Clean Air and Water Acts. New energy developments must now concern themselves, not only with Federal law, but with stringent State and local regulations. These regulations, however, do not cope with the wastes resulting from the radical changes in population, those changes that are present as well as those projected for more than 20 counties in the area. These population changes will need concomitant changes in solid waste disposal policies and facilities.

Concern over past problems and the costs of major new approaches to the problems are definite factors in the growing local opposition to the Federal energy development policies reflected in the RIIA I scenario.

Institutional

There are unresolved institutional issues that characterize this region and would seriously constrain energy development in an accelerated scenario. The major issues of air quality maintenance and use of water resources, for example, involve state and Federal agencies, Indian tribes, citizens groups, and industry in a struggle for the protection of their individual interests.

FEDERAL REGION 9

FINDINGS

- o Local air quality impacts are likely to be significant in urban areas of the region, with transportation fuel use (i.e., mobile sources) a major contributor to continued air quality degradation in these areas. The coastal urban areas in California will continue to be nonattainment for particulates, hydrocarbons, and carbon monoxide. In addition, NO_x and SO_x are also problem pollutants in some air basins.
- o Water availability for energy production will depend upon local site-specific factors. Competition between energy and other water users, notably agriculture, is likely for many noncoastal areas of the region. For certain siting areas in Nevada, as identified in the scenario, cooling water supplies may not be available based on the county-level assessment.
- o The county-level assessments indicate that there are potential conflicts between power plant siting choices and protection of endangered species in several areas of the region. These issues appear to be most significant in California, where every county has one or more endangered species.
- o Damage to agricultural crops due to emissions from fuel burning will continue to occur in important agricultural areas of the region, such as the Central and Imperial Valleys in California. Long-range transport of sulfur oxides from major emission sources outside these agricultural areas contributes to damage to sulfur-oxide sensitive crops.

o Coastal land use conflicts will be aggravated by increased production and transportation of oil and natural gas through the coastal zone. Expanded refinery capacities required to supply the projected gasoline demand will be difficult to accommodate, and may also have difficulty due to air quality constraints.

o New or expanded geothermal energy production in areas that are mainly rural, such as Lake and Imperial counties in California, have some sociological effects on community infrastructures and social environments.

o Per capita energy use in the region is smaller than the national average, totalling about 80 percent of the national average in 1975. Regional energy consumption is projected to increase more slowly than for the nation as a whole, resulting in a per capita use only two-thirds as large as the expected national average in 1990.

Description

The Mid-Mid Scenario presents few major departures from the present regional energy mix. The overall energy growth rate in Region 9 is projected to be 1.8% per year between 1975 and 1990, while the annual national energy growth is closer to 2.9% during the same period. Similarly, regional electrical energy demand grows 2% per year, while the comparable national figure is 4.6%. The overall dependence upon oil and natural gas changes little in the fifteen year period.

In assessing the scenario impacts, effort was directed to the effects of both energy production and energy use. California dominates the region in both energy supply and use, and the scenario projects little change in this situation.

Regional electric generating capacity changes slightly in composition as oil-fired generation declines, and nuclear and geothermal capacity both increase. Coal does not increase substantially in the scenario, either for electrical generation or for industrial purposes. Hydroelectric capacity does increase over existing levels; most of this expansion is pumped storage.

Proposals to expand energy development in Federal Region 9 will produce a number of conflicts, many of which are site or location specific. The more serious issues are water availability in noncoastal portions of the region, coastal land use conflicts aggravated by increased production and transportation of oil and natural gas through the coastal zone, and air quality problems in many urban industrialized areas.

Impacts related to absolute levels of energy consumption also remain as major contributors to environmental problems in the region, specifically in populated areas where both end-use energy consumption and energy use for conversion processes are high. Many of California's Air Basins are non-attainment for either oxidant or particulate, and similar problems exist for other populated areas in the region. (A notable exception to this is Honolulu County, where the easterly tradewinds aid in dispersing pollutants.) Siting of new facilities in these nonattainment areas will likely prove difficult, due to the additional stipulation of requiring trade-offs of existing air pollution sources.

With the exception of existing coal-fired electrical generation, coal is not widely used in the region. Its introduction as an industrial fuel will add to SO₂ burdens now due primarily to process and refinery sources. An additional problem of solid waste disposal and possible water quality effects may also result.

Competition for water among energy facilities, agriculture, industrial users and increasing urban demands will limit fresh water availability for new energy development in the region. Coastal siting conflicts create additional pressures since once-through cooling for new facilities is unlikely and would be further constrained by thermal discharge standards.

Overall, it appears likely that the scenario will not be implemented as described. This conclusion can be drawn on both a site-specific basis, and due to more generic concerns. This appears to be true even though changes in regional energy consumption do not keep pace with the national average. The scenario provides no details as to why the growth in energy demand is slower in the region, although this lower growth rate is consistent with recent regional trends in consumption of natural gas and electricity.

Conclusions regarding the region-wide impacts are discussed below by fuel cycle category.

i) Fuel Extraction

Coal production occurs only in Arizona, at an already existing operation. A major concern is that 65% of the strip-mined land remains unreclaimed. Regional production of other fossil fuels, oil and natural gas, takes place almost exclusively in California. The main impact areas identified in this study are expected in the coastal zone, with increasing pressure upon land use regulations for new and expanded on-shore facilities to service off-shore oil and gas production. New off-shore production may be constrained in many coastal areas in California.

ii) Transportation of Fuels

Increased oil and natural gas imports to the region will create similar coastal zone impacts due to expanded port and refinery facilities. A proposed LNG facility (postulated in the scenario as well) has encountered significant institutional difficulties due in part to siting issues within the coastal zone, and in part to questions of need and economic viability. The siting of transmission lines in Nevada and Arizona also pose land-use questions, although the new facilities projected by the scenario appear to be expansions of existing plants, hence few new transmission line corridors would be necessary.

iii) Energy Conversion

Refineries in the region are primarily concentrated in five counties, and new capacity required by the projections of gasoline demand will create land-use and air quality conflicts. These problems may significantly constrain additional refinery expansions, and the issues will be decided on a site-by-site basis. Nuclear plant expansion in the scenario is limited to facilities presently under construction. Public concern over health and

safety issues and waste disposal questions have been translated, in part, into an institutional structure in California that would constrain any future nuclear power growth and may affect operation of present plants or those now under construction. Part of the nuclear expansion is occurring in Arizona where, presently, nuclear plant opposition is low.

New coal capacity in Region 9 is projected for Arizona and Nevada, again reflecting plants already under construction or in actual operation. Present utility plans actually propose a greater utilization of coal than projected by the scenario, including proposals for plants in California. The analysis here suggests that air quality impacts due to visibility impairment might be expected in Arizona, notably in the Grand Canyon National Park, a Class I area. In addition SO_2 levels in parts of Southern California may exceed Prevention of Significant Deterioration (PSD) Class I increments due to long-range transport from the emitting areas. The scenario expects that natural gas will be available for electrical generation, both for fuel switching at existing plants and for new facilities. While the environmental aspects of natural gas use are small, the scenario projection appears contrary to both State and national plans and regulations, and institutional constraints can be expected.

Expanded hydroelectric generation projected by the scenario will have ecological and land-use implications, and much of the pumped storage capacity appears to be infeasible either economically or topographically. Geothermal expansion raises concerns over water availability and competition with agriculture for land and water. The projected use of existing geothermal resources in the Imperial Valley (California) is close to the expected maximum rate of expansion, and the development rate will depend, in part, upon its integration into the existing economic structure, which is heavily dependent upon agriculture.

Expansion of geothermal power production in Northern California raises fewer direct competitive impacts; however, local community impacts are likely to be large, and the present expansion plans are accumulating opposition. Much of this appears to arise out of concern that the communities and counties involved have not adequately accommodated the impacts of expanded geothermal use in county or community plans, and that an expanded population will require additional services or make other changes in the community infrastructure.

iv) Energy End-Use

Finally, the analysis of energy end-use impacts has focused most closely on the transportation sector, and the projections of increased gasoline consumption. Impacts due to other sectors do not appear to change substantially over present levels. Coal use in the industrial sector does not increase dramatically and no major problems are expected at a county level. (Site-specific impacts are another matter, however.) The projections of gasoline use were disaggregated to the county level on the basis of present motor vehicle registrations. Assuming the projected auto efficiency standards are implemented, as are the expected emission rate requirements, the projected air quality impacts are substantial in most urban areas. These high levels of NO_x and hydrocarbons, due to mobile sources, will affect other aspects of the scenario as well, since siting of

new industrial or electrical generating facilities in these areas will be difficult, requiring air quality trade-offs and more stringent control of emissions.

FEDERAL REGION 10

FINDINGS

- o The reduction in electric generating capacity of 568 MW, specified by the scenario for Alaska, will not be realized because of institutional constraints and economic impacts.
- o Development of 1000 MWe of geothermal generating capacity in Region 10, called for by the scenario, will not be met by 1990. Besides technical feasibility and economic constraints, procedures in Oregon and Washington for securing leases and siting permits have not been fully developed.
- o The location and impacts associated with construction and operation of oil and gas transshipment facilities, such as the proposed pipeline to transport natural gas from fields in northern Alaska to the lower 48 States and the pipeline to transport Alaskan oil through Washington State to refineries in the Midwest, are likely to be important issues in the Region.
- o The addition of 7,951 MW to the currently existing hydroelectric generating capacity of 29,990 MW by 1990 will intensify competition among multiple uses of limited water resources of the Columbia and Snake River systems which drain Idaho, Oregon and Washington. Irrigation, recreation, transportation, maintenance of wildlife habitats and anadromous fisheries conflict and compete with hydroelectric power generation.

o Public opposition to further development of nuclear power currently exists and seems to be intensifying in light of recent events. Opposition results from failure, in the public view, of the Federal Government and the nuclear industry to prove the safety of nuclear power and to find an acceptable method of storing nuclear waste. The scenario-specified addition of 4816 MW of nuclear generating capacity to the Region's current nuclear capacity of 2016 MW may be jeopardized by this opposition; specifically, the 1174 MW addition to Oregon's nuclear capacity may not be realized.

DISCUSSION

The major issues in the region that will impede implementation of portions of the scenario are primarily institutional in nature rather than environmental. Socioeconomic impacts may be high because the energy facilities projected by the scenario will occur primarily in rural areas. However, the Region is somewhat accustomed to rapid growth, and socioeconomic impacts should be amenable to mitigation.

The scenario specifies an unrealistic electric generating capacity for Alaska in 1990 of less than half the existing capacity, and calls for no gas-fired generating capacity in Alaska by 1985. Currently, approximately 50% of the total electric generation capacity in the state is of this type. Elimination of this capacity would have a high impact in terms of unemployment, loss of personal income, and economic depression.

The pumped storage portion of the scenario for Oregon may not be realized by 1990. Lead times are sufficiently long that, should planning begin immediately, even modest political opposition could delay completion of a facility within the time-frame of the scenario.

The increased coal-fired power generation specified by the scenario is assumed to occur through expansion of existing power plants and surface coal mines, and completion of one plant presently under construction. Since no additional sites are to be developed, significant ecological impacts are not expected.

According to the scenario, a 150 MW coal-fired generation facility is to become operational at Healy, Alaska, by 1985. The site also contains the state's only existing coal mine. The coal facilities with 54 MW capacity currently supply electricity to Fairbanks. The proposed new facility was reduced to 105 MW and, early in 1979, plans for the facility were cancelled by the utility because of inflationary cost escalation and air quality requirements. If the scenario is to be implemented, this decision will have to be reviewed. The proposed site is located only 10 miles from Mt. McKinley National Park, a Class I area. Operation of the coal plant expansion may cause air quality standards for Mt. McKinley National Park to be violated.

The use of coal as a fuel for electric generation will necessitate the disposal of approximately 46,500 tons of ash per month. Increased industrial use of coal will necessitate the development of adequate disposal sites. Potential adverse impacts for ash disposal, such as leaching of toxic materials, contamination of groundwater, or blowing dust, will be minimized by careful selection of the disposal site and proper treatment of the ash.

The coal-fired facility currently under construction and specified by the scenario uses a man-made reservoir for water supply. Therefore, no significant water availability or water quality impacts on existing river systems will result from facility construction and operation.

Increased air concentrations of sulfur dioxide are associated with the coal-fired generating plants. Several species of native vegetation and several important crops are sensitive to SO_2 . Such crops cover more than 30% of some counties in north-central Oregon and south-central Washington. Estimates of probable atmosphere SO_2 levels associated with the plant under construction in north-central Oregon suggest that significant ecological impacts are unlikely.

Significant opposition to the siting of nuclear power plants exists in some areas within the Region. In part, this opposition results from the failure of the Federal Government, in the view of the public, to prove the safety of plant operation and to find an acceptable nuclear waste disposal method. In addition, the Federal Government has not clearly defined the role that nuclear power will play in the Nation's energy supply. If Federal policy relating to the use of nuclear power is not clearly defined and supported by the Federal Government, the growth of nuclear power as specified by the scenario will be jeopardized.

Given the economic uncertainties, the time required in securing geothermal permits, and the current state of development of the technology required to generate electricity from the low to medium-temperature geothermal resources predominant in the Region, the scenario-specified figure of 1000 MW of geothermal capacity in the Region by 1990 will not be met. In addition to problems of technical and economic feasibility, geothermal power generation in the Region must contend with slow response to applications for geothermal leases. However, some procedures are established and several utilities are actively pursuing the development of geothermal resources, at least to the stage of securing leases on private property.

COAL

Industrial Use

As part of the National Energy Policy, existing industry is being encouraged to switch from oil, natural gas, and electricity to coal as their primary fuel source. New industry will also be encouraged to use coal as its primary fuel source. The result is an increased demand for coal in the region, about half of which will be used by industry. Industrial development is expected to increase in the Puget Sound-Willamette Lowlands; in the metropolitan and industrial area of Spokane, Washington; in the mining area of Kellogg, Idaho; and in the agricultural area of Pocatello, Idaho. Air quality is projected to exceed standards in these areas, which could restrict industrial development unless pollution offsets or advanced pollution control techniques are used. Some of the anticipated impacts from industrial use of coal are:

- o Increased reliance on coal as an energy source for industry will impact air quality in Region 10, and result in continued nonattainment of eight of its air quality control regions in the region.

o The scenario projects development which will cause violation of water quality in ASA 1705 (western Oregon). Industrial facilities sited by the scenario in this area will contribute to existing water quality violations.

o Based on lead lab projections, total deaths from the effects of air pollution due to fossil fuel combustion are expected to increase between 1975 and 1990, but will still be lower than any other region in the country.

Coal Mining

The scenario specifies coal production of 156 trillion Btu/year in 1990. Of this production, 88% will be met by surface mining in western Washington with the rest coming from coal fields in Alaska. Impacts that are identified for coal mining are:

o Approximately 7000 acres will be disturbed by surface mining by 1990. In comparison, development of subsurface mines will impact only 45 acres of surface land.

OIL

The scenario specifies that the region will produce 4,978 trillion Btu/year of crude oil. Alaska is the only state with proven recoverable reserves of crude oil and almost all of this will be exported from the State. The scenario does not, however, specify how the crude oil will be transported. Crude oil currently moves from Alaska's North Slope by oil pipeline south to Valdez, Alaska's northernmost year-round, ice-free port, and is shipped by tanker to oil terminal facilities along the West Coast. Additional oil pipelines are being considered to move crude oil from the West Coast to other areas of the lower 48 States. Concern exists over the possibility of oil spills and related ecological damage. Impacts related to oil production and transportation include:

o Construction of pipeline corridors and related facilities will have a direct impact upon current use of the land. The nature and scope of the impact varies with the land use involved. Pipeline corridors generally result in alteration of habitat in the right of way. Since the routes and capacities of energy transmission systems are not included in the scenario, the extent of the impacts on land use and ecology cannot be specified.

o Oil Transshipment facilities, tanker traffic, and off-shore petroleum extraction create potentials for large oil spills and generate chronic low-level oil pollution, which may be equally damaging. Environmental pressures in marine areas may also increase because of expansion of both the commercial fishing industry and Outer Continental Shelf (OCS) activity.

NATURAL GAS

The scenario specifies 1,450 trillion Btu of natural gas production in 1990. All of this production will come from Alaska. Although there are no transport facilities to the lower 48 States currently in place, a natural gas pipeline from Alaska through Canada is currently in the planning stage. Impacts associated with the natural gas pipeline are:

- o If a natural gas pipeline is built to transport gas from the North Slope fields, air quality impacts may occur from construction, operation, and decommissioning of the system.
- o Construction of a natural gas pipeline could cause water quality impacts through both erosion of disturbed areas and accidental discharges of pollutants.
- o The pipeline will require substantial land for construction and right-of-way. Because of the uncertain ownership and management status of the lands through which the pipeline may pass, specific conflicts with other current and potential land uses cannot be identified at this time.
- o Similar to the impact of the Trans-Alaska pipeline system, the socioeconomic impact of the gas pipeline would be important in terms of changes in lifestyle and economic changes that would occur. Previous studies indicate that regardless of the actual route chosen for the gas pipeline the bulk of the impacts will occur in Anchorage, even though the routes do not pass through the city. Another factor potentially contributing to the socioeconomic effects of the gas pipeline is the timing of the construction relative to other planned developments in the State. The longer the delay in starting the project, higher ultimate costs and greater competition for scarce human and financial resources can be expected.

ELECTRICAL SECTOR

The impacts associated with the expansion of the region's electric generating capacity are discussed by generating technology in the following sections.

Hydroelectric Generation

Hydroelectric generation accounts for almost 80% of the electric generating capacity in Region 10. Washington produces almost 60% of this hydroelectricity, followed by Oregon, which contributes about 33% while Idaho produces about 7%. Most of Washington's hydroelectric potential has already been developed, but several small-capacity sites and potential pumped-storage sites have been identified. Idaho and Oregon have somewhat more undeveloped potential. Aside from site-specific environmental impacts, concern for the future of the Columbia River system anadromous fisheries may affect further hydroelectric development in Idaho, Oregon, and Washington. Alaska currently produces about 0.5% of the hydroelectricity in the region and has great potential for development, particularly in the south-central and southeast subregions. However, seismic activity in these subregions may restrict such development.

Expansions of existing facilities currently under construction or currently planned will meet most of the scenario-specified capacity by 1990. The major impacts associated with increased hydroelectric generating in the region are:

- o Increased use of the Columbia and Snake Rivers for hydroelectric generation will lead to water availability conflicts between fisheries, agriculture, recreation, and power generation. Because of this competition,

the availability of water to meet scenario requirements for hydroelectric power is uncertain.

- o Over the last several decades, self-maintaining runs of anadromous fish in the Columbia and Snake Rivers have declined drastically because of the construction of dams on these rivers. Although steps are now being taken to reduce fish loss due to dam operation and to develop improved fish passage facilities, it remains uncertain as to whether self-maintained populations can be sustained. Further hydroelectric use of these rivers will exacerbate the problem.

- o Development of thermal electric generating facilities will result in a shift of use of hydroelectric facilities from base load to peak load operation. This will result in fluctuating water levels which can adversely impact aquatic ecosystems and riparian wildlife. These impacts result from, or are associated with, increased periodicity and amplitude of water level fluctuations.

Coal-Fired Generation

About 5% of the electricity currently generated in the region is produced by two mine-mouth coal-fired plants. Another plant using coal from Wyoming is under construction. Air quality standards, particularly near Class I areas, are the major obstacle to further development of coal-fired electric generation in the region. No significant environmental or social impacts associated with coal-fired electric generation as specified by the scenario were identified.

Nuclear Generation

Almost 7% of the electricity currently generated in the region is from nuclear plants. There are five units currently under construction in Washington, with two more proposed in the state and two proposed in Oregon. According to the scenario, nuclear power will provide about 16% of the region's electricity by 1985. Completion of the plants currently under construction and construction of the proposed plants will exceed the scenario-specified nuclear capacity for 1990. Washington, especially the south-central section of the State where defense-related nuclear facilities have been in operation for over 35 years, appears to be more accepting of nuclear power than the other states in the region. Public opposition has been mounting in recent years, particularly in Oregon where recent events may have intensified opposition and actually jeopardized the construction of that state's two proposed nuclear plants. Impacts associated with nuclear power are highlighted below:

- o As nuclear plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus affect water quality on the Columbia and Snake Rivers.

- o New nuclear plants are planned for Washington and Oregon. Although this implies increased employment within the region and expanded energy resources, the potential negative impacts have resulted in widespread public debate and resultant project delays. The people who bear

most of the social costs of these developments often receive a much smaller portion of the economic benefits from them.

Natural Gas Generation

Natural gas-fired electric generating facilities in the region are located primarily in Alaska. The impacts associated with this technology are presented below.

o The scenario calls for no gas-fired generating capacity for 1985 and 1990. Currently, approximately 50% of the total generation in Alaska is of this type. This elimination of capacity would have a high impact, in terms of its effect on personal income, levels of unemployment, and the health of the economy that is dependent on existing, if not growing, energy production.

Geothermal Generation

Although geothermal energy is currently utilized for space heating and industrial process heat, no electricity is generated by facilities utilizing geothermal resources. The region contains some of the most promising low to medium-temperature geothermal resources found in the Nation. A 5 MW pilot plant at Raft River, Idaho, should be operational by the early 1980s, and, if successful, will stimulate further development. The major impacts associated with geothermal development are discussed below:

o Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers need to be studied.

o The geothermal developments in Idaho, Oregon, and Washington are likely to occur in relatively remote, undeveloped areas. Because of the small land areas involved, and because geothermal facilities have not yet been sited except in Idaho, no specific ecological impacts can be identified.

o Proposed geothermal development may cause some socioeconomic impacts because of their isolated locations. These locations may require the developer to establish and support temporary construction work camps, removed from existing communities.

Transmission

Expansion of electric generating facilities invariably requires expansion of transmission facilities. Expansion of the extensive high voltage grid in Idaho, Oregon, and Washington may require clearing little additional land

for transmission corridors because expansion of generating facilities will occur primarily at existing facilities. Increased transmission capacity can be accomplished by modifying existing lines. Construction of transmission corridors in undeveloped areas of Alaska can be expected to have substantial impact. Major impacts associated with transmission corridors are listed below:

- o Construction of new transmission corridors and related facilities have a direct impact upon the current use of land. The nature and scope of impact vary with the land uses involved. Since routes and capacity of energy transmission systems are not specified by the scenario, the extent of the impacts on land use cannot be specified.

- o Loss of life has resulted when people have touched powerlines with irrigation pipes. Marginal expansion of the Region 10 transmission corridor system should not exacerbate this problem.

FEDERAL REGION 1

BROOKHAVEN NATIONAL LABORATORY

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Report Authors	J. Brainard S. Munson
Program Manager	P. Meier
Air Quality	F. Lipfert L. Kleinman R. Cedarwall R. Meyers
Water Quality	E. Kaplan
Solid Waste	T. Le
Health Effects	S. Morris K. Novak
Socioeconomics	W. Metz
Institutional	C. Bryant
Other Contributions	J. Carroll, University of New Hampshire M. Lapping, University of Vermont J. Edinger, J. Edinger Associates
Graphics and Report Production	R. Stern
Typing	M. Bruck B. Franz

FEDERAL REGION 1

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REGIONAL OVERVIEW - REGION 1

Analysis of the energy problems of New England and their solutions is complicated by the varied nature of the basic characteristics that directly or indirectly affect energy use in the region.* The coastal area from Southwestern Connecticut to Boston marks the northern extension of the mid-Atlantic megalopolis characterized by high population density, extensive development, concentrated commerce and industry, and intensive environmental demands. Moving north and inland, population becomes dispersed, population density decreases, business and industry become less concentrated, and the demands on the environment change. Average state population density in Rhode Island is some 26 times as large as in Maine. More than 85% of the total population is in metropolitan areas in each of the three southern states, versus less than 35% in each of the northern states. Less than 5% of the total land area in each of the northern tier states is in special uses (including urban and transportation areas), versus more than 20% in each of the southern ones.

Average per capita income (1975) in New England ranged from 82 to 117.5% of the U.S. average, being above it in the southern states and below it in the northern states. Two states, Massachusetts and Connecticut, accounted for more than 76% of the regional value added in manufacturing in 1975 (the three northern tier states contributed only 15%), and industry is concentrated in two small bands of counties in Eastern Massachusetts and Southern Connecticut (Figure 1-1). All of New England except New Hampshire had unemployment rates higher than the national average in 1976. Between 1970 and 1976 a net out-migration of the work force occurred, but, except in Massachusetts, no clearcut trend towards loss of the work force is apparent.

The environmental characteristics and quality in New England, like the population, industry, and income, are variable. The region has 3.8% of the U.S. general coastline and 6.9% of its tidal shoreline. Glacial features are characteristic, and poor drainage, drumlins, eskers, and outwash plains mark both the coastal and interior topography. New England has two major ecoregions. The Laurentian Mixed Forest Province includes most of the northern tier states and parts of Massachusetts and Connecticut. Its winters are moderately long and severe, with snow staying on the ground most of the season. Average annual temperatures range from 35, to 50, F, and precipitation averages from 24 to 45 in. per year and is greatest during the summer. Vegetation is of the Northern Hardwoods - Spruce Forest types: either mixed coniferous/deciduous stands or a mosaic-like arrangement with pure deciduous stands in favorable habitats and pure coniferous forests in less favorable habitats. Eastern Massachusetts, Rhode Island, and Connecticut are part of the Eastern Deciduous Forest Province. Winters are cold and summers warm, and the average annual

*For a detailed review of the region, see, e.g., J. Brainard et al., The Energy Situation in New England, BNL 50580, Nov. 1976.

Figure 1-1

Geographical Distribution of Industry (as measured
by Value Added in Manufacturing),

temperature is from 40° to 60° F. Precipitation averages 35" per year and is greatest during the summer. Temperate deciduous forest dominated by tall broadleaf trees is characteristic.

In the judgement of the EPA, progress in environmental protection and improvement has been slow but steady over the past year.* Air and water quality and solid and hazardous waste management are the most important environmental issues in the region. Regarding air quality, the following points merit emphasis:

*Regional Administrator's Annual Report, Environmental Quality in New England, U.S. Environmental Protection Agency, Region I, Boston, Dec. 1978.

- o The entire region is in non-attainment for photochemical oxidants (except for a few unclassified areas in Northern Maine).
- o The entire region is in attainment for SO₂, except for some localized areas near pulp mills.*
- o Attainment status for TSP shows wide variations in the region.

Controversies have erupted over every major energy facility or resource development proposal despite the range of sites from rural to urban and from inland, to coastal. Neither the importance of the conflicting economic, environmental, and energy objectives nor that of the primary actors in decision making or influence bearing positions should be underestimated. New England's traditional citizen participation in government seems as strong today as ever.**

THE REGIONAL SCENARIO

The regional scenario in terms of sectoral energy consumption is shown in Table 1-1, with the 1975 and 1990 fuel mix compared on Figure 1-2. Note that the high dependence on oil continues with only a nominal percentage decline (but with an increase in actual oil use, as indicated on Table 1-1).

The fuel mix in the electric sector (Figure 1-3) indicates that the region will continue its very high reliance on nuclear energy (some 51% of 1990 generation vs. a nationwide average of 25.3%) and its high dependence on oil, which even by 1990 will provide some 22.1% of total electric generation (vs. 5.6% nationwide). However, because of the overall lower-than-average growth in population and energy in the region, the scenario requires a relatively small number of new electric generating plants: five major nuclear units, one coal unit, and some 300 MW of combined cycle between

*In light of this, several states are now contemplating a relaxation in sulfur-in-fuel regulations as part of their revisions to state implementation plans required by the 1977 Clean Air Act Amendments.

**The generally favorable public climate in New England towards biomass, low-head hydro, and other small-scale technologies is a manifestation of the traditional values of Yankee independence—any measure that makes the citizen independent of large institutions, be they central governments or electric utilities, is well received; this is more generally reflected in very strong home rule traditions giving extensive powers to local governments. This has some unfortunate manifestations as well, as many decisions affecting the region's energy supply may be made on quite parochial grounds. A good example is the rejection of the refinery site in Durham, NH, by a vote of the citizens of that town not to grant the necessary variance of a zoning ordinance.

1979 and 1990 (Figure 1-4). At least in part, the requirement is a function of currently very high reserve margins in the New England Power Pool (estimated at 42.8% at the time of the December 1978 peak*), which the MEFS model assumes will fall to 20% by 1985.

Table 1-1

REGION I ENERGY CONSUMPTION (10^{12} Btu/yr)

SECTOR/FUEL	1975	1985	1990
Residential	629	793	834
Commercial	552	721	775
Industrial	276	484	572
Transportation	799	955	1031
Raw material	20	39	49
TOTAL	2276	2991	3261
Electricity	228	298	342
Oil	1733	2248	2445
Natural gas	309	442	471
Coal	6	3	3
TOTAL	2276	2991	3261

Figure 1-2

1975 and 1990 Fuel Mix

The trends in industrial and utility fuel use in Region I (Table 1-2) show industrial use of oil growing considerably while utilities dramatically increase their use of coal between 1975 and 1985. The corresponding SO_2 emissions (Table 1-3) may be used to assess the degree of emissions

*New England Load & Capacity report, Jan. 1, 1978. Report of the NEPOOL Planning Committee, p. 20. Although the Pool as a whole (and the northern tier) has a winter peak, utilities in the Southern New England tend to have summer peaks.

Figure 1-3. 1990 Electric Sector Fuel Mix

Figure 1-4. Major Electric Facilities in the Region by 1990

control. The SO₂ emission rates from oil remain relatively constant, while those from coal are drastically reduced. These projections may not be realistic in view of the positions taken by individual states, discussed below.

Table 1-2

FUEL USE TRENDS (10¹² Btu/yr) IN REGION I

	Oil and Gas		Coal	
	Utilities	Industrial	Utilities	Industrial*
1975	410	199	43	6
1985	460	329	231	5
1990	254	387	218	6

*Excluding metallurgical coal.

Table 1-3

SO₂ EMISSION RATES (lb/10⁶ Btu) IN REGION I

	Oil		Coal	
	Utilities	Industrial	Utilities	Industrial
1975	0.78	1.01	2.46	3.0
1985	0.90	1.0	1.13	1.2
1990	0.90	1.02	1.13	1.0

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

Many of the more important issues and impacts felt in New England as a result of the scenario are national and multi-regional in scope, requiring a scale for analysis much broader than the state or regional. Three important issues in New England are long-range transport of air pollutants, radioactive waste disposal, and U.S.-Canadian relationships.

Summary of Region I Environmental Impacts

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	M	M	L	L	L	L	L
Oil	L	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	L	L	L	L	H
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	L
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	-	-	-	-	L	-	-	-	-
End Use										
Industry	M	-	-	-	-	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table 2

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Long-Range Transport

Because Region I is near highly industrialized areas to the west and south, it receives considerable amounts of air pollutants generated outside the region. The impact of acid rain on natural vegetation, agricultural crops, and aquatic ecosystems is of some concern; it is expected to be aggravated by increased fossil-fuel burning within the region but ameliorated by reductions of pollutants from outside the region. Both sulfates and oxidants in the air are postulated to have impacts on human health,* and the levels of both are thought to be dominated by long-range transport effects. Calculations indicate 91% of the population-weighted sulfate originated outside the region in 1975 and 85% in 1990.** The impacts shown in Table 1-4 reflect a judgemental tradeoff between the effects of increased nitrogen oxides (and very likely oxidants) and decreased sulfur oxides. Therefore, the issues of compliance of Midwestern sources and emissions reductions in Region II (NY/NJ) may continue to be important to New England.

Table 1-4

DISAGGREGATION OF NATIONAL IMPACTS TO REGIONAL LEVEL

	<u>Air</u>	<u>Water</u>	<u>Regional socioeconomics</u>
Electric Sector			
Coal	M ¹ , M ⁴	M ³	
Oil			
Nuclear		M ³	H ²
Supply			
Coal			
Oil			
Nuclear			
Gas			
Solar			
Hydro		M ³	
Industrial Sector			
Coal	M ¹ , M ⁴	M ³	

¹Long-range transport from Regions II, III, IV, and V.

²Nuclear waste management perceived as a national problem.

³U.S.-Canadian water use issues.

⁴U.S.-Canadian pollution transport issues.

*The specific estimates of health effects related to fossil-fuel combustion, presented below, are based entirely on SO₄ concentrations.

**Population-weighted concentrations are calculated by summing the product of concentration and population for individual grid square elements and then dividing by the total production. These aggregated averages are most reliable for larger areas such as state or federal regions. In this report, ambient air quality concentrations are reported on a population-weighted basis.

Figure 1-5 indicates the trends in population-weighted sulfate in Region I (due to major fuel-burning sources) by region of origin. Region V (Ohio west to Wisconsin) is the major source and accounts for a significant fraction of the total sulfate in New England; the emission rates in Region V tend to be an order of magnitude larger than in Region I for all years.

Although the long-range transport analysis used to make these projections does not specifically take into account terrain features (such as the Allegheny mountains) and urban or seacoast dispersion characteristics, is based on only one month's meteorological records, and reflects linear chemistry, the gross features shown in Figure 1-5 are believed to be qualitatively correct.

Radioactive Waste Management

One of the more severe constraints on the realization of the Mid-Mid scenario is the degree to which the high reliance on nuclear capacity in the electric sector will be constrained by widespread opposition by the public and state environmental agencies on grounds of inadequate arrangements for radioactive waste disposal.* The problem of disposal is widely perceived as a federal responsibility, to be solved by action at the national level, and continued inaction will provide a focus for continued opposition to further nuclear plants.

Much of the opposition to nuclear power in New England rests on more general issues of public health and safety and the adequacy of the federal regulatory apparatus but, the issue of radioactive waste disposal is a tangible environmental issue unencumbered by esoteric probabilistic arguments and should be placed high on the agenda of federal action if continued reliance on nuclear power is to be attained in the region.

U.S. Canadian Relationships

New England shares a number of energy, water and pollution problems with Canada. Canada already supplies some of the oil, natural gas, and electricity used in New England, and may supply much more in the future, but many of the major energy projects proposed for New England, particularly those involving the use of boundary water for energy-related activities, have been opposed by the Canadians. Air quality problems in New England are significantly affected by industrial and utility activity in Canada.**

*Indeed, Governor Grasso of Connecticut has recently signed legislation ("An Act Concerning the Construction of Nuclear Power Facilities") which provides that no nuclear facilities may be built in the State until the State's Department of Environmental Protection has certified that there exists a bonafide national waste disposal method.

**For a detailed discussion of U.S.-Canadian relationships and their impact on the region's energy future, see J. Carroll, "Environmental Aspects of Eastern Canada-Northeastern U.S. Energy Relations: An Identification of Issues", RIIA Issue Paper No. 2, Division of Regional Studies, BNL, May 1979.

Figure 1-5

Sulfate Concentration in Region 1

- o Overall ambient sulfate concentration decreases by 1985.
- o 85-90% of sulfate concentration in the region is due to sources in other regions, with Region IV (The Midwest) the dominant contributor.

REGIONAL ISSUES

Regional Air Quality

Regional air quality considerations are different in the southern portions of the region. In the south, the large population centers are part of the Washington-Boston megalopolis, and human health exposures are important. In the north, the emphasis is more on protection of visibility and ecological values. The region has several Class I PSD areas, for which pristine air quality is a goal.

Long-range transport effects are important because both atmospheric aerosol and oxidant concentrations tend to be dominated by outside sources. The complexities of transport across mountain ranges have not been considered in this analysis, nor those of atmospheric dispersion and chemistry in either the urban or seacoast environments of Region I; and area sources, which may be important in urban areas, are not included in the model. However, this analysis does indicate that improved sulfur oxides air quality in New England will depend heavily on the degree to which the postulated controls are realized in the regions to the north and west. The computed trends in SO₂ emissions are shown on Figure 1-6; the resulting trends in ambient concentrations are shown on Figure 1-7.

Water Quality and Availability

The major inland water issues in New England related to energy activities concern the use of water for cooling electric generation plants. Competing uses for water at times of low flow and difficulties in providing adequate flow augmentation may pose serious obstacles to the siting of some plants. The impact of the consumptive water use at the planned Montague nuclear plant in Massachusetts, for example, is of concern as far downstream as the Connecticut River estuary in Southern Connecticut.

The major coastal issues concern the severe impacts that oil spills and once-through power plant cooling systems can have on marine organisms. Increased barge and tanker traffic in harbors and coastal waterways, particularly LNG tankers in urban ports, may also conflict with existing uses.

Land Use, Ecology, and Solid Waste

The Mid-Mid scenario anticipates only one new coal-fired power plant in the region (Sears Island) and no significant level of industrial coal use. Solid waste issues are unlikely to be the constraining factor at Sears Island. The principal coal-related solid waste problems will be associated with the oil-to-coal conversions under the Energy Supply and Environmental Coordination Act (ESECA). These conversions will likely be constrained primarily by air quality but the absence of land for disposal near the plants is a strong factor in utility resistance to ESECA, since many of these plants

- o Sharp increases of SO₂ emissions in Maine are a result of the postulated new coal fired power plant in Waldo County.
- o Emissions in the other states all increase by 1985, although to a quite varying degree.
- o Sharp decline of emissions in Massachusetts in 1985-1990 due to retirement of old oil fired electric capacity.

SO₂ EMISSION TRENDS

Figure 1-6. SO₂ Emission Trends

- o Annual average ambient concentrations of SO_2 generally decrease in all states except Maine.
- o Worsening of sulfur oxide air quality in Maine is due to the major coal-fired electric plant postulated for Waldo County.

TRENDS IN AMBIENT SO_2 CONCENTRATIONS

Figure 1-7. Trends in Ambient SO_2 Concentrations

are in urban or coastal areas where land use pressures have foreclosed areas previously available. At present, the only ESECA conversion likely to be made is that of one of the three Brayton Point units.*

Nuclear waste management problems have two aspects: the general public and political concern over every new nuclear plant has been used as a basis for political platforms at the state and local level, and more specific manifestations. For example, several existing nuclear plants in New England will run out of storage pool capacity for spent fuel assemblies in the mid-80's. This, coupled with the current lack of national planning for nuclear waste management, may constrain future nuclear energy development. In addition, many local governments, following the lead of New London, CT, and New York City, are now considering local ordinances that ban shipment of nuclear wastes through their jurisdictions.

The major ecological problem related to energy activities in Region I is potential disruption of the aquatic ecosystem by oil pollution and power plant cooling systems. Estuarine ecosystem productivity is one of the issues that surfaced for the coastal zone. Acid rain may become a serious problem in the future, but there is currently considerable doubt concerning the severity of acid rain impacts in New England.

Restoration of anadromous fisheries in New England rivers is another central issue in the relicensing of older run-of-the-river hydropower plants. The provision of fish ladders for all dams on rivers that have anadromous fish (whether for hydropower or not), and the maintenance of instream flow may be limiting criteria.

Sensitivity to environmental problems in the region is higher, and continued ecological-energy confrontations seem probable. Development proposals that threaten critical or unique habitats, such as tidal marshes, or involve disruption or development of natural areas with great economic value such as fishery areas, or prime forestland, seem the most likely to invite confrontation. In addition, proposals that involve the development and use of large areas of land (for example Dickey-Lincoln) are certain to be sensitive.

Social, Economic, and Institutional Issues

The vast majority of the new energy facilities planned for 1976 and 1990 are situated along the coast, in areas with high population densities and major transportation arteries, which enhance the availability and accessibility of workers for projects. Generally 10% or less of a construction work force finds it necessary to relocate to a site area, and area accommodations are sufficient to accept these immigrants with little difficulty. A possible exception to the commuting rule could be the Sears Island, ME, project. Potential manpower availability problems could be increased if several of

*The following ESECA conversions are postulated in the MID-MID Scenario: three units at Brayton Point in Bristol, MA, totaling 1100 MW; Norwalk Harbor, CT, 333 MW; Middletown, CT, 420 MW; Mt. Tom, MA, 144 MW.

the nuclear plants scheduled to become operational in 1990 do not have their construction schedules staggered.* Figure 1-8 summarizes the socioeconomic impacts of the scenario in the region, with an indication of laborshed and construction work force for each of the major power plant additions.

Offshore oil development will compete only minimally for labor with the proposed power plants and is not expected to cause facility delays. The scenario foresees only 0.1×10^6 barrels per day of offshore oil by 1990 and 241×10^6 cubic feet for gas, production levels unlikely to lead to major onshore socioeconomic impacts. Indeed, such levels may well lead to revitalization of many old fishing towns that could readily absorb the necessary OCS development support facilities.**

The legislature of every state in New England has passed or introduced bills to curb, regulate, or impose moratoria on construction of nuclear power plants, storage of radioactive wastes, and/or transport of radioactive materials. Although many of these statutes, if enacted and tested, may eventually be found to conflict with federal preemption, their possible future impact on the development of nuclear power in this region should not be discounted, for they reflect widespread and growing disquietude and opposition to the use of nuclear power.

A particularly controversial issue in many New England states concerns the perceived relationship between rising electricity bills and the financing of nuclear power plants. At issue is whether a utility should be permitted to charge current customers for the cost of construction work in progress (CWIP) by including the cost in the rate base, or whether it should wait to earn a return on its investment until the plant is in service. The financial strain on the utility from prohibiting CWIP charges may lead to postponement or abandonment of some nuclear projects, particularly the Seabrook, NH, facility. Currently, five of the six New England states disallow CWIP (New Hampshire, has introduced but not yet enacted legislation to prohibit CWIP financing) and the issue is a politically sensitive one throughout much of the region.

Health and Safety

Given that sulfate levels in the region are estimated to decrease the concomitant health effects from fossil fuel combustion, as indicated by

*For further details, see W. Metz. Socioeconomic Impact of Proposed Power Plants in the Northeast, RIA Issue Paper No. 1, Division of Regional Studies, BNL, May 1979.

**See, e.g., New England River Basins Commission, A Methodology for the Siting of Onshore Facilities Associated with OCS Development, Dec. 1975.

- o Total electric plant construction payroll in region to 1990 estimated at \$1.3 billion
- o Annual 1990 local property tax revenues from electric plants estimated at \$32 million.
- o On average, about 185 immigrants per major project during the construction phase.
- o New plants are generally located near metropolitan regions, with major labor markets in close proximity.

Figure 1-8. Socioeconomic Impacts

Table 1-5

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION²

	Population-weighted SO ₄ ⁴ conc., ug/m ³	Individual risk level deaths per 10 ⁶ person/year ^b	Estimated attributable annual deaths ^b
1975	6.1	30-490 ²	3780- 5900
1985	3.8	19-380	690-11000
1990	3.7	19-300	250- 4000

²Effects shown are on an annual basis, but may actually occur in some future years.

^bThe range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

Table 1-6

ESTIMATED ANNUAL RADIATION INDUCED CANCERS DUE TO NUCLEAR POWER PLANTS

	Nuclear Power Plant Workers	General Public	
		Routine	Non-Routine ^a
1975	0-0.29	0-0.008	0-0.3
1985	0-0.47	0-0.012	0-0.9
1990	0-1.45	0-0.023	0-0.9

^aAnnualized effect of catastrophic accidents

population exposure to sulfates derived from fuel burning emission sources, will also decrease, as indicated on Table 1-5.* Nevertheless, there is growing recognition in the region of the importance of interregional pollution transport; and indeed by 1990, some 85% of the deaths shown on Table 1-5 can be attributed to sources located outside of the region.** In addition, any health effects due to NO_x or oxidants may worsen; such effects have not been quantified.

The other major health related concern, given the absence of coal mining in the region, is radiation induced cancers from nuclear plant operation. With the increase in nuclear generation in the region, these will generally increase, as indicated on Table 1-6. Note that the nuclear health effects are based on average conditions and do not reflect local population density or meteorology.

STATE ISSUES

CONNECTICUT

Air Quality

- o Scenario hypothesized ESECA conversions at Norwalk and Middletown are in TSP non-attainment areas.
- o Local air quality analysis predicts potential SO_2 violations in Fairfield County.
- o Control of air pollution from upwind states is a critical factor in achieving air quality goals.

Industrial SO_2 emissions are postulated to increase in Connecticut by 48% and utility emissions to decrease by 4%. Since the current oil sulfur content limit is 0.5%, the coal conversions will require scrubbers to meet this requirement. The local air quality analysis predicted SO_2 air quality standards violations in Fairfield County due to the additional sources there. Since the standard in question was the 3-hr average this is unlikely, as the effects of new and existing sources would not necessarily be additive. A more detailed analysis at the sub-county level would be appropriate. There are no non-attainment areas for SO_2 , but three AQCRs have shown particulate problems (see Figure 1-9).

*For detailed documentation of these computations, see S. Morris, et al, "Health Effects of the EIA MID-MID Scenario". Biomedical & Environmental Assessment Division, Brookhaven National Laboratory, forthcoming report.

**All of the New England States except New Hampshire are coplaintiffs in a suit against EPA contesting current attainment rules in light in interstate movements of pollution.

- o SO₂ emissions will increase slightly between 1975 and 1985 but will drop below 1975 levels by 1990.

- o SO₂ ambient concentrations, however, are expected to decrease between 1975 and 1985 and again between 1985 and 1990.

- o SO₄ ambient concentrations decline between 1975 and 1985 and increase slightly thereafter.

Figure 1-9. Emissions and Air Quality Trends in Connecticut

Since improvements in air quality are due largely to controls on sulfur oxides in the face of increases in fuel use, concentrations of other pollutants, including nitrogen oxides and oxidants may increase. The influx of air pollution into Connecticut is an important issue, and a citizens' group has instituted legal action against upwind states and sources. The tobacco crop is sensitive to oxidants, which are already at fairly high levels throughout the state, (Figure 1-9), and a worsening of this situation could have severe impacts. Connecticut has no PSD Class I areas, but visibility is important and should be improved by the postulated improvement in sulfur concentrations.

Scenario-Induced Changes

- o An overall improvement in population-weighted SO_2 and SO_4 by 1985 will result from reductions in upwind, out-of-state sources.
- o In-state SO_2 emissions will be reduced by 1990.

Water Quality and Availability

- o Water quality impacts and consumptive use of water for thermal generation on the Connecticut River in Massachusetts (particularly at the proposed Montague plant) may affect water quality and availability in Connecticut.
- o As the majority of planned thermal capacity additions and ESECA conversions are clustered along the coast, the potential aggravation of water quality problems in Long Island Sound is a key issue.

Consumptive use of water for thermal power generation on the Connecticut River in states upstream of Connecticut is estimated at some 47 cfs for the 1990 Mid-Mid scenario, some 2.1% of the low flow of 2160 cfs. This may not be a significant fraction in itself, but, coupled with the potential flood skimming diversions via the Northfield, MA, pumped storage project, it makes the entire issue of upstream allocation of Connecticut River water a matter of serious concern in the state, if only from the viewpoint of setting legal precedents. The first major trans-basin diversion involving the Connecticut River, litigated before the Supreme Court in the 1930s,* was upheld, but many observers expect new debate on interstate riparian issues if these projects proceed.**

*See, e.g., Engineering News Record, April 1931, for a discussion.

**See, e.g., NERBA draft policy on Connecticut River diversion, in Environmental News, EPA Region I, Jan. 1979. The riparian rights issues associated with energy-related projects on the Connecticut River are discussed in detail in M. Lapping, Legal Aspects of Water/Energy Problems in the Northeast Region, in C. Bryant, Editor, Selected Institutional Aspects of Energy Development in the Northeast, RIIA Issue Paper No. 3, Division of Regional Studies, BNL, May 1979.

Background Issues

- o Large segments of the Connecticut River are water quality limited because of combined point, sewer, and non-point source problems.
- o Water quality in Long Island Sound is affected by numerous point and non-point sources characteristic of extensive residential and industrial development.

Land Use, Ecology, and Solid Waste

- o Protection of coastal resources and amenities is of key concern in Connecticut.
- o The disposal of wastes from plants required to convert to coal under ESECA orders may be a problem because most of these plants are located coastally while potentially available sites are inland.

Connecticut is one of the nation's leaders in resource recovery from municipal waste, with large-scale facilities under construction or planned in Bridgeport, Hartford, and New Haven, each with the potential for producing significant amounts of refuse-derived fuel suitable for use as an industrial boiler fuel or as a supplementary fuel in coal-burning utility plants. This potential is not explicitly considered in the Mid-Mid scenario, but, because of its environmental benefits compared with conventional landfill disposal, it represents an important overall gain to the state.

Background Issues

- o Connecticut is a state with diverse land use pressures and patterns. The existing and postulated thermal plant siting does not complement this pattern; rather, it appears to locate plants in areas of intensive growth pressure.

Social, Economic, and Institutional

- o All the proposed new power plants are sited in the heavily populated coastal counties. The labor force of the state is quite skilled and no shortages of workers are forecast. No significant work force in migration is anticipated.
- o A number of institutional issues and problems may crop up in the time covered by the Mid-Mid scenario which will affect energy development. Some of these, such as water diversions, have been covered in other sections of this report.

Connecticut has comprehensive siting laws and planning mechanisms covering major energy facilities. Although decision of the State Power Facility Evaluation Council can override those of local authorities for most types of energy facilities, local voter approval is required for the construction of oil refineries. This reflects concern and apprehension over the potential environmental impact of Outer Continental Shelf oil exploration and associated onshore development. Connecticut, through its Office of Policy Management, also takes an active role in statewide energy

planning and forecasting, in contrast to the primarily reactive posture toward utility initiatives adopted by many other New England states.

The Connecticut Legislature is currently considering a bill that would impose a moratorium on the construction of nuclear power facilities pending resolution of the nuclear waste problem.* At the same time, legislation supported by a coalition of pro-nuclear groups has recently been introduced to ban local restrictions on nuclear material transport such as those adopted by New London.

Health and Safety

o A major safety concern regarding nuclear power is the transportation of nuclear materials.

o Concern over the effects of low level radiation may affect licensing of Millstone 3.

Nuclear power is viewed as a potential health concern. Low level radiation from a number of possible sources but specifically from the Millstone nuclear complex is perceived by some as a potential cancer threat to residents of the immediate area surrounding the site. This idea is supported by the Clam Shell Alliance, which also has raised a number of environmental issues. The analysis indicates, however, that the expected annual number of radiation-induced cancers in the general public, in the entire state, attributable to nuclear power plants rises from 0.112 in 1975 to 0.36 in 1990, including the annualized effect of potential catastrophic accidents. The other major concern regarding nuclear power is the transport of nuclear materials. Legislative action on this issue (Rep. John Anderson and Rep. David Lavine) is currently being considered.

Conservation of energy is a highly verbalized concern of state energy officials. Associated with this initiative are a number of measures that have direct health consequences. Certainly insulation materials (i.e., urea-formaldehyde and asbestos) are known or suspected to be health hazards. An increase in the number of home fires has been attributed partly to increased use of wood and other materials as supplemental heating sources; continuation of this trend is a concern. Another conservation measure encouraged by state agencies is to reduce home hot water temperatures, and this has had the secondary positive effect of reducing the number of burns, which has recently been rising.

Scenario-Induced Changes

o The expected annual number of radiation-induced cancers in the general public in Connecticut attributable to nuclear power rises from 0.112 in 1975 to 0.36 in 1990, including the annualized effect of catastrophic accidents.

*This bill was recently signed by Gov. Grasso.

- o The range of estimated total deaths attributed to fossil-fuel combustion falls from 100-1700 in 1975 to 76-1200 in 1990.
- o The maximum personal risk to death from fossil combustion sources decreases by from 0.53×10^{-3} in 1975 to 0.32×10^{-3} in 1990.

RHODE ISLAND

Air Quality

- o The small size of Rhode Island, coupled with modest emissions, makes out-of-state sources the dominant factor by about 10:1 for SO_2 and 100:1 for SO_4 .
- o The Metropolitan Providence Intrastate Air Quality Control Region is in violation of the primary TSP standard.

Scenario-Induced Changes

- o SO_2 emissions from major sources are projected to decrease (Figure 1-10).
- o Population-weighted concentrations of SO_2 are projected to decrease between 1975 and 1990, and those of SO_4 to decrease between 1975 and 1985 and to increase slightly between 1985 and 1990.

Water Quality and Availability

- o There are no major scenario related water availability problems in Rhode Island.
- o Siting of NEP 1, an 1150-MW nuclear unit near Charleston on Block Island Sound, will raise the usual problems of thermal pollution. Groundwater requirements during construction may conflict with other uses.

Land Use, Ecology and Solid Waste

- o There are no major scenario-related issues regarding land use, ecology or solid waste in Rhode Island.

Social, Economic, and Institutional

- o There are no major, scenario-related socioeconomic impacts in Rhode Island.
- o Several institutional issues will have a bearing on nuclear development particularly the proposed NEP-1 nuclear facility.

Local socioeconomic issues should pose no problem for Rhode Island energy development. The area around the old Quonset Naval Air Station, near Charlestown can easily accommodate the workers needed for activities supporting the offshore oil developments at Quonset. For NEP-1, labor availability may pose a problem in the boilermaker craft since the workers would be drawn from a Boston-based union hall. The utility and the Rhode

- o SO₂ emissions will decrease between 1975 and 1985.

- o SO₂ ambient concentrations will decrease between 1975, 1985, and 1990.

- o SO₄ ambient concentrations will decrease between 1975 and 1985 but increase slightly thereafter.

Figure 1-10. Emissions and Air Quality Trends in Rhode Island

Island Construction Trades Union estimate that 75 to 85% of the labor force will be Rhode Islanders if proper training and apprenticeship are provided.

New England Power Company's plan for NEP 1, an 1150-MW nuclear power plant on the Quonset Air Station site, has met with considerable citizen opposition. The state legislature is currently considering a bill that would give the General Assembly the power of final approval or veto of all plans for energy facilities in the state. Utility officials have stated that such a bill, if enacted, could delay the project as much as three years. However, the proposed site for NEP has not yet been secured by the utility from General Services Administration (GSA), which is charged with disposal of this federal property. Extensive litigation concerning optimal use of this land must be anticipated, resulting in further delays in licensing.

Health and Safety

- o The estimated range of annual deaths attributable to emissions from fossil fuel combustion (sulfates) falls from 29-470 in 1975 to 23-360 in 1990.
- o The estimated number of annual radiation-induced cancers in the general public increases from 0.001 in 1975 to 0.17 in 1990, including the annualized effect of catastrophic accidents. The sharp increase is due to the nuclear unit (NEP 1) postulated for Washington County.

MASSACHUSETTS

Air Quality

- o The Mid-Mid scenario includes 380 MW of combined-cycle capacity in Hampden County, 70 MW of combined-cycle capacity in Bristol County, and ESECA conversions in Somerset and Hampden Counties.

Massachusetts has no non-attainment areas for SO₂ and only a few local non-attainment areas for TSP. The state has granted higher-sulfur fuel variances for certain point sources, and would like to continue and extend this program; therefore, further SO₂ emissions increases are to be expected. The Brayton Point plant in Bristol County is being converted from oil to coal (voluntarily) under an agreement with EPA allowing up to 3.5% sulfur coal to be used in exchange for tighter controls of particulate emissions.*

*This agreement between the Massachusetts Department of Environmental Protection and the utility, in which SO₂ emissions were traded off against particulate emissions, with the utility installing additional particulate control equipment in exchange for a guarantee that emission standards will remain unchanged for 15 years, represents a considerable innovation. It should be noted that since the emissions calculations for this facility were based on 2.2% sulfur coal, SO₂ emissions for Massachusetts may be understated.

The long-range transport analysis showed a decrease in population-weighted concentrations of SO₄ and, to a lesser extent of SO₂. However, much of the population is near the seacoast and thus subject to maritime air movements not taken into account in this analysis.

Massachusetts has no Class I PSD areas, but, like Connecticut, is concerned about visibility and ecological effects. A Massachusetts citizens' group is also a party in the Connecticut suit against interstate air pollution.

Scenario-Induced Changes

- o The state will experience nearly constant industrial SO₂ emissions from 1975 to 1990 (Figure 1-11).
- o Utility emissions will increase substantially from 1975 to 1985 and then decrease between 1985 and 1990, but will remain above the 1975 level (Figure 1-11).
- o Population-weighted concentrations of SO₂ will decrease between 1975 and 1990; those of SO₄ will decrease between 1975 and 1985 and increase slightly thereafter (Figure 1-11).

Water Quality and Availability

- o Iron, manganese, cadmium, cyanide, and alkalinity levels currently exceed applicable standards in the Connecticut River, and cooling tower blowdown at the proposed Montague site would raise these levels.
- o Groundwater quality and availability are of concern in coastal areas. The groundwater table may be disrupted during construction of Pilgrim 2.

Water quality issues will be of general concern in both the Montague and Pilgrim 2 hearings. Regarding cooling tower blowdown, where concentration results solely from evaporative loss and discharge back to the river over a reduced cross section determined by diffuser configuration, it is not clear whether the utility would be required to treat this waste stream.* A decision by the 4th U.S. Circuit Court** has taken the view that pollutant discharge, as defined by the Act, refers only to substances added to the intake stream. A discharge permit may be written by a state or regional EPA office limiting the levels of some substances due to the concentration effect; but such limitations, if any exist, have not yet been tested in the courts. The water quality computations addressed only cooling tower blowdown effects; inclusion of the impacts of discharging biocides and scale preventative would require further analysis.***

*R. Stoll, attorney, Office of the General Counsel, EPA, Washington, DC, personal communication (4/20/79).

**Appalachian Power vs Train, 4th Circuit Court, 545 Fed W (1351), p. 1337 (k) Credit for Intake of Pollutants.

***For complete details, see K. Kaplan, Water Quality Investigations at Proposed Freshwater Sites for Thermal Power Generation Additions, RIA Issue Paper No. 4, Division of Regional Studies, BNL, May 1979.

Figure 1-11

Emissions and Air Quality Trends in Massachusetts

Background Issues

- o The proposed diversion of Connecticut River floodwaters raises serious riparian rights issues.
- o Aggressive water quality management programs have greatly improved surface water quality in the state but have not had a measurable affect on groundwater quality.

Land Use, Ecology and Solid Waste

- o The ecological impact of transbasin diversion via the Northfield pumped storage project may be extensive.
- o The ecologic impacts of OCS development and support activities are of grave concern to the New England commercial fishing industry.
- o The disposal site for solid wastes due to the Brayton Point ESECA conversion is sufficient only to 1984.

The Brayton Point plant, the only one in the region now considered likely to undergo ESECA conversion, will use an ash disposal site some 12 miles distant, requiring expensive trucking, and with sufficient capacity for only 5 years; an alternative site (presumably even more distant) will be required if some use for the ash cannot be developed.*

The planned diversion of Connecticut River floodwaters into the Boston water supply system via the Northfield pumped storage project raises serious concerns about ecosystem impacts as well as a host of downstream riparian rights issues. The Connecticut River is frequently subject to serious flooding problems and its valley also has a unique agricultural productivity (tobacco, asparagus, and corn being important cash crops); any drastic change in hydrologic regime altering its role in enhancing fertility would be of serious long-term concern.*

Massachusetts is interested in exploring the potential for offshore oil, but the effects of this activity on fishing, the environment, and health are of general concern. Drilling operations could pollute the coastal waters with heavy metals such as beryllium and cadmium. Tanker spills and increased shipping traffic also pose a potential hazard. Significant finds of oil and gas could require the dredging of ports such as New Bedford which is known to have large amounts of PCBs residing on its harbor bottom. Disturbing this relatively stable mass could contaminate fishing and lobster grounds.

*M. Ertel, Study of Possible Environmental Effects of Proposed Diversion of Connecticut River to Quabbin Reservoir, Report on Phase I. Institute for Man and His Environment, U. of Massachusetts, Amherst, Feb. 1974.

Social, Economic, and Institutional

- o Labor availability in specialized crafts would pose a problem only if the construction schedules of too many facilities overlap or if other construction activities in the Boston area increased too greatly (see Figure 1-8 for plant-specific impacts).
- o Major institutional actions will be required to decide the riparian rights issues evolving from any potential diversion of Connecticut River waters.

Since 1974 Massachusetts has had a comprehensive Energy Facilities Site Evaluation Act. As amended, this statute invests the state with decision-making powers over most types of major new energy facilities including electric generating plants, oil refineries, storage terminals, and pipelines, and natural gas facilities. The Massachusetts General Court (the state legislature) is currently considering legislation that would impose a moratorium on nuclear power plant construction pending resolution of nuclear waste problems. The impact of these measures on future energy facility siting cannot be accurately predicted or evaluated now, but may seriously inhibit the construction of nuclear power plants in the state.

Local socioeconomic impacts of proposed new energy facilities should not cause any schedule delays. The sites of the combined-cycle and other oil-fired power plant units are near heavily populated areas and are readily accessible to construction workers. Few workers will relocate during the construction period, and operations personnel who relocate will be easily accommodated. For the two nuclear facilities, Pilgrim 2 and Montague 1, it is estimated that about 10% of the staff will relocate.

Background Issues

- o In the recent past, state representatives have expressed concern over the boom-and bust impacts of energy developments on local economics.
- o The resolution of (past) solid waste disposal site proposals must be viewed as unsatisfactory in light of the potential demand for sites for coal-fired power plant wastes. Proposals for such sites may raise intra-state equity issues.

Health and Safety

- o Concern over hazards of LNG tanker traffic in Boston Harbor may constrain LNG imports.
- o Dredging of New Bedford Harbor and other old ports to support onshore facilities for OCS development may release significant amounts of PCBs.
- o Concern over use of urea-formaldehyde as a home insulation material may affect conservation objectives.
- o Evaluation of nuclear sites is of grave concern because of their location near transportation bottlenecks on the way to major recreation areas.

Currently one of the most prominent energy-related health issues in the state is the use of urea-formaldehyde (UF) to insulate buildings and homes. Within the past year about 500 complaints, primarily of skin and eye irritation, along with respiratory impairment, were received from families who recently insulated their homes with UF, which may have been used in an estimated 3000 to 5000 homes in the state. Under certain circumstances, possibly as a result of improper mixing and installation, UF breaks down to produce formaldehyde fumes. Massachusetts is in the forefront of the movement to ban the use of UF insulation, but a number of similar complaints in other states (CA, NH, WI, MS) have been reported including one suspected death, that of an infant in Minneapolis. The Massachusetts State Department of Public Health and the Center for Disease Control in Atlanta, GA, are planning an epidemiological study of the situation.

Scenario-Induced Changes

- o The estimated range of annual deaths attributable to fossil-fuel combustion (sulfate emissions) falls from 180-2900 in 1975 to 140-2200 in 1990, and the average personal annual risk of death decreases from 0.51×10^{-3} in 1975 to 0.32×10^{-3} in 1990.
- o The estimated number of annual radiation-induced cancers in the general public increases from 0.07 in 1975 to 0.32 in 1990, including the annualized effect of catastrophic accidents. The sharp increase is due to the Montague and Pilgrim nuclear units postulated by the scenario.

VERMONT

Air Quality

- o No major problems are identified or expected from energy-related activities implied by the Mid-Mid scenario.

Both industrial and utility emissions were projected to increase in Vermont, although the absolute levels will remain quite low. This is consistent with the reported desire of the state to relax its sulfur-in-fuel limit from 1% to 2%. The entire state meets the SO₂ and primary TSP ambient air quality standards.

The long-range transport analysis projects a decrease in population-weighted concentrations of both SO₂ and SO₄ due primarily to out-of-state reductions (see Figure 1-12). Visibility is expected to improve at the Class I PSD area in Vermont (Lye Brook Wilderness).

Water Quality and Availability

No major problems are identified or expected from energy-related activities implied by the Mid-Mid scenario.

Land Use, Ecology, and Solid Waste

No major problems are identified or expected.

- o SO₂ emissions are expected to double between 1975 and 1990, nonetheless, emissions levels will remain significantly low.

- o SO₂ ambient concentrations will decline between 1975 and 1985 and increase slightly between 1985 and 1990.

- o SO₄ ambient concentrations will halve between 1975 and 1985.

Figure 1-12. Emissions and Air Quality Trends in Vermont

Social, Economic, and Institutional

No major problems are identified or expected.

In response to widespread public concern over safety problems associated with the operation of the Vermont Yankee nuclear plant and with nuclear power in general, Vermont enacted legislation in 1975 giving the state legislature the power of final approval or veto of proposed nuclear facilities. The effect of this legislation on future energy supplies in the state is uncertain because it has not yet been tested and no additional nuclear facilities in Vermont are now being planned. Of more immediate (and positive) potential impact is the outcome of current negotiations by Vermont utilities and by state power authorities with Quebec and with Ontario Hydro for the purchase of Canadian electric power.*

Health and Safety

The major immediate energy-related public health concern in Vermont centers of surprisingly, on solar energy. Already as many as 60% of all homes are estimated to use wood to supply at least part of winter home heat (in other than purely decorative fireplaces), and the number of homes fires has increased drastically in the past two years. Several agencies are now mounting campaigns to focus public attention on the hazards of wood burning in inadequate facilities (or those that violate building codes). Another cause for concern is the use of antifreeze in solar heating systems (to prevent freezing in heat absorption coils during very cold weather), particularly with regard to possible contamination of the domestic drinking water supply. These issues will not significantly impede attainment of the scenario technology mix, but they are emerging technology-related public health concerns in the state.

Scenario-Induced Changes

- o The estimated range of annual deaths in Vermont attributable to fossil-fuel combustion (sulfate emissions) falls from 13-210 in 1975 to 8-130 in 1990, and the corresponding individual risk probability falls about 50% from 0.46×10^{-3} to 0.23×10^{-3} .
- o The estimated number of annual radiation-induced cancers in the general public falls from 0.04 in 1975 to 0.03 in 1990, including the annualized effect of catastrophic accidents.

NEW HAMPSHIRE

Air Quality

- o The local air quality analysis projected exceedance of Class I PSD increments in Cross County due primarily to industrial emissions.

*See Carroll, op. cit., for further discussion.

- o Both industrial and utility emissions are projected to increase between 1975 and 1985 and then to decrease to less than 1975 levels by 1990 (Figure 1-13).

- o Population-weighted concentrations of SO₂ will decline between 1975 and 1990, but those of SO₄ will decline from 1975 and 1985 and increase slightly thereafter (Figure 1-13).

The emissions of SO₂ from major sources in New Hampshire are projected to remain fairly constant over the period 1975-1990. There are some local non-attainment problems due to pulp mills, but otherwise no important pending regulatory constraints.

The local air quality analysis projected exceedance of the Class I PSD increments of Cross County due primarily to industrial emissions. The long-range transport analysis showed very low SO₄ concentrations because of decreases from out-of-state sources, and visibility was therefore expected to improve in the Class I areas of New Hampshire.

Water Quality and Availability

- o Conflicts over the use of groundwater during construction of Seabrook I have already arisen.

- o No other major problems are identified or expected.

Land Use, Ecology, and Solid Waste

No major problems are identified or expected.

Social, Economic and Institutional

- o Public opposition to nuclear power in the state has focused on the Seabrook nuclear generating station.

- o Local socioeconomic impacts would interfere with energy development in the state.

- o Growing public opposition to nuclear power facilities, a regionwide and nationwide phenomenon, has been most dramatically manifested in recent massive public demonstrations against construction of the Seabrook nuclear generating station in New Hampshire. Completion of this facility is now further impeded by financing problems due in part to this widespread opposition. The recent election of Governor Hugh Gallen (who campaigned on an anti-CWIP platform) has no doubt spelled an end to the construction work in progress (CWIP) charges on which Public Service of New Hampshire was relying for a substantial part of the Seabrook plant's financing.

Additional legislation aimed at curbing or regulating nuclear power facilities has been introduced in the New Hampshire Legislature. One bill would prohibit the disposal of nuclear wastes within the state, and another would mandate state investigation and monitoring of low-level radiation emissions.

- o SO₂ emissions will increase between 1975 and 1985 and then drop below 1975 levels by 1990.

- o SO₂ ambient concentrations, however, show a constant decrease out to 1990.

- o SO₄ ambient concentrations will decrease between 1975 and 1985 and increase slightly thereafter.

Figure 1-13. Emissions and Air Quality Trends in New Hampshire

The obstacles to the construction of the Seabrook plant posed by current or proposed legislative impediments and by public opposition could result in power supply delays and shortfalls that would be felt throughout the New England Power Pool.

Local socioeconomic impacts should not interfere with proposed energy developments in New Hampshire. Most energy facilities will be sited in the populous southern part of the state and therefore readily accessible to construction workers. Of the June 1975 Seabrook construction work force of 2200, for example, only 246 had immigrated to Rockingham (where the plant is sited) and adjacent Stratford County in the last two years.

Health and Safety

- o The estimated range of annual deaths attributable to fossil fuel combustion falls from 25-300 in 1975 to 17-270 in 1990, and the corresponding individual personal annual risk of death falls from 0.048×10^{-3} to 0.03×10^{-3} .
- o The estimated number of annual radiation-induced cancers in the general public rises from essentially zero in 1975 to 0.17 in 1990, including the annualized effect of catastrophic accidents. The sharp increase is due largely to the Seabrook nuclear unit postulated by the Scenario.

MAINE

Air Quality

- o Total statewide SO_2 emissions are expected to triple by 1990, even with full NSPS controls (Figure 1-14).

The scenario postulates substantial increases in power generation and fuel use in Maine, including 1150 MW of coal-fired capacity corresponding to the proposed Sears Island Plant, and a 60-MW combined-cycle plant by 1985.* In addition, a 600-MW oil-fired plant has recently come on line. These major additions will result in a substantial increase in emissions in Maine over those in the 1975 base year, even with controls for sulfur oxides emissions. Accurate projection of the effects of these changes is hampered by the presence of continental maritime flow patterns, which are near important population centers (and near some sources), and by the great distance from the large Midwestern sources that dominate long-range transport effects. The long-range transport analysis does show an exchange between local and long-range effects of SO_2 and a slight improvement of SO_4 due to reductions elsewhere, so that visibility in the two Class I PSD areas in Maine (Acadia National Park and Moosehorn Wilderness) is expected to improve.

*The scenario coal requirement makes this a larger plant than is currently planned by the utilities for Sears Island.

Figure 1-14. Emissions and Air Quality Trends in Maine

Background Issues

- o Maine has some local non-attainment problems for SO₂ associated with paper mills (which are not included in this analysis) and also a few local TSP violations. These situations could subject future plant siting to constraints that would depend on a subcounty local analysis.

Scenario-Induced Changes

- o Total statewide SO₂ emissions are expected to triple by 1990, even with full NSPS controls (Figure 1-14).
- o The long-range analysis showed the possibility of a PSD Class I SO₂ exceedance for Acadia National Park by 1985.
- o Population-weighted concentrations of SO₂ will increase between 1975 and 1985 and decrease slightly thereafter; those of SO₄ will decrease between 1975 and 1985 and increase slightly thereafter, as shown in Figure 1-15.
- o Industrial SO₂ emissions will increase by 100,000 tons/yr between 1975 and 1985 and by 30,000 tons/yr between 1985 and 1990.

Water Quality and Availability

- o No major water availability problems are identified or expected from energy-related activities implied by the Mid-Mid scenario.
- o No major water quality problems are identified or expected; however, ecologic issues in the Sears Island siting and Maine Yankee rerating hearings are related to water quality.

Land Use, Ecology, and Solid Waste

- o The Maine Yankee nuclear plant is expected to exhaust the capacity of its storage pool for spent fuel assemblies in the near future.
- o The ranges of a number of species of flora and fauna with endangered, listed, or review status include part or all of Maine.
- o Changes in water quality or flow dynamics in areas adjacent to operating power plants may affect commercial fish species and their larvae.
- o Most of the new energy developments are located in coastal counties.

The Maine Yankee nuclear plant is expected to exhaust the capacity of its storage pool for storage fuel assemblies and this will require immediate action (possibly transfer to a plant still having pool capacity). A satisfactory regional solution to the nuclear waste management problem must be found by the mid 1980s.

The presence of endangered species on or near proposed energy facility sites may cause delays or indefinite postponements in construction; for

example, the U.S. Fish and Wildlife Service had indicated that the existence of the Bald Eagle in the East would be threatened by the proposed oil refinery at Eastport. The Main Yankee nuclear plant rerating may aggravate existing thermal, entrainment, and impingement problems. The Sears Island coal plant is meeting opposition from intervenors, who will raise similar issues of adverse impacts on the marine ecosystems from chemical treatment of plant cooling water and, if cooling towers are used, from blowdown discharges. The offshore areas of Cumberland, Lincoln, and Waldo Counties, where power plants are proposed are highly productive fishing grounds that may be disrupted by the cooling systems.

Social, Economic, and Institutional

- o The locations of most proposed energy developments are in the areas with the most of the state's population.
- o No major social or economic problems are identified or expected from energy-related activities implied by the Mid-Mid scenario.

It is estimated that the Sears Island coal-fired power plant (1150 MW) will employ 1875 workers at peak construction. Most of these will be Maine residents, as were 92% of the workers on the Maine Yankee plant. The Sears Island plant will have a greater immigration of workers than the Maine Yankee site because it is farther from Portland. The local socioeconomic impact, centered in Waldo County and extending into Penobscot County, should not cause delays in the construction schedule.

The proposed Sears Island electrical generating facility has been the focus of considerable political debate and controversy raised by groups perceiving the plant as posing a variety of environmental problems and hazards, perhaps the most serious being its location only 10 to 12 miles from the outer island of Acadia National Park.

Background Issues

- o Maine has no energy facility siting legislation, but does have laws that set standards and procedures for the siting of major developments along the coast and inland.

Health and Safety

- o The use of wood as a residential and commercial fuel may result in increased accidents.
- o The estimated range of annual deaths in Maine attributable to fossil-fuel combustion falls from 20-230 in 1975 to 12-190 in 1990, and the corresponding individual personal annual risk of death falls from 0.03×10^{-3} to 0.19×10^{-3} .
- o The estimated number of annual radiation-induced cancers in the general public rises from 0.07 in 1975 to 0.09 in 1990, including the annualized effect of catastrophic accidents.

Maine, like Vermont and New Hampshire, has recently developed a strong dependence on wood as a home heating fuel. It is estimated that 80 to 85% of homes are heated primarily by oil and 15 to 20% by electricity, but 40 to 55% burn wood for supplemental heating. The health concerns associated with this use of wood are (1) pollution from wood combustion, (2) home fires due primarily to faulty installation of wood-burning stove, and 3) accidents during wood harvesting.

FEDERAL REGION 2
BROOKHAVEN NATIONAL LABORATORY

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Report Authors	J. Brainard S. Munson
Program Manager	P. Meier
Air Quality	L. Kleinman R. Cedarwall R. Meyers
Water Quality	E. Kaplan
Solid Waste	T. Le
Health Effects	S. Morris K. Novak
Socioeconomics	W. Metz
Institutional	C. Bryant
Other Contributions	J. Carroll, University of New Hampshire M. Lapping, University of Vermont J. Edinger, J. Edinger Associates
Graphics and Report Production	R. Stern
Typing	B. Burke
Editing	M. Denes

FEDERAL REGION 2

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REGIONAL OVERVIEW - REGION 2

New York and New Jersey, which comprise Federal Region 2, are marked by large environmental and physiographic contrast. Their three main ecoregions are the Adirondack Highlands of the Laurentian mixed Forest Province (all of New York north and west of New York City); the eastern Deciduous Forest Province (Long Island, New York City, and Central New Jersey), and the southeastern mixed forest of the Outer Coastal Plain Forest (Southeastern New Jersey). Relief ranges from sea level to 3000 ft with occasional peaks higher than 5000 feet. Topography is rolling and, as the southern extent of glaciation bisects the region, glacial features are frequent from Long Island north. New York and New Jersey have more than 5800 miles of tidal shoreline and 413 miles of general coastline. Barrier beaches and tidal wetlands are important environmental and economic assets.

Monthly maximums for the coldest and warmest months (January and August, respectively) range from 26° to 43° F and from 69° to 81° F in different parts of the region. Total average annual degree days range from 4847 to 8237 for heating and from 170 to 960 for cooling. Average annual precipitation ranges from 32 to 45 in. with precipitation occurring in all months. Mean annual total snowfall ranges from 12 to 126 in. and the average annual number of days with snow cover ranges from 20 to 140. Small summer water deficits occur in some areas.

In 1975, 12% of the U.S. population lived in New York and New Jersey; the respective state population densities were 6 and 16 times the national average. The density varied from 67,808 people per square mile in the Borough of Manhattan to less than 20 in some rural areas. In 1975, average per capita income in the region was about \$6600 or 113% of the national average, and value added in manufacturing was \$17.8 billion in New Jersey and \$35 billion in New York, concentrated in the greater New York, Buffalo, and Rochester areas (Figure 2-1). The unemployment rate in 1976 was about 10.3% or 140% of the national rate. Since 1970, the region has had a net outmigration of approximately 209,000 workers, 95% of them from New York.

New Jersey and New York have strong socioeconomic ties, evidenced by many interstate organizations, particularly in the metropolitan areas, where coordinated planning is required to avoid duplication of services, particularly transportation. The governments of the two states and of New York City (which, because of its large political base, is extremely influential in the region) have worked closely together and will continue to do so.

The problems and opportunities that each government must deal with are, however, quite different. The most pressing problems for New York City are to provide services and to maintain the integrity of its financial base; environmental protection and energy planning have second or third priority. In addition, the energy and environment problems of the city are quite different from those of the states. For example, the individual and mass transit problems facing New York City not only differ from those of rural and other urban areas but are also dealt with by distinct agencies such as the new York-New Jersey Port Authority. Similarly, the air quality

Figure 2-1
Geographical Distribution of Industry (as measured by value added)

problems (and solutions) of the city are quite different from those of upstate New York or Southern New Jersey.

Many of the energy controversies in the region can be explained by the proximity of large population centers to the Atlantic coastline and the consequent intense pressure on natural resources. Such pressure creates problems for the siting of energy facilities even if the supply of the resource at issue (e.g., water) is quite abundant compared with that elsewhere (e.g., the arid regions of the West). Problems of environmental quality and protection are of considerable concern and priority in the region, and the diversity of environments and activities results in their being varied and numerous. Because energy facilities are highly visible targets they often serve to catalyze opposition from groups with widely different environmental concerns. Almost every major energy facility proposed in the last few years has met with considerable opposition, and this trend must be expected to continue.

THE REGIONAL SCENARIO

The energy scenario for Region 2 is summarized on Table 2-1, with Figure 2-2 indicating a 1990 comparison, fuel supply sector, with the nation. We note a much higher dependence on oil in the region (some 66%) than the nation as a whole (46%), again reflecting a continuation of current conditions.

New power plant construction of units larger than 60 MW will total 31,320 MW from 1976 to 1990, with most to be built along the coastlines of Lake Ontario, Lake Erie, Delaware Bay, Long Island Sound, and the Atlantic Ocean and others on the Raritan River (NJ) and the Hudson River and its tributaries. Of the proposed units 47% are nuclear, and all units to be built between 1986 and 1990 are nuclear (9755 MW). The major electric sector facilities in the region by 1990 are shown on Figure 2-3*. As indicated, a number of the facilities in the scenario do not correspond with current utility expectations. The electric sector fuel mix (Figure 2-4) shows a much higher than average reliance on nuclear and oil.

Figure 2-4
1990 Electric Sector Fuel Mix

Several other features of the scenario are important to the region. The West Valley nuclear fuel reprocessing facility in Western New York is postulated to supply 30% of U.S. reprocessing capability by 1990. Offshore production in the Region is assumed by the scenario to be landed entirely in New Jersey, at 1990 levels of some 233×10^9 cubic feet of gas per day and 0.1 million barrels/day of oil. As noted below, the former will be highly

*This scenario was prepared before announcement of the permanent postponement of the Atlantic 1 offshore nuclear unit. An analysis of siting constraints in the Mid-Atlantic indicates that Delaware Bay location would be the most likely substitute. (See P. Meier and B. Hobbs, "Water Resource Constraints to Power Plant Siting in the Mid-Atlantic," Water Resource Bulletin, forthcoming.)

Table 2-1

REGION II ENERGY CONSUMPTION (10⁹ Btu/YR)

<u>Sector/Fuel</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
Residential	1224	1476	1500
Commercial	986	1126	1155
Industrial	613	950	1089
Transportation	1584	1809	1893
Raw material	56	121	152
Total	4463	5482	5789
Electricity	472	705	801
Oil	2940	3548	3739
Natural gas	882	1001	1005
Coal	109	220	224
Total	4463	5482	5789

Table 2-2

FUEL USE TRENDS (TRILLION BTU/YEAR) IN REGION II)

	<u>Oil & Gas</u>		<u>Coal</u>	
	<u>Utilities</u>	<u>Industrial</u>	<u>Utilities</u>	<u>Industrial^a</u>
1975	720	553	198	124
1985	630	481	830	277
1990	503	544	810	300

^aExcluding metallurgical coal

Table 2-3

SO₂ EMISSION RATES (11b/10⁶ BTU) IN REGION II

	<u>Oil & Gas</u>		<u>Coal</u>	
	<u>Utilities</u>	<u>Industrial</u>	<u>Utilities</u>	<u>Industrial^a</u>
1975	0.82	0.6	3.18	2.71
1985	0.14	0.41	0.93	0.55
1990	0.21	0.41	0.94	0.57

Figure 2-2
1975 and 1990 Fuel Mix Comparison

Figure 2-3
Electric Sector Additions 1975-1990

constrained by institutional problems and the latter appears remote in light of disappointing results of exploratory drilling in the Baltimore Canyon area. The successful local opposition to recent refinery, oil storage and terminal proposals, even in the already highly industrialized Jersey City area, is indicative of the problems likely to arise if commercial quantities of offshore oil and gas are found*.

Table 2-2 shows trends in the fuels used in industrial and utility sectors in Regions II; use of oil decreases slightly while coal is increased. Utility use of coal jumps drastically between 1975 and 1985. The corresponding SO₂ emissions per million Btu input are given in Table 2-3, which may be used to assess the degree of emissions control implied. SO₂ emissions, especially from oil are drastically reduced. These assumptions may not be realistic in view of the positions taken by individual states, described below.

REGIONAL ASSESSMENT

National Issues With Regional Impacts

Many of the more important issues and impacts affecting New York and New Jersey as a result of the scenario are national and multi-regional in scope and require analysis on a scale much broader than the state or region. Four such issues must be addressed: long-range transport of air pollutants, radioactive waste disposal, the impact of OCS development, and pollution of U.S. and Canadian international waters (Lake Erie, St. Lawrence River).

Long-Range Transport:

Region 2 is near highly industrialized areas to the west and therefore receives considerable amounts of air pollutants generated outside the region. The impact of acid rain on natural vegetation, agricultural crops, and aquatic ecosystems is currently a subject of some concern, and control of local pollution sources can provide only slight alleviation. In addition, airborne sulfates and oxidants have both been postulated to affect human health,** and the levels of both are thought to be dominated by long-range transport: 74% of the population-weighted*** sulfate concentration originated outside the region in 1975, and 73% is expected to in 1990. Thus the impacts shown in Table 2-4 reflect a judgemental tradeoff between the

*See e.g. D. Morell "Who's in Charge: Governmental Capabilities to Make Energy Facility Siting Decisions in New Jersey," Princeton Center for Environmental Studies, July 1977.

**The estimates of health effects related to fossil fuel combustion presented below are based entirely on SO₄ concentrations.

***Population weighted concentrations are calculated by summing the products of concentration and population for individual grid-square elements and then dividing by the total population. These aggregated averages are most reliable for larger areas such as federal regions.

effects of decreased sulfur oxides and those of increased nitrogen oxides (and very likely oxidants), and the issue of compliance of Midwestern sources may continue to be important in Region 2.

Figure 2-5 shows the amounts of population-weighted sulfate in Region II originating from major fuel burning sources in the various regions (note the extremely minor role of Region 1). The substantial improvement in air quality in Region 2 results more from reductions in upwind regions than from local reductions.

Although the long-range transport analysis used to make these projections does not specifically take into account the effects of terrain features (i.e., the Allegheny Mountains) and of urban or seacoast dispersion characteristics, and is based on only one month's meteorological record, and reflects simple linear chemistry, the gross features of the results are thought to be correct.

Table 2-4

DISAGGREGATION OF NATIONAL IMPACTS
TO REGIONAL LEVEL

	<u>Air quality</u> <u>(due to long-range transport)</u>	<u>Regional</u> <u>socioeconomics</u>	<u>Water</u>
Electric sector			
Coal	M ¹	L	L
Oil	M ¹	L	L
Nuclear	-	H ²	L
Supply			
Gas	-	L	M ³
Oil	-	L	M ³
Urban waste	-	L	L
Solar	-	L	L
Coal mining	-	-	-
End use			
Industry	M ¹	L	L

1. NO_x and photooxidant increases may offset SO_x decreases.
2. Radioactive waste disposal problems, seen as requiring federal action.
3. OCS impacts amenable to mitigation at scenario-postulated production levels.

o Ambient sulfate concentrations in the region fall sharply between 1975 and 1985.

o 75% of the total concentration in Region 2 is due to sources outside Region 2 - with Regions 3, 4 and 5 the major contributors.

Figure 2-5

Radioactive Waste Management

One of the more severe constraints on the realization of the Mid-Mid scenario is the degree to which the high reliance on nuclear capacity expansion in the electric sector will be constrained by widespread opposition on grounds of inadequacy of arrangements for radioactive waste disposal. The waste problem is widely perceived as a federal responsibility, to be solved by action at the national level, and continued inaction will provide a focus for continued opposition to additional nuclear plants.

Much of the opposition to nuclear power in the region is based on more general issues of public health and safety and the adequacy of the federal regulatory apparatus. Nevertheless, the issue of radioactive waste disposal is a tangible environmental issue unencumbered by esoteric probabilistic arguments and should be placed high on the agenda of federal action if continued reliance on nuclear power is to be attained in the region.

Impacts on OCS Development

Offshore oil and gas production levels in the Mid-Mid Scenario may be significantly constrained by continued opposition in New York on environmental grounds. In any event, the results of exploratory drilling on

the Baltimore Canyon area to date indicate few hydrocarbon finds (nine holes dry, six still being drilled, and only two with hydrocarbon finds, of as yet undetermined potential).

U.S. - Canadian Water Issues

There are several international water issues in the region, given that Lakes Erie and Ontario, and the St. Lawrence River represent the northern boundary of the region. Important controversies include the Great Lakes Winter Navigation question, the regulation of lake levels, and the pollution of Lake Erie. While these issues are largely scenario independent, their resolution has important implications for coal supply and cooling modes of power plants on Lake Erie and Ontario, and hydroelectric generation at a number of locations on the border*.

REGIONAL ISSUES

Regional Air Quality

All the population centers of Region 2 are within reach of emissions from the heavily industrialized regions of the mid-west and Appalachia under appropriate meteorological transport conditions, but this analysis has not treated the complexities of transport across the Allegheny Mountains or of the atmospheric dispersion and chemistry of either the urban or coastal environments in Region 2. The core of the Washington-Boston megalopolis is in this region and some of the worst air quality episodes occur in Region 2 when winds are roughly aligned with this axis (transporting material northeast). The computer trends in SO₂ emissions and ambient concentrations are shown on Figure 2-6 and 2-7, respectively. Both emissions and ambient concentrations are shown to decrease significantly by 1985, but increase slightly by 1990.

The region also contains areas for which the ecological effects of air pollution may be critical. Brigantine National Wilderness in New Jersey is a Class I area for Prevention of Significant Deterioration (PSD) and thus may require additional controls for any new fossil-fuel plants within about a 100-km radius. In New York, both the Catskill and Adirondack areas, although not designated Class I areas, are noted for their natural values and are thus sensitive to further air quality insults.** In particular, because the Adirondack area contains a number of lakes sensitive to acid precipitation, additional fossil-fuel emissions affecting it are likely to be contested. The results of the Mid-Mid scenario show a decrease in area-weighted SO₂ and SO₄ for these areas due primarily to reductions in long-

*For further details see J. Carroll, "Environmental Aspects of Eastern Canada - Northeastern U.S. Energy Relations: An Identification of Issues," RIIA Issues Paper No. 2, Division of Regional Studies, BNL, July 1979.

**As state rather than federal parks these areas were not automatically classified as Class I areas under the terms of the 1977 Clean Air Act Amendments. They are obvious candidates for additional Class I designations initiated by the State.

Summary of Region II Environmental Impacts

	Air	Water		Land		Health & Safety	Social and Economic			
Energy Source	Quality	Quality	Availability	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	M	L	M	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	M	L	L	H
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	M	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	-	-	-	-	L	-	-	-	-
End Use										
Industry	M	-	-	-	M	L	L	L	L	L

range transport, but an increase in nitrogen oxides and/or nitrates is quite likely (a quantitative analysis of which is beyond the scope of the present study) and thus it is not possible to project the net change in acidic deposition for these critical areas. The conclusions of this analysis must also be tempered with the realization that at least some of the protected new nuclear capacity will not in fact be built,* and that substitution of fossil plants for nuclear plants will result in emissions greater than estimated.

Figure 2-6. SO₂ EMISSION TRENDS IN THE REGION

o SO₂ emissions decline by 33 percent between 1975 and 1990 but increase by approximately 10 percent between 1985 and 1990.

Water Quality and Availability

Inland, the major water issues related to energy activities in Region 2 concern the use of water for cooling electric generation plants. Competing uses for water at times of low flow and difficulties in providing adequate flow augmentation may pose serious obstacles to the siting of some plants.

In the coastal zone, major water issues concern the severe impacts that oil spills and once-through power plant cooling systems can have on marine

*For example, as a result of a Nuclear Regulatory Commission staff study recommending against the Greene County site, one of those assumed in the scenario, the Power Authority of the State of New York (PASNY) has cancelled this project there.

organisms. Increased barge and tankers in urban ports, may also conflict with existing uses.

Figure 2-7. TRENDS IN AMBIENT SO₂ CONCENTRATIONS

o SO₂ concentrations decrease by more than 10 ug/m between 1975 and 1985 but increase thereafter.

In some areas, such as Northern New Jersey, water supplies simply are not sufficient to meet projected demands for all sectors, and their use for energy production, particularly by nuclear power plants, will create substantial public controversy.

Land Use, Ecology, and Solid Waste

The Mid-Mid scenario assumes significant increments of coal-fired based-load electric capacity in the region, primarily along the shores of Lake Ontario and Lake Erie. Even though these plants will require FGD systems under current NSPS proposals, adequate land area for disposal of both FGD system sludge and ash is expected to be available since the plants are generally far from urban centers.

Nuclear waste management issues in the region have two aspects. One is the general public concern over the inadequacy of waste disposal arrangements in the industry as a whole, and which has been the basis for anti-nuclear political platforms in a number of recent elections (most notably the 1978 New York gubernatorial campaign). The political rhetoric tends to aggravate public anti-nuclear sentiments, which contribute to licensing difficulties. The second aspect is the specific manifestation of inadequacy: several nuclear plants in the region will exhaust their storage pool capacity for spent fuel assemblies in the mid 1980s—the Fitzpatrick plant in New York as early as 1981. A subject of more contention is the

Western New York Nuclear Service Center in West Valley, closed since 1972, whose reopening technically could ease the storage capacity shortage in the region, but politically is extremely unlikely*. Thus the ability to meet the nuclear capacity figures in the Mid-Mid scenario by 1990 will depend on the Federal Government providing solutions to the nuclear waste management problem.

Oil spills have resulted in damage to some areas of Region 2. The long-term impacts of coastal transportation cannot at present be estimated, but there is widespread regional concern that future offshore oil development and associated onshore refinery development will aggravate coastal environmental problems. Some studies indicate that onshore diffuse sources (e.g., residential and commercial developments) and coastal point sources (e.g., large rivers that concentrate pollutants and then dump them along the coast where they merge and mix) are greater contributors to coastal pollution than are offshore transportation or potential OCS development.

Social, Economic, and Institutional Issues

Local socioeconomic impacts in this region could be significant enough to cause a delay in several power plant schedules. Construction-related immigration should range from a few percent for units near major urban areas to as high as 20% for units in more rural areas.

Labor availability could cause a problem due to overlapping construction schedules in four locations: (1) Southern and Eastern New Jersey, (2) near Lake Erie, (3) around Oswego, NY, and (4) near Albany. Adjustments in facility scheduling or a strong preconstruction commitment by utility and union leaders could alleviate this problem. Figure 2-8 summarizes the socioeconomic impacts of the scenario in the region, with an indication of the labor and construction workforce for each major power plant addition.**

The problems of siting nuclear power plants are compounded by active political opposition to this power option in both New York and New Jersey. This opposition has as yet had no major reverbrations at the

*The recent announcement that the State and Federal Departments of Energy had reached agreement on a temporary reopening of the facility was followed by immediate passage by the lower house of the legislature of a bill opposing such action, and a denial by Governor Carey that any such agreement was imminent. The entire question of public opposition to nuclear power in the Northeast is examined in further detail in C. Bryant, Selected Institutional Aspects of Energy Development in the Northeast, RIIA Issue Paper No. 3, Division of Regional Studies, BNL, July 1979.

**For further details, see W. Metz, Socioeconomic Impact of Proposed Power Plant in the Northeast, RIIA Issue Paper No. 1, Division of Regional Studies, BNL, July 1979.

Figure 2-8
Socioeconomic Impacts

- o Power plant construction payroll in region to 1990 estimated at \$7.5 billion;
- o Annual local tax revenue in 1990 estimated at \$210 million;
- o Construction projection in four major areas - The Buffalo Metropolitan Area; Oswego County on Lake Ontario; Greater New York; and Southern New Jersey. Construction Labor is drawn from throughout the region, as indicated below;
- o Average number of construction phase in migrants estimated 700 per project site.

legislative level in New Jersey, but the New York Legislature has recently introduced a number of bills to curb, regulate, or impose moratoria on the construction of nuclear power plants and the storage of radioactive wastes.

Although neither state now prohibits putting all Construction Work in Progress (CWIP) charges into the utility base rate—an issue with far-reaching implications for the financing of large power facilities—although such charges can be disallowed for individual projects, as occurred in the case of the scenario's proposed 1150-MW Atlantic Nuclear Generating Station.

The tidal and coastal part of Region 2 is one of the largest marine habitat and recreation areas in the East, and a number of emerging environmental issues related to it are common to New York and New Jersey. To date, one of the dominant issues has been petroleum exploration and development in the Baltimore Canyon area. This may be moot since drilling has failed to reveal commercial quantities of oil or natural gas, but continuation of the leasing program has led to continued concern on the part of state governments and private groups. The major issues related to offshore development are the coastal and offshore impacts of petroleum pollution or development activities (e.g., on commercial fisheries or on breeding habitat); the onshore impacts of offshore development (e.g., affects on the local economy of support-base development or refinery construction and operation); and support of state and local planning and management activities (e.g., requesting federal financing for coastal zone management planning directed specifically at dealing with development related to offshore activities).

Health and Safety

Since sulfate levels in the region are projected to decrease, the concomitant health effects from fossil-fuel combustion, as indicated by population exposure to sulfates derived from fuel burning emission sources, will also decrease (Table 2-5).*

Nevertheless, there is growing recognition in the region of the importance of interregional pollution transport; indeed, by 1990 some 73% of the effects shown can be attributed to sources outside the region.** In addition, any health effects attributable to NO_x or oxidants may worsen, although such effects have not been quantified.

The other major health-related concern, given the absence of coal mining in the region, is radiation-induced cancers from nuclear plant operation. With the increase in nuclear power generation in the region, cancers generally increase (Table 2-6), but the impact levels are an order of magnitude lower than those associated with the scenario-postulated nuclear waste reprocessing activity at West Valley, NY (see below section on Health and Safety).

*For detailed documentation of these computations, see S. Morris, et al., Health Effects of the EIA MID-MID Scenario, Biomedical & Environmental Assessment Division, forthcoming report.

**Both New York and New Jersey are coplaintiffs in a suit against EPA contesting current attainment rules in light of interstate movements of pollution.

Table 2-5

ESTIMATED HEALTH EFFECTS FROM AIR
POLLUTION FROM FOSSIL FUEL COMBUSTION

	<u>Pollution weighted SO₄ conc., ug/m⁴</u>	<u>Individual risk level, deaths per 10⁻⁶ persons/year</u>	<u>Estimated attributable annual deaths*</u>
1975	c 9.5	48-770	1200-19000**
1985	5.0	24-380	690-11000
1990	4.9	25-390	700-11000

*Effects are shown on an annual basis but may actually occur in some future year.

**The ranges shown for deaths in this table and in sections below reflect approximate 60% confidence limits based on a subjective probability distribution of coefficients relating mortality linearly to ambient sulfate concentrations.

Table 2-6

ESTIMATED ANNUAL RADIATION-INDUCED CANCERS
DUE TO NUCLEAR POWER PLANTS*

	<u>Nuclear power plant workers</u>	<u>General public</u>	
		<u>Routine</u>	<u>Non-routine**</u>
1975	0-0.256	0-0.006	0-0.26
1985	0.0.89	0-0.031	0-0.091
1990	0-1.58	0-0.047	0-1.6

*Long-range atmospheric transport effects not included.

**Annualized effects of catastrophic accidents.

STATE ISSUES

NEW JERSEY

Air Quality

- o A large improvement in sulfur oxides air quality from major fuel burning sources both in and out-of-state, and thus it appears likely that New Jersey will remain in attainment of the SO₂ ambient standards.
- o Due primarily to reductions in out-of-state sources, sulfate concentrations are projected to drop substantially in New Jersey and thus an improvement in visibility would be expected at the Class I area of Brigantine Wilderness.

New Jersey contains four EPA air quality control regions but only one is wholly within the state and thus interstate concerns are important. The entire state had attained the SO₂ and NO₂ standards in 1978 but was in non-attainment for oxidants. Primary total suspended particulates standards (TSP) were not met in Jersey City or Camden. As a result of the attainment of SO₂ standards, there have been some relaxations of SO₂ emissions requirements in the south Jersey and Camden areas. Northern New Jersey remains tightly controlled because of its proximity to New York City.

Scenario Induced Issues

- o Significant improvements in SO₂ and SO₄ ambient concentrations due to lower SO_x emissions in the scenario are expected; SO₂ concentration decreases from 22 µg/m³ in 1975 to 13.7 µg/m³ in 1990, and sulfates from 9.6 µg/m³ in 1975 to 5.6 µg/m³ in 1990 (Figure 2-13).

Water Quality and Availability

- o The low flow augmentation requirements for postulated thermal plants in Salem and Hunterden Counties may significantly constrain the scenario.

The estuarine and bay areas of New Jersey comprise one of the most important breeding areas for commercial and recreational fish species in the Northeast and are used intensively for commercial and recreational purposes (particularly the Delaware River and Bay). Because these areas are highly sensitive to both traumatic and sustained pollution and are already intensively used, proposals for activities that may have a detrimental effect on water quality are receiving intense scrutiny. Such activities would certainly include the construction of power plants and OCS-related facilities.

Background Issues

- o Water quality in the Delaware River Estuary is seriously degraded by municipal and industrial discharges in the Trenton, Camden, and Wilmington areas.

Figure 2-9

- o SO₂ emissions from both industrial and utility sources will more than half between 1975 and 1985.

- o SO₂ concentrations will decline between 1975 and 1990.

Trends in SO_x Emissions and Populated Weighted Concentrations:
New Jersey

- o One of the main causes of water quality problems in New Jersey is the heavy discharge of organic, oxygen-depleting wastes which cause the receiving waters to be plagued with low concentration of dissolved oxygen and high Biochemical Oxygen Demand and bacterial counts.

Scenario-Induced Issues

- o Plants sited in Hunterden and Salem Counties will require low flow augmentation but water for this will not be available from existing reservoirs. The Hope Creek nuclear plant in Salem County was to have used the now defunct Tocks Island Dam project for this, and a replacement has yet to be found. Low flow augmentation of 176 cfs would be required by 1990 in the Delaware River Basin for the scenario to be realized (which represents 12% of the current low flow).

Land Use, Ecology and Solid Waste

- o Utility siting trends postulated in the scenario conflict with land use priorities in the coastal zone.
- o New Jersey has one Class I PSD area and numerous fish and wildlife management areas located in and adjacent to the coastal zone. In at least one case, the manager of such an area has opposed plans for a power plant.
- o Habitat alteration in bay and estuarine areas is of serious concern to the recreation and fisheries industry.

New Jersey has diverse land uses, population concentrations, and habitats. Moreover, because of its location and industrialized nature, the conflicts between development and environmental protection often seem more straightforward than in other states. Such conflicts assume added dimensions, however, in respect to the seasonal recreation use of the southern and eastern shores and the importance of bay and estuarine areas to the commercial and recreational fisheries in the entire Northeast.

Insofar as postulated electric capacity additions are generally sited along bay and estuarine areas, and major petroleum transportation routes lead into Delaware Bay, and the emphasis of existing legislation and public concern is focussed on coastal areas, it would seem that such plants or activities will face continued opposition. And, in light of the fact that New Jersey's coastal waters have suffered from both traumatic and sustained pollution, future regulatory initiatives may become even more restrictive.

Background Issues

- o Bay and estuarine areas in New Jersey are among the most productive aquatic habitats in the Northeast.
- o Traumatic pollution incidents have seriously damaged large areas yet chronic pollution that threatens habitat change or species disruption may outweigh those of traumatic incident.

Scenario Induced Changes

- o Electric capacity additions are to be located primarily in the coastal zone.

Social, Economic, and Institutional

- o Labor availability for the construction of the proposed nuclear plants in Southern New Jersey may be a problem.
- o No explicit institutional constraints exist (as yet) for the sites proposed for both fossil and nuclear generating stations. But, several places of legislation are being considered which may prolong the licensing process and delay realization of the scenario timetable.

Even though the addition of 2760 MW of oil and coal-fired electric generation capacity is projected for 1985 in four Northern New Jersey counties, it is very likely that sufficient labor for the construction of the plants would be available from the Newark-Paterson urban area and New York City. Little socioeconomic impact should result from the small immigration and the need for accommodations in the area.

Delays in the construction of the proposed nuclear plants in southern New Jersey are more likely, although the continuity of construction at Salem 1 and 2 and then Hope Creek 1 and 2 may keep an established, skilled work force in the area, helping to avoid delay. Forked River will be able to draw on some of northern New Jersey's work force. Still, labor availability is an issue of concern for the proposed plants.*

New Jersey as yet lacks comprehensive statewide energy facility siting legislation. However, its Coastal Area Facilities Review Act (CAFRA), Coastal Wetlands Act, Flood Plain Law, Pinelands Act, and other environmental legislation may well constrain the development of many major new energy facilities in this highly populous and heavily industrialized coastal area.

The 1150-MW Atlantic Generating Station, which was to be located in the Atlantic Ocean about 12 miles northeast of Atlantic City, has for several years faced determined opposition from local and statewide anti-nuclear groups. Public Service Electric and Gas Company has already abandoned its plans for this controversial facility, partly because new demand projections indicate a lack of need for the plant and partly because the utility has been prohibited from including project costs in its rate base.

Background Issues

- o The Three Mile Island incident has magnified concern over the feasibility of evacuation plans for areas around nuclear power plants. This

*For detailed discussion of the socioeconomic impacts of nuclear power plants in the Mid-Atlantic States, see W. Isard et al., Regional Economic Impacts of Nuclear Power Plants, BNL 50562, Aug. 1976.

issue is of special importance along the East Coast, which has a large influx of seasonal visitors: In New Jersey, on the barrier islands off the Atlantic Coast, the influx is significant in summer, yet evacuation would be possible over only one or two bridges.

Health and Safety

- o Health and impacts due to sulfate exposure from fossil-fuel combustion are expected to show decreases by 1990, parallel to decreases in ambient sulfate concentrations.

In recent years growing public concern over significantly higher than average cancer rates in the heavily industrialized areas of northern New Jersey ("Cancer Valley") has raised the level of public interest in the health effects of exposure to low levels of toxic chemicals and radiation.* More recently, the mercury pollution episode in the Meadowlands, also in northern New Jersey, has focused attention in the ability of state and federal government to deal effectively with such problems.** This naturally affects energy projects as well, and these will be subjected to intense public scrutiny.

Scenario-Induced Issues

- o The range of estimated total deaths in the region attributable to sulfate exposure from fossil-fuel combustion is 350 to 5700 in 1975 and 250 to 4400 in 1990; thus, the average personal annual risk of death due to this source drops 0.78×10^{-3} to 0.44×10^{-3} .
- o The estimated number of expected annual radiation-induced cancers in the general public due to nuclear power plant operation (including the annualized effect of catastrophic accidents) increases from 0.057 in 1975 to 0.53 in 1990.

*The National rate for cancer mortality in 1950-1969 was 174 per 100,000 for white males, 130 per 100,000 for white females. The comparable New Jersey rates are 205 and 147, for white males and white females, respectively. The rate for males is the highest in the Nation, that for females exceeded only by New York (at 148 per 100,000). See T.J. Mason et al "U.S. Cancer Mortality by County, 1950-1969", U.S. Dept. of Health, Education Welfare, Report DHEW-NIH 74-615.

**This is analogous to the impact of the Love Canal toxic waste scandal in New York.

NEW YORK

Air Quality

- o Sulfur oxides air quality in the state is expected to show considerable improvement in 1990; much of this is attributable to reductions in out-of-state areas.
- o Coal plants postulated by the scenario for Chautaugua, Erie, and Niagara Counties may be constrained by non-attainment problems in the Buffalo metropolitan area.

Discussion

New York contains eight AQCRs including the tri-state metropolitan New York City region. As of 1978 the entire state was in non-attainment for oxidants, the Niagara Frontier (Buffalo) area for TSP and SO₂, and the Syracuse area for TSP. In addition, a part of New York City that could not officially be classified for SO₂ was thought to be in violation of the annual (primary) standard. The non-attainment status of the Buffalo area could be a major constraint for the siting of new coal-fired power plants along Lake Erie although the scenario postulates a substantial decrease in SO₂ emissions in Erie County.

In recent years New York State has been trying to relax certain sulfur-in-fuel limitations in regions that meet the SO₂ ambient standard by a wide margin. This trend is likely to continue because of economic pressures, although pressure is also being exerted by the State of Connecticut to reduce interstate transport of sulfur oxides and other pollutants.

Background Issues

- o Considerable controversy has arisen over the 700-MW coal-fired unit originally planned by the Power Authority of the State of New York (PASNY) for Staten Island and now proposed for a South Bronx location.
- o So far two requests by Consolidated Edison to burn high-sulfur fuels in the New York City area to lower consumer costs in the wake of recent oil price increases have been rejected on environmental grounds.
- o Canadian sources of atmospheric pollution are of considerable importance to air quality attainment in New York State. Emissions from these sources are large: the smelter at Sudbury, Ontario, emits about a million tons of SO₂ per year. A large coal-fired power plant* under

*This 3000-MW(e) plant is located 55 miles directly upwind of the Buffalo AQCR. For further details see J. Carroll, Environmental Aspects of Eastern Canada- Northeastern U.S. Energy Relations: An Identification of Issues, RIIA Issue Paper No. 2, Division of Regional Studies, BNL, July 1979.

construction on the north shore of Lake Erie is of particular importance to air quality problems in the Buffalo area.

Scenario-Induced Issues

o SO₂ emissions are projected to decrease by 200,000 tons/yr between 1975 and 1985, and to increase slightly between 1985 and 1990 (Figure 2-10). From 1975 to 1990, population-weighted SO₂ and SO₄ concentrations due to energy-related emissions projected in the scenario show significant decreases: from 19.3 to 10.3 ug/m³ for SO₂ and from 9.5 to 5.1 ug/m³ for SO₄ (Figure 2-14).

Water Quality and Availability

Most new electric generation facilities will be sited on Lake Erie, Lake Ontario, Long Island Sound and the Hudson River. Some major controversies could arise regarding these sites but they would not stem from water availability problems. Indeed, unless plans for major inter-basin diversions are put forth, water availability other than for domestic consumption will not be a major issue in the state. However, two types of issues may be raised. The first concerns water quality in water bodies that have recently undergone either significant deterioration or improvement such as the Great Lakes and the Hudson River where drawn-out litigation against major polluters has kept water quality in the public and governmental eye.* The second type of issue concerns multiple uses of water bodies and will be touched on in the ecology section.

Land Use, Ecology, and Solid Waste

o Several nuclear plants will exhaust their storage pool capacity for spent fuel assemblies in the mid 1980s, the Fitzpatrick plant as early as 1981.

o Although the Western New York Nuclear Service Center at West Valley could ease the radioactive waste storage capacity problem in the state and the region, it is unlikely that this will happen. The trend of the current debate over this facility, closed since 1972, is towards its continued closure and eventual decommissioning.

o Practically no land is available for waste disposal for the Arthur Kill fossil plant now proposed for a South Bronx location.

Although most of the additional coal-fired electric capacity proposed by the MID-MID scenario in New York would probably be located in Upstate areas on Lake Ontario and Lake Erie coal plants have also been proposed for the New York City area. The 700-MW Arthur Kill fossil plant, originally sited on Staten Island, is now being proposed for a South Bronx location where practically no land is available for waste disposal. Ocean

*The problem of PCB pollution in the Hudson, for example, has been highly publicized in recent years; see, e.g., P. Moskowitz et al., *Troubled Waters: Toxic Chemicals in the Hudson River*, Env. Defense Fund, NY, NY, 1977.

- o Utility sources are the largest contributors to SO₂ emissions, which are projected to decline slightly by 1985.

- o SO₂ concentrations will halve between 1975 and 1985 and show only a marginal increase thereafter.

- o SO₄ concentrations will halve between 1975 and 1985 and show only a marginal increase thereafter.

Trends in SO_x Emissions and Population Weighted Concentrations
New York

disposal would be the least expensive, but this must be regarded as questionable in light of EPA implementation plans for phasing out ocean dumping in the New York Bight.

Although attempts will be made to minimize the impacts of cooling systems on fin and shellfish by careful planning to avoid sensitive aquatic ecosystems and by using well engineered equipments, such impacts can be expected to be controversial, especially for plants sited on the Hudson near spawning grounds for striped bass.

A major land use issue in the state is the proposed 765-kV transmission network of the New York Power Pool. Several lines already in construction for operations at 765 kV are still operating at 345 kV, and the proposed 765 kV line for bringing power from Quebec Hydro has encountered strong opposition from agricultural and environmental groups.*

Background Issues

- o Significant loss and/or alteration of habitat, recreation, and agricultural lands in New York is resulting in the promulgation of increasingly stringent regulatory and management measures designed to control growth in, and protect, other sensitive areas. Among the management activities are those of the Adirondack Park Agency and the Coastal Zone Management Program.
- o Among the more insidious threats to flora and fauna are the systemic effects of prolonged incremental changes in environmental quality. Significant research is under way to evaluate some of these impacts, such as habitat disruption due to changes in pH.
- o Some existing land uses are perceived to be incompatible with energy development. For example, the use of farmland for transmission corridors faces increasing opposition on the grounds that it forces changes in cropping and irrigation patterns and results in lower crop yields.**
- o As a result of regulatory actions some waste disposal alternatives will be foreclosed in the near future. For example, ocean disposal will not be available because of the Environmental Protection Agency's plans to halt dumping in the New York Bight by the end of 1980.

*Since Quebec Hydro is a winter peaking system and the New York Power Pool a summer peaking system, seasonal exchanges are obviously for mutual benefit. The Churchill Falls hydro project on Hudson Bay will be the major source of exports in the 1980s.

**The transmission corridor for the proposed Jamesport nuclear plant in Eastern Long Island was opposed by farming interest on the grounds that it would be a pathway for spread of the potato nematode. Since potatoes are a major source of farm income in this area, this possibility was of real concern.

Social, Economic, and Institutional Issues

- o Several areas may experience problems of labor force availability for power plant construction projects unless construction schedules are carefully optimized.
- o Most baseload capacity additions postulated by the scenario for New York are likely to experience significant licensing delays due to institutional problems, particularly the inability of the state licensing agencies to reach decisions in a timely manner
- o Problems of nuclear power plant siting are compounded by active political opposition: the New York Legislature has recently introduced bills to curb, regulate, or impose quasi-moratoria on the construction of nuclear power plants and the storage of radioactive waste.
- o Continuation of public opposition to both nuclear and coal power alternatives is likely. Key issues include the health effects of low level radiation, the adequacy of evacuation plans, and radioactive waste disposal.

Except for some local socioeconomic effects directly related to the scenario, most of the institutional concerns are generic. The political and executive process is such that the reallocation of authority or duty, the creation of new agencies with discrete powers, or the evolution of major regulatory measures becomes extremely subjective, and susceptible to error. It must, however, be recognized that the technical and environmental factors addressed in the previous sections require major institutional decisions: decisions on nuclear waste disposal, the uniformity of enforcement of air quality regulations, and major land use and coastal zone reforms will determine whether the level of energy development postulated by the MID-MID scenario can be met and, if so, with what costs and impacts.

New York's progressive energy facility siting legislation is comprehensive and detailed and it imposes stringent standards and regulation on the state's utilities. Already several planned facilities sited in the RIA scenario including the Storm King pumped-storage facility, the Jamesport nuclear plant, and the Arthur Kill coal-fired plant, have been cancelled or postponed, at least partly because of state-level regulatory problems and obstacles. In the case of the Jamesport nuclear plant, the Nuclear Regulatory Commission has granted Long Island Lighting Company a construction permit but work has been delayed by the Public Service Commission's finding that the plant will not be needed until 4 to 5 years after its planned completion date. The question of the need for new capacity will be raised at future hearings on plans for the Sterling nuclear plant.

The siting of nuclear facilities in New York is further complicated by the presence of numerous, vocal and active anti-nuclear groups. Opposition to nuclear power has recently received additional impetus from the controversy about the fate of the bankrupt West Valley, NY, nuclear waste processing plant. Since January 1, 1979, three bills have been introduced in the New York Legislature to prohibit the construction of nuclear waste facilities in the state.

Background Issues

- o The distribution of benefits (essentially tax revenue and employment) from the construction and operation of large energy facilities are not matched by the distribution of impacts.
- o The state siting law, intended to facilitate the siting procedure by creating a one-step process, has not resulted in any noticeable diminution of institutional constraints to siting.
- o Opposition to the siting of large energy facilities has become exceedingly vociferous, partly because activist groups are improving their use of political and judicial leverage; even small local groups are participating in siting hearings to an extent not previously experienced.
- o Cooperation and coordination among local, state and federal agencies in the siting process are extremely poor.

Scenario-Induced Issues

- o Several areas in upstate New York may experience problems of labor availability, especially Oswego and Cayuga Counties, where specific skills will be in short supply if the postulated construction schedule is realized.
- o Chautauqua, Oswego, and Cuyaga Counties have inadequate accommodations for the level of immigration expected during the construction phase of nearby power plants.
- o Skilled worker shortages and infrastructure problems may arise in Greene and Schoharie Counties where nuclear and pumped-storage facilities are postulated for about the same time. Schoharie is a rural county with a small population and poor access. Greene County is also rural and could be heavily affected because it would lack the tax revenue (PASNY being a public utility) needed to upgrade the local infrastructure to accommodate the predicted 14 to 20% immigration of construction workers.* The agricultural and service-oriented nature of this area's economy may result in a shortage of certain skilled craftsmen, and inadequate accommodations could cause work for productivity to decline. The overlapping in construction periods for these plants may also aggravate the skilled worker shortage.

Health and Safety

- o Health effects due to sulfate exposure related to fossil-fuel combustion will decline by 1990.

*The siting scenario for this study was prepared in 1978, prior to abandonment of the Greene County site by PASNY in early 1979, largely on esthetic impact grounds.

- o Public concerns over low level radiation effects, rather than actual risk levels, may constrain realization of the nuclear goals of the scenario.
- o The health effects to be anticipated at the West Valley reprocessing facility, if it is reopened as assumed by the scenario, represent a significant constraint to scenario implementation.

Potential health damage from air pollution due to fossil-fuel combustion in utility plants and industry is of major concern in New York State, as evidenced by opposition to the construction of a new coal-fired power plant by PASNY and the conversion of existing oil plants to coal. The highly publicized toxic waste scandal in the Love Canal area of Buffalo has heightened public awareness of waste disposal problems of all kinds.

Background Issue

- o Important facility-specific safety concerns in the New York City area have emerged in the last few years: e.g., the spread of viruses and chemical carcinogens from waste via cooling tower drift at the Arthur Kill plant and the hazards of storing naphtha in Manhattan for a Consolidated Edison 4.8-MW fuel-cell unit.
- o The concern over both occupational and public risk of radiation exposure at the Nuclear Fuel Services plant in West Valley makes future use of this plant for either reprocessing or waste storage and disposal unlikely. As noted in the discussion of institutional issues, public concerns have been translated into specific legislative initiatives.

Scenario-Induced Issues

- o The number of estimated total deaths attributable to fossil-fuel combustion as estimated in this analysis for the whole of New York State decreases from a range of 860 to 14000 in 1975 to a range of 550 to 8800 in 1990, and average personal annual risk of death due to this source decreases from 0.41×10^{-3} to 0.16×10^{-3} .
- o The estimated annual numbers of radiation-induced cancers from waste management and reprocessing* are as follows:

		<u>Occupational</u>	<u>General public</u>	
			<u>Routine</u>	<u>Accidents</u>
Reprocessing	1985	0.09	7.8	0.001-0.004
	1990	0.19	15	0.002-0.007
Waste management	1985	0.00048	--	--
	1990	0.0006	--	--

*Morris et al., Op. cit. The comparable values for 1975 are all zero, the facility having been shut down in 1972.

o The estimated number of expected annual radiation-induced cancers in the general public due to nuclear power plant operation (including the annualized effect of catastrophic accidents) increases from 0.2 in 1975 to 0.87 in 1990; the number due to reprocessing is an order or magnitude higher.

FEDERAL REGION 3

BROOKHAVEN NATIONAL LABORATORY

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Report Authors	J. Brainard F. Lipfert
Program Manager	P. Meier
Air Quality	L. Kleinman R. Cedarwall R. Meyers
Water Quality	E. Kaplan
Solid Waste	T. Le
Health Effects	S. Morris K. Novak
Socioeconomics	W. Metz
Institutional	S. Munson C. Bryant
Other Contributions	J. Carroll, University of New Hampshire M. Lapping, University of Vermont J. Edinger, J. Edinger Associates
Graphics and Report Production	R. Stern
Typing	B. Burke
Editing	M. Denes

FEDERAL REGION 3

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REGIONAL OVERVIEW - REGION 3

Federal Region 3, the mid-Atlantic region, comprising Pennsylvania, Maryland, Delaware, Virginia, West Virginia, and the District of Columbia, marks the southern extension of the megalopolis that stretches from Boston, MA, through Norfolk, VA. As this suggests, most urban centers are located along the coast, although some core cities such as Pittsburgh, PA, and Charleston, WV are located inland. State population densities in the region range from roughly the national average (WV) to seven times the average (MD, with approximately 419 persons per square mile). In urban areas population densities are much higher than the national average (more than 15,000 persons per square mile in Philadelphia) and in some rural areas they are much lower.

Employment in the region is largest in the manufacturing, government, and services sectors. Value added by manufacturing in the region was 48.3 billion dollars: 60% of this occurred in Pennsylvania. State unemployment rates in 1976 bracketed the national average with the highest rate in the District of Columbia (9.1) and the lowest in Virginia (5.9). The number of unemployed individuals in the region in 1976 was about three-quarters of a million people, more than 50% of whom resided in Pennsylvania. Total personal income in 1976 (constant 1972 dollars) was 118.8 billion dollars. Pennsylvania, with 57-8 billion dollars in personal income, and Delaware, with 3.2 billion dollars, were the extremes. Average per capita income ranged from \$5392 in West Virginia to \$8648 in the District of Columbia. Median family income in West Virginia was only 80% of the national average, whereas in Maryland it was about 120%. Urban intermediate budgets (for a four person family) and cost of living indices for selected cities and SMSAs in the region are well above the national average.

The region is also noted for its concentrations of coal mining, mostly underground, in Pennsylvania and West Virginia; it provided 56% of U.S. deep-mined coal and 26% of the surface mined coal in 1975. Current energy use is dominated by the industrial sector, and by oil fuel. Although nuclear plants supply only a few percent of the region's needs, the recent accident at Three Mile Island, PA dramatized the nuclear role and heightened public perception of the attendant risks.

Air quality in the region is largely acceptable, except in localized urban areas and some industrial areas in Pennsylvania, and except for photochemical oxidants, which are in violation of ambient standards nearly throughout the region. Dominant winds are from the southwest in July and April, the northeast in October, and the northwest in January. Westerly or southwesterly winds bring long-range pollution from the heavily industrialized Tennessee and Ohio Valley areas.

REGIONAL SCENARIO

The energy supply and demand scenario for Federal Region 3, summarized in Table 3-1, was the basis for the county-level utility, industrial, and mining siting patterns developed by ORNL, BNL, and MITRE, which in turn provided the basis for impact assessment. Figure 3-1 shows the fuel mix for the region in 1975 and 1990: the most significant change is the increased share of electricity.

Table 3-1

REGION III ENERGY CONSUMPTION
(10^{12} Btu/yr)

<u>Sector</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
Residential	1047	1135	1162
Commercial	714	751	802
Industrial	2046	2628	2951
Transportation	1784	2066	2232
Raw Materials	115	205	258
TOTALS	5706	6785	7405
Electricity	616	956	1143
Oil	2610	3164	3458
Natural Gas	1258	1336	1385
Coal	1222	1329	1419
TOTAL	5706	6785	7406

Figure 3-1

Table 3-2
FUEL USE TRENDS IN REGION III
(10⁹ Btu/yr)

	Oil & gas		Coal	
	Utilities	Industrial	Utilities	Industrial*
1975	400	716	1675	332
1985	165	816	2043	312
1990	166	922	2532	356

*Excluding metallurgical coal

Table 3-3
SULFUR OXIDES EMISSION RATES IN REGION III
(lb SO₂/10⁶ Btu)

	Oil & gas		Coal	
	Utilities	Industrial	Utilities	Industrial
1975	1.69	0.75	3.26	4.11
1985	1.87	0.72	1.17	2.07
1990	1.83	0.76	1.11	2.00

Trends in fuel use in the industrial and utility sectors in Region 3 (Table 3-2) show industrial use of oil growing slightly while utilities' use is drastically cut back in favor of coal. Sulfur dioxide (SO₂) emissions rates (Table 3-3) may be used to assess the degree of emissions control implied: SO₂ emissions from oil remain relatively constant, while those from coal are drastically reduced. The decrease in utility coal emissions by 1985 reflects the assumption that SIPs will be fully met by 1985; the further decrease by 1990 is a result of the new NSPS proposals that call for eventual 90% SO₂ removal.

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

Many of the potentially more important issues and impacts encountered in Region 3 as a result of this scenario are national or multi-regional in scope, requiring a focus for analysis much broader than the state or regional scale. These concern long-range transport of air pollutants, protection of coastal water quality in the fact of OCS oil and gas development, and socioeconomic impacts resulting from National energy policy.

Long Range Pollutant Transport

Region 3 is heavily industrialized, and its 1975 sulfur dioxide emissions were 3rd highest among those of the ten Federal Regions (2nd highest on the basis of emissions per square mile). Even so, in 1975, 58% of the population-weighted sulfate concentration* resulted from emissions from outside the region. Thus, local air pollution controls have only limited usefulness in improving air quality in Region 3. For all time periods analyzed, Region 3 had the highest population-weighted sulfate concentrations of the ten Federal Regions, both because of its relatively high population density and because of its location just downwind from other large industrialized regions.

Emissions of nitrogen oxides are not likely to be as well controlled as those of sulfur oxides, and thus the impact of these species and of photochemical oxidants may actually worsen for both 1985 and 1990 depending on the efficacy of the EPA control strategies. Therefore, long-range transport of air pollutants into the region (as well as out of the region eastward) may continue to be important issues for the MID-MID scenario, even if the postulated sulfur oxides reductions are achieved.

Figure 3-4 indicates the dominant role of major fuel-burning sources in neighboring regions play with respect to sulfate concentrations in Region 3. The substantial improvement in air quality projected is due to emissions controls in all regions but especially in Region 5 immediately to the west. Note that Region 4's contribution is relatively constant.

It should be noted that the long-range transport analysis used to make these projections did not specifically take into account the presence of terrain features (such as the Allegheny Mountains) or urban and seacoast dispersion characteristics, and is based on only one month's meteorological record (July 1974), and reflects linear chemistry.** Nevertheless, the gross features shown in Figure 3 4 are thought to be qualitatively correct.

Coastal Water Resources

There has been continuing opposition to oil and gas development in the Baltimore Canyon area of the outer continental shelf. This opposition is based, in part, on a concern for protecting existing uses of the coastal waters, particularly for recreation and commercial fishing, and it may increase if major oil or gas deposits are found.

*Population-weighted concentrations are calculated by summing the product of concentration and population for individual grid-square elements and then dividing by the total population. These aggregated averages are most reliable for larger areas such as states or Federal Regions. In this report, ambient air quality concentrations are reported on a population-weighted basis.

**That is, we assume that the transformation rate from sulfur dioxide (SO_2) to sulfate (SO_4) was constant.

Figure 3-2
Major Electric Sector Additions 1979-1990

Figure 3-2 shows the major electric facilities postulated in the scenario. The Delaware River Basin will be the site of approximately 30% of the 30,500 MW of new power facilities (60MW and larger) planned for Federal Region 3 between 1976 and 1990, and the Ohio River watershed will contain 25% of them; 53% of the proposed plants are postulated for Pennsylvania, which encompasses most of these two watersheds. The regional fuel mix in the electric sector (Figure 3-3 indicates the high reliance on coal (68.3% compared with the national average of 51.8%).

Coal and nuclear fueled plants are each slated to provide about 11,500 MW and pumped storage hydroelectric another 5500 MW. The other 2000 MW will come from smaller oil-fired peaking and combined cycle units.

Figure 3-3
1990 Electric Sector Fuel Mix

- Overall ambient sulfate concentration decreases sharply between 1975 and 1985
- In all years, over 50% of the ambient concentration is due to sources in other regions. Regions 4 and 5 (Midwest and Southeast) are the principal external sources of sulfates.

Figure 3-4. Contributions to SO_4 Concentrations from sources with the region and from sources in other regions.

DISAGGREGATION OF NATIONAL IMPACTS TO REGIONAL LEVEL

	<u>Air</u>	<u>Water</u>	<u>Regional Socioeconomics</u>
Electric sector			
Coal	M ¹		
Oil			
Nuclear			H ²
Supply			
Coal			M ³
Oil		M ⁴	
Nuclear			
Gas		M ⁴	
Solar			
Hydro			
Industrial Sector			
Coal	M ¹		M ³

1 = Long range transport from Regions IV and V.

2 = Nuclear waste management perceived as national problem.

3 = Local socioeconomic hardships.

4 = OCS impacts, amenable to mitigating measures.

National Socioeconomic Issues

Offshore oil exploration as yet has had little socioeconomic impact in mid-Atlantic coastal communities. If offshore oil fields are located and developed, there may be some expansion of the fuel service port facilities in the region and a few new drilling/production platform construction yards. This may foster minor growth in the major port areas, but the socioeconomic impact of product delivery facilities will be minimal since the region already has an estimated refinery capacity of 800,000 barrels per day. Then the replacement of imported oil by the new oil or the expansion of present facilities would reduce any regional impact.

The continued intrusion of western coal into eastern coal markets (as a result of air quality regulations, decreasing cost competitiveness of eastern deep-mined coal), and federal surface-mine regulations will cause socioeconomic hardships in many regional coal fields. However, the scenario assumes a 15% growth in coal production in the region, mostly as a result of minemouth power plants and metallurgical coal needs.

REGIONAL ISSUES

Air Quality

The MID-MID scenario predicts over 50% reduction in sulfate concentrations in the region by 1985, due to reductions from both local emissions and from neighboring regions. Trends in SO₂ emissions in the region are shown in Figure 3-5. Even with these reductions, Region 3 is projected to have the highest average sulfur oxides concentrations in the U.S. (Figure 3-6) so that realization of these reductions is a critical issue. The computed trends in sulfur oxides air quality (Figure 3-7) indicate a slight deterioration from 1985 to 1990.

Water Quality and Availability

Energy-water conflicts in the region act as one of the more important constraints to realization of the future embodied in the MID-MID scenario. Both in the coastal zone, where Delaware, for example, has one of the most restrictive coastal zone acts in the U.S., and in inland areas, where consumptive use for evaporative cooling requires low flow augmentation to meet River Basin Commission policies, severe constraints on energy facility siting must be expected. Unfortunately, much of the pollution comes from abandoned mines which cannot be readily controlled by current statutes; therefore even with stringent application of new standards (under NPDES or new strip mine regulations) to operating and new facilities, resolution of the conflicts may be decades distant.

Land Use, Ecology, and Solid Waste

Region 3 is an area of highly varied land use and habitat characteristics and has a large potential for energy resource development, but such development is in conflict with environmental protection goals. For example, recent findings regarding the damage of coastal pollution (from both onshore and offshore sources) to sensitive estuarine and tidal habitats and to commercial and recreational fish and shellfish species have resulted

- Pennsylvania and West Virginia show sharp decreases in SO₂ emissions by 1985
- 4 of 6 states show slight increases in SO₂ emissions between 1985 and 1990.

Figure 3-5. SO₂ Emissions in the Region

Region III has highest annual average SO_4 concentrations in the country in 1985, despite sharp emissions reductions within the region (See Figure 9).

Figure 3-6. Ambient SO_4 Concentrations by Region

- SO₂ ambient air quality improves for all states by 1985.
- Slight increase in ambient SO₂ air quality between 1985-1990.

Figure 3-7. Trends in Ambient SO₂ Concentrations, by State.

in increased anti-development sentiment within the region. The concern for the environment, as manifested in regulatory activities, has to date focused primarily on large industrial polluters and on potential coastal development resulting from offshore oil exploration. However, some studies indicate that onshore diffuse sources (e.g., residential and commercial developments) and coastal point sources (e.g., large rivers that concentrate pollutants and then dump them along the coast, where they merge and mix) are greater contributors to coastal pollution than are offshore transportation or development sources.* Accordingly, there is growing opposition to any but the most benign uses of regional coastal areas.

Although coastal land use and planning is a dominant concern, Region 3 has additional ecological problems: large water demands result in periodic flow disruptions in areas of limited surface water supply; habitat disruption and air and water quality deterioration are caused by utility and industrial activities and by mining operations; and the pH levels of rain over large portions of the region are among the lowest (most acidic) in the Northeast, which is an issue of increasing concern.

The central scenario-related land use issue in the region is the reclamation of strip-mine lands. The economic impact of new regulations under the 1977 Surface Mining Control and Reclamation Act on the coal industry, especially on smaller mining concerns, has been fiercely debated in the coal producing states of the region. The MID-MID scenario hypothesizes an increase in underground mining in the region from 156 million/tons/year in 1975 to 200 in 1990 and a decrease in strip mined coal production from 80 to 71 million tons yr. Land requirements for ash and scrubber sludge disposal are not expected to pose significant problems in the region, given ample opportunities for exploiting the terrain to allow deposition depths of up to 200 or 300 ft.**

Social, Economic, and Institutional

Local socioeconomic impacts should not delay any proposed power plant facilities in the region, although certain local problems may require mitigation. Figure 3-8 summarizes the socioeconomic impacts of the scenario for the region, with an indication of the laborshed and construction work force for each major power plant addition.***

*See e.g., A. Mueller et al., Contaminant Inputs to the New York Bight, NOAA Tech. Memo ERL-MESA-6, Marine Ecosystems Analysis Program, Boulder, CO, 1974.

**T. Le, P. Meier, and H. Rostoke, The Solid Waste Impacts of Increased Coal Utilization, BNL 224786, Feb. 1979. The Bruce Mansfield plant in Western Pennsylvania, for example, will build a 420 ft. impoundment for disposal of its lime-limestone slurry.

***For further details, see W. Metz, Socioeconomic Impact of Proposed Power Plants in the Northeast, RIIA Issue Paper No. 1, Division of Regional Studies, May 1979.

- Total Electric Plant Construction Payroll in Region to 1990 estimated at \$7.7 billion.
- Annual 1990 local property tax revenues from electric plants estimated at \$52 million.
- On average, about 700 in-migrants per project during the construction phase.
- New plants dispersed throughout region, drawing on numerous labor markets.

Figure 3-8. Regional Socioeconomic Impacts

One of the dominant political concerns of the mid-Atlantic region is related to the coastal environmental impacts of petroleum exploration and development in the George's Bank and Baltimore Canyon areas. To the extent that current drilling has failed to result in commercial quantities of oil or natural gas, such issues may be moot.* Nonetheless, continuation of the leasing program has resulted in concern on the part of state governments and private groups. All the coastal states of the Northeast have enacted some form of coastal zone environmental legislation in response both to federal mandates and to ongoing OCS oil exploration, but the legislatures of the mid-Atlantic coastal states appear especially sensitive to energy-related threats to their coastal resources. Delaware's Coastal Zone Act, for example, is the most stringent coastal environmental legislation in the Northeast: it entirely prohibits all new heavy industry and all offshore gas, liquid, and solid bulk production transfer facilities in a wide coastal zone along the entire length of the state. The provisions of the Maryland Coastal Facilities Review Act, are not as stringent as those of the Delaware Act, but they apply to an area comprising approximately 65% of the state's land area. Most new major energy facilities in either state would necessarily have to be sited in the areas covered by these acts.

Health and Safety

Energy-related health and safety concerns in Region 3 involve both ends of the fuel cycle, coal mining and the conversion of fuels to energy.

Table 3-4

ESTIMATED HEALTH EFFECTS FROM COAL MINING IN REGION III

	Accidental		Occupational Diseases	
	<u>Deaths</u>	<u>Injuries</u>	<u>Deaths</u>	<u>Incidence</u>
1975	37-135	3810-14460*	0-90*	0-1060*
1985	44-164	4680-17600	0-110	0-1320
1990	46-169	4900-17900	0-115	0-1380

*approximate 60% confidence limits on estimates

*As of June 1979, only TENNECO and TEXACO have found any hydrocarbons in the Baltimore Canyon area, and neither has yet made any determination of commercial quantities.

Coal mining is an important part of the economy in Region 3 and is projected to increase with time. Table 3-4 shows the estimated occupational health and safety impacts on the region for each year. These data are based on national averages and reflect neither regional differences (except deep vs. surface mining), nor possible changes in accident rates over time.

Table 3-5

ESTIMATES HEALTH EFFECTS FROM AIR POLLUTION FROM
FOSSIL FUEL COMBUSTION IN REGION III

	Population- weighted SO ₄ conc., ug/m ³	Individual risk level deaths per 10 ⁶ person/year	Estimated attributable annual deaths*
1975	14.9	75-200**	1800-29000**
1985	7.3	36-580	980-16000
1990	8.0	40-640	1100-18000

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

For this analysis the public health impacts of fossil fuel combustion were indexed to annual average sulfate concentration, expressed as attributable mortality (Table 3-5). Population exposures to sulfates are projected to decrease substantially with time because of emission reductions both within and without the region. Other species that affect air quality such as NO_x and oxidants, may increase, but their effects were not quantified.

STATE ISSUES

DELAWARE

The scenario projects the following major new facilities in the state:

- o By 1979 - coal-fired plant in Sussex County (400 MW).
- o By 1990 - coal-fired plant in New Castle County (1000MW). No coal is mined in the state.

The impacts arising from these changes are discussed in the following sections.

*For detailed documentations of these computations, see S. Morris et al., Health Effects of the EIA MID-MID Scenario, Biomedical & Environmental Assessment Division, Brookhaven National Laboratory, forthcoming report.

SUMMARY OF REGION III ENVIRONMENTAL IMPACTS

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	M	L	L	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	L	L	L	H
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	L
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	L	H	L	H	L	M	L	M	L	H
End Use										
Industry	M	-	-	-	-	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Table 3-6

ESTIMATED ANNUAL RADIATION INDUCED CANCER DEATHS
DUE TO NUCLEAR POWER PLANTS IN REGION III

	Nuclear power plant workers	General public	
		Routine	Non-Routine*
1975	0-.41	0-0.010	0-0.41
1985	0-1.07	0-0.028	0-1.07
1990	0-1.32	0-0.034	0-1.32

*Annualized effect of catastrophic accidents

Air Quality Impacts

- o 1990 statewide SO₂ emissions are expected to be lower despite a 1400-MW increase in coal-fired generation.
- o Both local and background sulfur oxides concentrations in the air are expected to be greatly lessened; those of nitrogen oxides may increase.

Delaware is a small state lying mostly on the coastal plain. The Wilmington area in the north is part of the Northeastern urban corridor, and subject to the pervasive air quality problems characteristic to this densely populated area—including those related to transportation and chemical industry sectors. The climate is influenced by continental flows, modified by the proximity of the Atlantic Ocean and Chesapeake Bay. There are no PSD Class I areas in the state.

Background Issues

- o Although Delaware is officially in attainment for SO₂, several monitoring sites show a worsening trend, and there are some excesses over the state secondary standard.
- o Total suspended particulate levels are in violation at several locations but show a generally improving trend.

Scenario-Induced Issues

- o Sulfur dioxide levels are expected to decrease between 1975 and 1985 and increase slightly thereafter (Figure 3-9).
- o Since controls for nitrogen oxides are less strict, the increase in coal burning may result in higher levels of these species and possibly also oxidants.
- o In spite of federally mandated sulfur oxides emissions controls, the overwhelming contribution in Delaware is from outside the state.

Water Quality and Availability Issues

- o No major water quality or availability issues related to energy activities implied by the MID-MID scenario are expected in the state.

- Large reductions in sulfur oxides emissions by 1985, with modest increases to 1990.

- Sulfur dioxide concentrations follow the emissions reductions, but industrial sources are proportionately more important.

- Large reductions in ambient sulfate reflect emission decreases in upwind states.

Figure 3-9. Emission and Air Quality Trends in Delaware

Land Use, Ecology, and Solid Waste Issues

- o No significant land use, ecology, or solid waste issues related to the energy activities implied by the MID-MID scenario are expected in the state.

Social, Economic, and Institutional Issues

- o Simultaneous construction of adjacent power plants could create a labor availability problem in 1990.
- o Nuclear power faces strong opposition in the state, which may effectively foreclose that alternative.

Under Delaware's 1971 Coastal Zone Act, all new heavy industries (and all new offshore gas, liquid, or solid bulk product transfer facilities) are entirely banned in a coastal zone encompassing the entire length of Delaware's shore and extending landward approximately 2 to 5 miles in most areas and seaward to the state's territorial limits. Other industrial and energy-related uses are not expressly prohibited but are tightly controlled through a permit system.

Possible nuclear alternatives may also face formidable obstacles due to strong opposition in the state. In 1975, for example, in response to proposals to build the Summit nuclear generating station, a bill was introduced in the state legislature to impose a two-year moratorium on the construction of nuclear power plants. The proposals were abandoned, and no other nuclear facilities have since been planned for the state. The bill has not been acted upon, but its timely introduction, coupled with the strong environmental concerns manifested in the Coastal Zone Act (the most stringent in the Northeast) suggest that prospects for nuclear power facilities—or for any other major energy developments in the state—are uncertain at best.

Scenario-Induced Issues

- o The scenario calls for simultaneous construction of 1000-MW power plants in adjacent counties in Delaware and Maryland in 1990; a labor shortage in certain skills may require attention.

Health and Safety

- o Population exposures to sulfates are projected to decrease substantially with time, because of emission reductions both within and without the region (Table 3-7).

Table 3-7

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION
IN DELAWARE

	Population- weighted SO ₄ conc., ug/m ³	Individual risk level deaths per 10 ⁶ person/yr	Estimated attributable annual deaths*
1975	12	69-990**	86-520**
1985	6.1	30-490	20-330
1990	6.9	35-550	24-390

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

MARYLAND AND DISTRICT OF COLUMBIA

The scenario projects the following major changes:

- o By 1990 - 1000 MW coal-fired plant in Cecil County.
- o Increase in coal mining in the western portion of the state.

Air Quality Impacts

- o State will be highly impacted by out-of-state emissions.

Maryland has two climatological regions, the coastal region in the east and the more mountainous region in the west. Most of the population is distributed in the first region, especially along the western and northern shore of Chesapeake Bay. Here coastal modifications to continental circulations are important, especially in the summer and fall. There are no PSD Class I areas in the state.

Background Issues

- o Local areas of non-attainment for particulates.
- o Widespread oxidant level violations.

Scenario-Induced Changes

- o Sulfur oxides levels are expected to decrease from 1975 to 1985 and then to increase slightly to 1990 (Figure 3-10).

Water Quality and Availability Issues

- o Chesapeake Bay location of 1990 new plant assures adequate water supplies.
- o Water quality will be protected by using cooling towers with brackish water and blowdown treatment.
- o Modest level of coal mining assure minimal impacts on inland water.

Land Use, Ecology, and Solid Waste Issues

- o Coal mining increases confined to underground mining, thus minimizing land disturbance.
- o Adequate land available for disposal of coal extraction wastes.
- o Problems of disposals of ash from existing plants may become exacerbated.

Coal mining in Maryland is done mainly in the northwestern part, in Alleghany and Garrett Counties. Production has been relatively small, 2.5 million tons of surface coal and 0.1 million tons of underground coal in 1975. The MID-MID scenario projects a slight decrease in surface mining

- Sulfur oxides emissions drop in 1985 and then increase to nearly the same level by 1990.

- Sulfur dioxide concentrations show only modest changes.

- Sulfate concentrations are greatly reduced, reflecting emissions reductions in upwind states.

Figure 3-10. Emissions and Air Quality Trends in Maryland

and a ten-fold increase in underground mining. Land availability for disposal of coal extraction wastes does not appear to present a significant constraint. Most of the mining in the state is projected to remain in Garrett County.

Maryland currently has a number of coal-fired generating plants. In the many urbanized areas of the state disposal of fly and bottom ash has been one of the major concerns of the electric utilities. The Potomac Electric Power Company, which serves the District of Columbia and portions of Maryland and Virginia, has been reported to truck coal ash 90 miles to limestone quarries in Pennsylvania because of restrictive zoning ordinances and county-wide bans on disposal of wastes.

Social, Economic, and Institutional Issues

- o Possible construction labor shortage by 1990.
- o State licensing board could be overruled by county vetoes.

As a result of serious controversies focusing on environmental degradation of Chesapeake Bay and its tributaries associated with the Calvert Cliffs nuclear generating station, Maryland enacted its innovative 1971 Power Plant Siting Act (PPSA) which addresses long-range energy and land use planning. Through provisions for prior state acquisition of acceptable power plant sites. Although this Act has been criticized on the grounds that it does not include adequate provision for citizen participation, it has apparently been effective in streamlining and rationalizing the power plant siting process in Maryland.

Maryland's PPSA covers only power generating facilities and associated transmission lines. Other types of energy-related facilities (i.e., refineries, oil and gas pipelines, oil storage facilities) are regulated under Maryland's 1975 Coastal Facilities Review Act and related wetlands and flood plain legislation. Although the state's coastal environmental legislation is not as stringent as that in neighboring Delaware, county-level veto powers could adversely affect individual projects except for power facilities covered under the PPSA.

Health and Safety

Scenario-Induced Issues

- o Coal mining deaths and injuries will increase, but do not appear to be a constraining factor (Table 3-8).
- o Adverse public health effects of air pollution will decrease (Table 3-9).
- o Nuclear risks are minimal (Table 3-10).

PENNSYLVANIA

The Scenario projects the following major changes:

Table 3-8

ESTIMATED HEALTH EFFECTS FROM COAL MINING IN
MARYLAND

	Accidental		Occupational diseases	
	<u>Deaths</u>	<u>Injuries</u>	<u>Deaths</u>	<u>Incidence</u>
1975	0.2-0.6	11- 41	0-0.6	0-0.8
1988	0.4-1.6	40-146	0-0.6	0-0.10
1990	0.5-1.7	46-173	0-1.0	0-12

Table 3-9

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION IN
MARYLAND AND D.C.

	<u>Population- weighted SO₄ conc., ug/m³</u>	<u>Individual risk level death per 10⁶ persons/yr</u>	<u>Estimated attributable annual Deaths*</u>
1975	15.1	76-1200	370-5900**
1985	7.8	38- 620	220-3500
1990	8.8	43- 690	280-4400

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

Table 3-10

ESTIMATED ANNUAL RADIATION-INDUCED CANCER DEATHS
DUE TO NUCLEAR POWER PLANTS IN MARYLAND

	<u>Nuclear power plant workers</u>	<u>General public</u>	
		<u>Routine</u>	<u>Non-routine*</u>
1975	0	0	0
1985	0-0.10	0-0.0026	0-0.10
1990	0-0.12	0-0.0031	0-0.12

*Annualized effect of catastrophic accidents.

- o By 1982 nuclear plant in Lucerne County (2100 MW).
- o By 1984 coal plant in Indiana County (800 MW).
- o By 1985 coal-fired plant in Bucks County (800 MW).
- o By 1986 nuclear plant in Beaver County (885 MW).
- o By 1990 coal plant in Armstrong County (1666 MW).
- o Increase in underground coal mining from 45 to 57 million tons/yr but decrease in surface mining from 45 to 27 million tons/yr by 1990.

Air Quality Impacts

- o Net reduction in SO₂ emissions planned by 1985 despite increase in capacity.
- o Much of the air quality improvement depends on reduction in neighboring states.
- o Industrial emissions controls will be important.

Pennsylvania is the most industrialized state in the region, and its emissions are quite important with respect to both regional and northeastern air quality.

The Blue Ridge and Allegheny Mountains separate the urban centers of the coastal plain, such as Philadelphia, from the urban centers in the Allegheny Plateau, such as Pittsburgh. The atmospheric transport of pollution across these mountain and valley systems is extremely complex and is not well resolved in state-of-the-art assessment models. The western urban centers of the state are under the influence of continental circulation patterns which involve sources in the Ohio River Valley. The urban centers are on the eastern side of the state (coastal plain) are influenced also by sources within the coastal corridor from Washington, D.C. to Boston.

There are no PSD Class I areas in the state.

Background Issues

- o The state has extensive non-attainment areas for both sulfur oxides and particulates, which are believed to be mainly related to local effects of industrial sources.
- o Upwind background is also high because of similar situations in neighboring states.
- o Some sources are contemplating stack-height increases rather than emissions reduction to achieve compliance. This will not improve downwind background, as postulated in the scenario analysis.

Scenario Induced Issues

- o The Armstrong County (1990) coal plant could be constrained by non-attainment or "near-attainment," depending on control strategies adopted between now and 1990.
- o The large increase in coal burning could have other impacts, both local (trace metals, etc.) and long range (nitrogen oxides increases, leading to oxidants increases).
- o Sulfur oxides levels should decrease, on the basis of the scenario analysis assumptions (Figure 3-11).

Water Quality Impacts

- o The cooling tower blowdown concentration effect would cause water quality violations at several inland sites.
- o Water availability is a critical problem for thermal generating sites in the Delaware and western Pennsylvania river basins.
- o Significant water quality improvements would result from NPDES and surface mining regulations.

The central water availability problem is the adequacy of low flows in the summer months to meet the consumptive demands of thermal power plants. In the Delaware Basin, the River Basin Commission requires all new power plants to provide offsetting low flow augmentation, yet, at the same time, reservoir proposals such as the Tocks Island Project have met fierce

- Drastic decreases in sulfur oxides emissions from 1975, especially utility sources.
- Industrial sources very important in 1990.

- Sulfur dioxide ambient concentrations follow emissions reductions, showing importance of local sources.

- Sulfate concentrations roughly halved, utility contributions remain important.

Figure 3-11. Emissions and Air Quality Trends in Pennsylvania

public opposition. Thus, at the present time, the augmentation source for all new scenario-hypothesized thermal plants in the Delaware Basin (including the Limerick and Hope Creek nuclear stations) remains an unsolved problem. Similar problems of consumptive use and low flow augmentation are expected to arise in the Upper Ohio subbasins in Western Pennsylvania.

Scenario Induced Issues

- o Cooling tower blowdown may violate standards for copper, nickel, radium, and lead, in part because of high existing background (see Figure 3-12).*
- o Alkalinity violation may be eased by new plants.
- o Increased underground coal mining will strain water resources.

Land Use, Ecology, and Solid Waste Impacts

- o Additional land disturbance due to surface mining.
- o Continued water quality problems due to acid mine drainage.

Pennsylvania, a major coal-producing state, already has a significant utility coal-fired generation capacity (14 Gw in 1975) and is expected to add another 6 Gw capacity by 1990, and is therefore likely to face considerably greater land requirements for utility waste disposal than any other state in the region. Much of the capacity in Pennsylvania, however, is postulated for rural areas with terrain characteristics that can readily be exploited for land disposal. Currently in southwestern Pennsylvania, for example, most coal ash disposal sites are ravines or basins with depths of up to 200 or 300

*For a detailed analysis see E. Kaplan, Water Quality Investigations at Proposed Freshwater Sites for Thermal Power Generation Additions, RIA Issues Paper #4, Division of Regional Studies, May 1979. Total Dissolved Solids, NO₃-NO₂, SO₄, cyanide, Cu, Fe, Pb, and Mn backgrounds are currently above standard during at least the low flow period at all sites examined. Increments from biocides and demineralized regeneration wastes were not included in this detailed analysis, but these are usually comparatively small—see, e.g., Final Environmental Statements, Fulton Generating Station, Philadelphia Electric Company, April 1975.

Figure 3-12

Water Quality Standard Violations Due to Cooling
Tower Blowdown Concentration Effects

ft., which significantly reduces acreage requirements. Although the prospects for mine disposal of FGD sludge may not be very promising in light of acid drainage problems in mining areas, recent precedents at the Bruce Mansfield plant, where a 420-ft impoundment will serve to fill a ravine with such wastes, illustrates the potential for imaginative and environmentally sound solutions.

The average acidity of rain, calculated from samples taken from 1973 to 1975, was below pH 4.30 for the entire state of Pennsylvania and below pH 4.22 for about half of the state.* These values are the lowest (most acidic) in the Northeastern U.S.

Scenario Induced Changes

- o No land use availability problems per se are anticipated.
- o Continued acid drainage problems (water quality) are expected, especially with iron concentrations.
- o If effluent guidelines are observed, new waste water discharges should be acceptable.
- o Strip-mine reclamation may be difficult if not impossible in some areas.

Social, Economic, and Institutional Issues

Scenario Induced Issues

- o Local socioeconomic problems could delay energy facility development in Greene County, PA, where a 9.83% increase over 1978 county population

Table 3-11

ESTIMATED HEALTH EFFECTS FROM COAL MINING IN PENNSYLVANIA

	<u>Accidental</u>		<u>Occupational diseases</u>	
	<u>Deaths</u>	<u>Injuries</u>	<u>Deaths</u>	<u>Incidence</u>
1975	12-46	1140-4420	0-26	0-300
1988	13-49	1400-5280	0-31	0-380
1990	14-49	1388-5200	0-32	0-390

*These estimates do not anticipate decline in accident rates over time and should be interpreted as upper bounds in view of likely continued improvements, especially in underground mine safety.

*pH is a measure of acidity, on a scale of 0 (highly acidic) to 14 (highly alkaline). Normally rain has a pH of 6 to 8. If its pH is below 6; it is commonly referred to as acid rain.

is projected for 1990 due to the rapid growth in deep-mined coal production (from 7.1 million tons/yr in 1975 to 17.8 by 1990) anticipated in the MID-MID scenario. Annual costs for additional county services and facilities are estimated at about \$3,076,020 by 1990 (1977 dollars).

- o Mine problems of labor availability in eastern Pennsylvania during the mid 1980s might cause a few delays in power plant construction.

Health and Safety

Scenario Induced Issues

- o Increases in mining accidents and deaths (Table 3-11).
- o Decrease in sulfur oxides air pollution and associated public health impacts (Table 3-12).
- o Cancer risks from nuclear power continue to be minimal (Table 3-13).

Table 3-12

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION IN PENNSYLVANIA

	Population-weighted SO ₄ conc., ug/m ³	Individual risk level deaths per 10 ⁶ persons/yr	Estimated attributable Annual deaths*
1975	16	80-1300	950-1500**
1985	7.0	35- 560	469-7400
1990	7.7	38- 620	520-8300

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

Table 3-13

ESTIMATED ANNUAL RADIATION-INDUCED CANCER DEATHS
DUE TO NUCLEAR POWER PLANTS IN PENNSYLVANIA

	Nuclear power plant workers	General public	
		Routine	Non-routine*
1975	0-0.27	0-0.0068	0-0.27
1985	0-0.54	0-0.0014	0-0.54
1990	0-0.71	0-0.0018	0-0.71

*Annualized effect of catastrophic accidents

VIRGINIA

The scenario projects the following major changes:

- o 1977 - nuclear units in Louisa County (2-930 MW).
- o 1978 - pumped storage unit in Franklin County (100 MW).
- o 1981 - MW nuclear units in Louisa County (2-940 MW).
- o 1982 - pumped storage unit in Rockingham County (500 MW).
- o 1983 - pumped storage unit in Rockingham County (500 MW).
- o 1983 - pumped storage unit in Bath County (1120 MW).
- o 1984 - 975 pumped storage unit in Bath County (975 MW).
- o 1990 - pumped storage unit in Bath County (311 MW).
- o 1990 - pumped storage unit in Rockingham County (250 MW).
- o Slight decreases in both underground and surface coal mining.

Air Quality Impacts

- o Modest increases in SO₂ emissions, due to oil-coal conversions and industrial activity (See Figure 3-13).
- o Slight improvements in SO_x air quality due to reduction in neighboring states.

Virginia comprises three regions: the coastal plain of the east, the central Piedmont Plateau, and the mountainous Appalachian area of the west. Most of the economic and urban activity is located in the coastal plain along the western shore of the Chesapeake Bay and in the southern Piedmont area. In these urban areas, coastal circulation patterns from semi-permanent pressure systems dominate the summer and autumn circulation. In winter and spring, flows are more continental, from the northwest, except as modified along the coast.

Aside from oxidants, there are no non-attainment problems in the state. Shenandoah National Park is a mandatory PSD Class I area, located in northwestern mountainous region.

Background Issues

None

Scenario Induced Issues

- o Improvement in visibility at Shenandoah National Park because of 40% reductions in sulfate concentration.

- Increases in sulfur oxides emissions, especially industrial.

- Only modest changes in sulfur dioxide concentrations.
- Utility sources dominate for all years (annual average).

- Sulfate concentrations are reduced from 1975.
- Utility sources dominate.

Figure 3-13. Emissions and Air Quality Trends in Virginia

- o Continual attainment of air quality standards, based on the postulated new plant generation mix.

Water Quality Impacts

- o Construction and operation of pumped storage facilities may impact turbidity and BOD of affected streams.
- o Utility discharges may contribute to violations for total dissolved solids and phosphorous.

The State of Virginia contains portions of six Aggregated Subareas (ASA's), four of which are projected to have large water-for-energy demands with problems during seasonal low flow periods. Problem basins include ASA 205 (Chesapeake), ASA 206 (Potomac), ASA 301 (Roanoke - Cape Fear), and ASA 502 (Upper Ohio). Energy can be considered a major contributor to these problems, especially during peak periods of maximum base load electric generation. Furthermore, since the preponderance of water used in other sectors is by domestic users of manufacturing, the induced water quality effects resulting from pollutant concentrations during low flow periods may have serious impacts. Specifically, electric utility discharges may contribute to violations of domestic water supply criteria for total dissolved solids and phosphorus. Future water demands associated with the growing urban and manufacturing demands of the eastern seaboard may conflict with energy development and constrain the siting of energy facilities. Without alternate means of low flow augmentation these violations will force increasing problems with siting.

Land Use, Ecology, and Solid Waste Issues

- o Additional land disturbance due to surface mining and pumped storage facility construction.

Forecasted energy development will have little impact upon the terrestrial resources of Virginia. Surface mining will disturb 26,000 acres between 1975 and 1990 according to the MID-MID scenario but since the passage of the Surface Mining Reclamation and Control Act, most of the environmental impacts should be short term and minimal.

Creation of the pumped storage reservoirs, facilities, and transmission lines will result in loss of some aesthetic values, habitats, and recreational land. However, the scenario does not postulate any new massive solid waste disposal problems, aside from the issue of nuclear waste disposal.

Social Economic and Institutional Issues

Scenario Induced Issues

- o Preservation of scenic beauty and recreational lands may be impacted by further strip mining and pumped storage development.
- o Coastal zone may suffer from offshore oil drilling, if development proceeds.

- o Postulated energy mix (coal, nuclear, pumped-storage) could be affected by continual problems with nuclear plant operation and siting.

Health and Safety

Scenário Induced Issues

- o Modest changes in coal-related impacts (Tables 3-14, 15).
- o Cancer risks from nuclear power increase, but continue to be minimal. (Table 3-16).

Table 3-14

ESTIMATED HEALTH EFFECTS FROM COAL MINING IN VIRGINIA

	Accidental*		Occupational Disease	
	<u>Deaths</u>	<u>Injuries</u>	<u>Deaths</u>	<u>Incidences</u>
1975	6-21	550-2150	0-14	0-160
1985	5-19	540-2020	0-13	0-150
1990	5-20	560-2110	0-13	0-160

*The estimates, however, do not reflect improvements in accident rates over time, and should be interpreted as upper bounds in view of likely continued improvements in especially underground mine safety.

Table 3-15

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION IN VIRGINIA

	Population-weighted SO ₄ conc., ug/m	Individual risk level deaths per 10 ⁶ person/year	Estimated attributable Annual deaths*
1975	11	54-8600**	270-4300**
1985	6.8	34-540	190-3100
1990	7.5	38-600	240-3800

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

Table 3-16

ESTIMATED ANNUAL RADIATION-INDUCED CANCER DEATHS
DUE TO NUCLEAR POWER PLANTS IN VIRGINIA

	Nuclear power plant workers	General public	
		Routine	Non-routine*
1975	0-0.14	0-0.0035	0-0.14
1985	0-0.43	0-0.0011	0-0.43
1990	0-0.49	0-0.0013	0-0.49

*Annualized effect of catastrophic accidents

WEST VIRGINIA

The scenario projects the following major changes:

- o By 1979 - coal-fired unit in Pleasant County (626 MW).
- o By 1980 - coal-fired unit in Pleasant County (626 MW).
- o By 1980 - coal-fired plant in Mason County (1300 MW).
- o Increase in underground coal mining from 107 million tons/yr in 1975 to 134 tons/yr in 1990; for surface mining, from 23 million to 37 million tons/yr.

Air Quality Impacts

- o Net reduction in SO₂ emissions projected despite increase in capacity.
- o Dramatic improvements in sulfur dioxides air quality, based on emissions reductions both locally and upwind in neighboring states.
- o Visibility in PSD Class I areas should improve.

West Virginia is primarily continental in climate and lies mostly in the Allegheny Plateau, sloping westward toward the Ohio River Valley. The state is subject to stagnation periods of high air pollution due to both its climate and its location near the nation's highest emission areas.

Hancock and Brook Counties in the northern panhandle are currently identified by EPA as experiencing violations of Nation Ambient Air Quality Standards (NAAQS) for sulfur dioxide and total suspended particulates. Ohio and Marshall Counties are also experiencing occasional problems with suspended particulates. Utility and industrial siting within or near these counties will be restricted in the future. Counties immediately to the west of Ohio are also in violation of NAAQS and could impact adjacent West Virginia counties. Other counties in West Virginia experiencing NAAQS violations for suspended particulates are Kanawha and Fayette where Charleston is located.

The two PSD Class I wilderness areas in the state are located near the Virginia border, and thus should not be affected by the energy facility siting postulated by the scenario.

Background Issues

- o Non-attainment problems in the northern panhandle, due in part to interstate transport.
- o Air quality improvement depends in part on emission reduction in neighboring states.

Scenario Induced Issues

- o Sulfur oxides are expected to improve dramatically between 1970 and 1985, and worsen slightly thereafter. (Figure 3-14).
- o Other pollutants (NO_x , trace metals, etc.) related to coal combustion may show less improvement, because of the state's continual high reliance on coal.

Water Quality and Availability Issues

- o Seasonal low-flow problems indicated for ASA 206 (Potomac).
- o Combined mining and utility discharges may lead to water quality violations in ASA 502 (Upper Ohio).

Water-for-energy problems are indicated in two of the four ASAs contained in the State of West Virginia. ASA 206 (Potomac) is projected to have problems during seasonal low flow periods associated with the operation and development of water consumptive steam-electric generating facilities.

In ASA 502 (Upper Ohio), energy development of all types, fueled by the basin's large reserves of coal, is projected to increase substantially over the next decade. Increased industrial growth, beyond that reflected in the manufacturing projections used in this analysis, is also possible as a result of projected development in the coal-rich Upper Ohio mainstream. Combined mining and utility discharges may violate total dissolved solids and phosphorus criteria even if effluent guidelines are met. Energy-related discharges of metals, particularly iron, will be reduced, but background violations may remain.

Severe water shortages during low flow periods, that are not revealed as problems at the ASA level, exist along the lower Monongahela River (within ASA 501), and are possible on several other tributaries.

Land Use, Ecology, and Solid Waste Issues

- o Further land disturbances due to coal mining.
- o Severity of impacts from coal waste disposal depends on implementation of the Resource Conservation and Recovery Act.
- o Acid mine drainage problems may continue.
- o The postulated controls on local SO_2 emissions should ameliorate any local vegetation impacts due to plume impaction.

Projected land disturbances by 1990 include 9000 acres from deep mining and 70,000 acres from surface mining. The surface mining activity will create land disturbance problems for West Virginia; however, the Surface Mining Reclamation Act will minimize these problems if implemented fully. Solid waste from utilities and industries using coal-fired boilers with

Decreases in both industrial and utility emissions.

- Sulfur dioxide concentrations are roughly halved by 1985.
- Utility contributions dominate for all years (annual average).

- Sulfate concentrations are roughly halved.
- Utility contributions dominate.

Figure 3-14. Emissions and Air Quality Trends in West Virginia

scrubbers will present some problems, but not significant, unless EPA rules this waste to be hazardous under the Resource Conservation and Recovery Act.

There have been indications of vegetation damage from short-term SO₂ impacts in WV; however, SO₂ levels are predicted to decline in 1985 and 1990, and consequently the impacts upon croplands and forests will diminish.

Social, Economic, and Institutional Issues

Scenario Induced Issues

- o Possible impacts from construction worker population increase in Pleasants County (1981).
- o Increased coal production may strain existing railroads and coal haul roads.

Energy development in West Virginia is projected to reflect the State's role as the nation's second leading coal producer by emphasizing development and utilization of its coal reserves. Twenty-two counties are expected to experience coal mine construction of some consequence, while only two counties, Pleasants and Mason, are projected to receive coal-fired generating units. Pleasants is the only county that should encounter significant socioeconomic impacts from immigrating construction workers with the maximum population increased (23 percent) possibly occurring in 1981. The coal mining counties should all have a sufficient labor supply within commuting distance or require little in-migration. However, during the operation periods, one county, Upshur, is projected to gain about 470 permanent residents with an increase in the cost of annual public services and facilities amounting to about \$242,000. The total number of workers required in these 13 counties is estimated to be about 20,400 at the noncoincident peaks of the facilities. For both local jurisdictions and the State as a whole, the importance of coal-related impact lies in the large portion of the existing and future economic base generated by coal and not in the effect of in-movers.

West Virginia produces a high sulfur coal, less desirable now because of air quality standards imposed on users. The number of miners has fluctuated and state officials say there continues to be difficulty in providing housing and community facilities in mine areas when needed, resulting in some community instability and adding to labor-management problems. Railroads and coal haul roads are severely stressed, with an estimated 1,000 miles of inadequate coal haul roads and 137 and 183 inadequate vehicle bridges in 1980. The MID-MID scenario projects little additional generating capacity (up from 10,581 MW in 1975 to an estimated 13,113 MW in 1990, all in coal steam). West Virginia does not have a siting law; however, the Public Service Commission is required to approve construction of plants and transmission lines over 200 kv. West Virginia is concerned about the interstate impacts of regional power plant siting decisions.

Health and Safety

Scenario Induced Issues

- o Increased accidents and occupational disease due to coal mining. (Table 3-17).
- o Decreased public health impacts due to sulfur oxides. (Table 3-18).

These estimates, however, do not reflect improvements in accident rates over time, and should be interpreted as upper bonds in view of likely continued improvements in especially underground mine safety.

Table 3-17

ESTIMATED HEALTH EFFECTS FROM COAL MINING IN
W. VIRGINIA

	Accidental		Occupational diseases	
	<u>Deaths</u>	<u>Injuries</u>	<u>Deaths</u>	<u>Incidence</u>
1975	18-71	2069-7850	0-50	0-600
1985	26-94	2699-10260	0-65	0-780
1990	27-97	2910-10400	0-69	0-820

Table 3-18

ESTIMATED HEALTH EFFECTS FROM AIR POLLUTION FROM FOSSIL FUEL COMBUSTION IN
W. VIRGINIA

	<u>Population- weighted SO₄ conc., ug/m</u>	<u>Individual risk level deaths per 10⁶ persons/yr</u>	<u>Estimated attributable Annual deaths*</u>
1975	19	95-1500	170-2700**
1985	9.2	46- 730	85-1400
1990	9.9	50- 790	92-1500

*Effects shown are on an annual basis, but may actually occur in some future years.

**Range shown represents approximately 60% confidence limits from a subjective probability distribution of coefficients relating mortality linearly with ambient sulfate concentration.

FEDERAL REGION 4
OAK RIDGE NATIONAL LABORATORY

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Air Quality	Dick Raridon
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Health Effects	Annetta Watson
Solid Waste	Al Voelker
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Institutional	Marty Adler Fred Boercker
Regional Disaggregation	Dave Vogt Terry Corey
Computer Science	Don Wilson Paul Johnson Carol Dillard
General Support	Mike Hodgson Kerry Hake Luisa Freeman

FEDERAL REGION 4

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REGIONAL OVERVIEW - REGION 4

Federal Region 4 (the Southeast) is diverse in its energy needs and in its ability to meet these needs. This makes speaking of an energy problem or policy for the region as a whole difficult. For example, except for Hawaii, the state of Florida has the fewest heating degree days in the nation. Kentucky has seven times the number of degree days as Florida but still only 82% of the national average. The fossil energy resources of the region are concentrated in the coal fields of Kentucky, Tennessee, and Alabama. Except for modest amounts of oil and gas extraction in Mississippi and Florida, the rest of the region mines little fossil fuel. Paradoxically, the greatest growth in the region has been in Georgia, North Carolina, and Florida, which have few fossil energy resources of their own; Florida even imports some coal from overseas. The region has few large urban areas; of the 50 largest metropolitan areas in the U.S., only 7 are in the Southeast region, and 4 of these are in Florida.

Per capita personal income in this region has historically been well below the national average. Mississippi, long one of the poorest states in the country, had a state per capita income of only 69% of the national average in 1975. Florida had the highest per capita income in the region, but it was still only 95% of that of the nation. Partly for reasons of cost, partly from the region's relatively mild climate, and partly from cultural preferences, the region has a higher percentage of its housing stock in mobile and single-family homes than does the nation, and it relies more heavily on kerosene and liquefied petroleum (LP) gas for heating. These characteristics and others set the region apart from the nation in its response to residential energy policy.

As a whole, the region has mixed views about environmental quality and economic growth. As a relatively poor section of the country, the region welcomes industrial and energy development, particularly if it is directed toward the poorer portions of the region. There is substantial reluctance to impose environmental or other regulations that might make the region less attractive as a place to do business. At the same time, the land of Appalachia bears extensive strip mining scars, and rapid growth has placed strains on the ability of Florida's land and water to support the current population of the state. These problems could grow worse, and there is support in the affected areas to act before they do. There is growing concern that the region not make the same mistakes as the rest of the nation, but this concern has had neither the publicity nor the successes of some other parts of the country. Publicity over conflicts between energy and environment within the region has resulted much more from Federal decisions concerning the breeder reactor or the snail darter than from state and local actions. Concern over developing nuclear power plants, so great in other parts of the nation, seems less of a concern in the southeast Atlantic region than concerns over how environmental regulations will affect coal mining, coal exports to the rest of the country, and coal use within the region.

REGIONAL SCENARIO

Disaggregated Scenario

The energy supply and demand scenario for Federal Region 4 is summarized in Table 4.1. These projections were the basis for the county level utility, industrial, and mining siting patterns, developed by ORNL, BNL, and MITRE Corporation, which, in turn, provide the baseline for the impact statements. Whereas electrical generation accounts for over 75% of the industrial fuel use (thereby creating the larger proportion of environmental impacts), most of the analysis has focused on this sector. Figures 4.1 through 4.8 illustrate the regional distribution of electrical generation for coal, nuclear, oil, and gas between 1975 and 1990. Each graduated circle reflects the total electrical generation capacity for that county for the specified technology. All state projections are based upon the Mid-Range Projection series C Scenario and reflect the growth in electrical generation requirements to 1990.

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- Olson, R. J., et al. 1977. MULTIREGION: A Simulation Forecast Model for BEA Area Population and Employment, Oak Ridge National Laboratory, Oak Ridge, Tennessee, ORNL/RUS-25.
- Vogt, D. P., et al., forthcoming. REBS: A Methodology for Addressing the Regional Implications of National Energy Scenarios, Oak Ridge National Laboratory, Oak Ridge, Tennessee, ORNL/TM report.

Table 4-1. Energy supply/demand balance
for Region IV (quadrillion Btu's per year)

Projected series ^a	1975	1985	1990
<u>Domestic production</u>			
Crude oil	.65	1.79	2.02
NGL and butane	.09	.19	.20
Shale oil	0.00	0.00	.03
Natural gas	.21	.36	.38
Coal	4.06	4.96	5.38
Nuclear	0.37	1.58	2.93
Hydro and geothermal	<u>0.44</u>	<u>0.45</u>	<u>0.50</u>
Total domestic production	5.78	9.33	11.44
<u>Imports</u>			
Crude oil	.35	-	-
Petroleum products	2.87	3.80	3.90
Natural gas	1.67	1.30	1.16
Coal	-	-	<u>1.41</u>
Total imports	<u>4.90</u>	<u>5.10</u>	<u>6.47</u>
Total supply	10.68	14.43	17.91
<u>Domestic consumption</u>			
Oil	5.03	6.49	7.09
Natural gas	1.79	1.66	1.54
Coal	3.27	4.92	6.79
Nuclear	.37	1.58	2.93
Hydro and geothermal	<u>.44</u>	<u>.45</u>	<u>.50</u>
Total domestic consumption	10.90	15.11	18.84
<u>Exports</u>			
Crude oil	-	.579	.658
Coal	.61	.026	-
Refinery loss	<u>.01</u>	<u>.02</u>	<u>.01</u>
Total consumption and export	12.07	15.75	19.51
<u>Domestic consumption by sector</u>			
Residential	2.23	3.49	4.60
Commercial	1.49	2.07	2.44
Industrial	3.65	5.96	7.40
Transportation	<u>3.20</u>	<u>3.92</u>	<u>4.44</u>
Total domestic consumption	10.57	15.44	18.88

^aMid-Range Projection Series C

1975 COAL STEAM CAPACITY IN REGION IV

Figure 4-1

Total Coal Steam Electric Capacity by County for 1975

1990 COAL STEAM CAPACITY IN REGION IV

Figure 4-2

Total Coal Steam Electric Capacity by County for 1990

1975 NUCLEAR CAPACITY IN REGION IV

Figure 4-3

Total Nuclear Steam Electric Capacity by County for 1975

1990 NUCLEAR CAPACITY IN REGION IV

Figure 4-4

Total Nuclear Steam Electric Capacity by County for 1990

ORNL DWG 79-14416

1990 OIL STEAM CAPACITY IN REGION IV

Figure 4-5

Total Oil Steam Electric Capacity by County for 1975

ORNL DWG 79-14417

1975 OIL STEAM CAPACITY IN REGION IV

Figure 4-6

Total Oil Steam Electric Capacity by County for 1990

1975 GAS STEAM CAPACITY IN REGION IV

Figure 4-7

Total Gas Steam Electric Capacity by County for 1975

1990 GAS STEAM CAPACITY IN REGION IV

Figure 4-8

Total Gas Steam Electric Capacity by County for 1990

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

A number of issues cannot be limited to state or even regional boundaries. They are the product of national or multiregional developments. Some issues under this analysis that fall naturally into this category are long-range transport of pollutants and national socioeconomic impacts. Additionally, impacts affecting major natural water systems may be a product of several of the regional entities assumed for this study. The issues, however, are of great importance because individual regions may bear disproportionately both the impacts and the cost of proposed remedies in comparison with other regions.

Long-Range Transport

Because of the high probability that coal burning will increase in Texas, Louisiana, Arkansas, and Oklahoma, those states in Region 4 within the normal air flow path of the Southwest (particularly Kentucky and Tennessee) will be exposed to increasing concentrations of SO₂ and sulfates, even with National Ambient Air Quality Standards (NAAQS).

National Socioeconomic Issues

Because of national demand for skilled construction and operation manpower, not only in energy but also in other industries, the Southeast could experience possible shortages if the Series C Scenario is realistic. Also, energy development in Region 4 could be constrained by the competing national demands for construction capital. In addition, nuclear development will be affected by whether the nation resolves current reactor safety and waste disposal issues. These issues are closely tied to how the nation decides to handle licensing procedures.

In recent years it has become evident that considerable conflict exists in the federal-state-local infrastructure of authority. The relationship among federal, state, and local agencies with regard to control of energy resources (such as oil and gas) and who will use them has become a major national issue. A conflict also exists between national commitments for energy development and the desire to preserve the environment. This is exemplified by the conflicting goals of the coal conversion section of the NEA and the Clean Air Act Amendments of 1977.

In terms of health and safety, several federal acts and compliance issues will affect the well-being of residents in the Southeast. Enforcement of surface mining legislation will improve the water quality and diminish the possibility of health impacts in the region. Also, compliance with the clean air standards adopted by EPA will significantly reduce the exposure levels of sulfur dioxide (SO₂) and sulfates currently experienced by residents in the Southeast, particularly in Kentucky and Tennessee. Finally, enforcement of safe underground mining practices will reduce the additional mine deaths that could result from forecasted coal production levels.

Inland and Coastal Water Resources

Current EPA regulations regarding thermal discharge from power plants should be reexamined in view of the possible water shortage problems identified in the Series C Scenario. The current emphasis on wet cooling towers, in effect, may be trading the thermal problems of once-through cooling systems for a plethora of problems and conflicts associated with increased water consumption. Research and development of cooling options that require less water, including evaluation of state and federal regulations that inhibit full utilization of residual heat, also should be examined. Analysis of alternative sources of cooling water, including groundwater, consideration of alternate use of new and existing reservoir storage capacity, and use of saline water, are especially needed to identify viable mitigation strategies.

An appraisal of how state legislatures can best deal with water shortages is needed by the states, particularly those states following the riparian doctrine and containing problem basins defined in this analysis. Finally, data and projections of water use by competing (nonenergy) sectors is greatly needed to assess water availability conflicts.

REGIONAL ISSUES

The following is a summary of the environmental, social, and economic impacts of the scenario on the Southeastern region. Issues identified are those impacting more than one state in the region.

Local Air Quality, Visibility

Violations of National Ambient Air Quality Standards (NAAQS) for total suspended particulates (TSP), carbon monoxide (CO), and photochemical concentrations are currently occurring in several metropolitan areas in Region 4, most notably in Atlanta, Memphis, Birmingham, and Mobile. Violations for SO₂ are occurring around several Tennessee Valley Authority (TVA) coal-fired electric plants located near Paducah, Kentucky; Waverly, Tennessee (Johnsonville steam plant); and in northeastern Alabama (Widows Creek). Recent agreements between TVA and EPA will ease many of these problems. The region's air quality is only moderately impacted at present, but problems with air quality could worsen if the conversion of oil and gas boilers to burn coal occurs.

Overall, air quality in Region 4 is not expected to improve appreciably during the period from 1975 to 1990 because emissions of noxious gases and particulates to the atmosphere are likely to increase due to more burning of coal. Table 4.2 provides a summary of SO₂ and TSP emissions by states for 1975 and those predicted for 1990. Table 4.3 displays data on SO₂ and NO_x emissions for 1975, 1985, and 1990 for each of the Air Quality Control Regions (AQCRs) in Region 4. (See Fig. 4.9 for distribution of AQCRs.) Although SO₂ may not be a severe problem, except in localized situations, it is readily converted in the atmosphere to sulfates which are thought to have significant health effects. Sulfur dioxide, sulfates, and NO_x all contribute to increasing acid rain. The pH levels of many lakes, particularly in the Northeast, are now so low that fish populations are greatly reduced

Table 4-2

Summary of SO₂ and TSP Emissions for Region 4 (10³ tons/year)^{a/}

State	SO ₂			TSP		
	1975	1990	% change from 1975	1975	1990	% change from 1975
Alabama	977	912	- 7	737	276	- 63
Florida	834	1379	+ 65	380	417	+ 10
Georgia	620	999	+ 61	287	291	- 2
Kentucky	1489	1944	+ 31	411	349	- 15
Mississippi	145	271	+ 87	51	65	+ 27
North Carolina	472	873	+ 85	342	246	- 28
South Carolina	203	293	+ 44	155	128	- 17
Tennessee	1205	960	- 20	608	225	- 63
Totals	5945	7631	+ 28	2971	1987	- 33

^{a/} Data taken from SEAS, MED-MED Scenario

Table 4-3
Annual SO₂ and NO_x Emissions (Kilotons per Year)
by Air Quality Control Regions

Air Quality Control Region Number		SO ₂			NO _x		
		1975	1985	1990	1975	1985	1990
1	Alabama and Tombigbee Rivers	14	42	50	16	31	34
2	Columbus - Phenix City	11	17	20	37	32	30
3	East Alabama	17	23	25	25	24	24
4	Met. Birmingham	275	280	333	177	220	249
5	Mobile - Pensacola - Panama City - Southern Miss.	504	617	689	246	347	378
6	SE Alabama	1	134	172	11	44	53
7	Tennessee River Valley - Cumberland Mts.	573	245	241	139	136	132
18*	Met. Memphis	114	100	93	65	67	57
48	Central Florida	51	11	16	80	50	41
49	Jacksonville - Brunswick	128	75	82	104	76	73
50	SE Florida	95	34	45	224	143	118
51	SW Florida	20	4	4	30	16	14
52	West Central Florida	497	601	609	158	187	201
53	Augusta - Aiken	36	42	45	42	42	42
54	Central Georgia	75	197	260	69	133	169
55	Chattanooga	323	293	281	107	104	107
56	Met. Atlanta	105	180	217	137	161	174
57	NE Georgia	3	5	7	24	19	18
58	Savannah - Cairo	54	56	63	42	44	44
59	SW Georgia	26	31	32	33	29	28
72*	Paducah - Cairo	1237	1358	1243	235	299	274
77	Evansville - Owensboro - Henderson	631	537	600	115	209	257
78*	Louisville	367	316	321	106	126	130
79*	Met. Cincinnati	433	268	303	145	179	200
101	Appalachian	8	8	8	24	20	18
102	Bluegrass	74	82	84	44	42	45
103*	Huntington - Ashland - Portsmouth - Ironton	699	1023	916	217	315	307
104	North Central Kentucky	3	28	37	12	23	27
105	South Central Kentucky	42	47	46	26	24	23
134	Mississippi Delta	6	4	4	18	15	12
135	NE Mississippi	6	9	12	32	27	26
136	Northern Piedmont	30	34	39	56	50	52
165	Eastern Mountain	168	229	256	121	154	172
166	Eastern Piedmont	119	144	155	94	103	109
167	Met. Charlotte	116	155	166	121	138	140
168	Northern Piedmont	28	47	60	14	12	12
169	Sandhills	12	13	15	28	24	23
170	Southern Coastal Plain	79	80	80	57	56	54
171	Western Mountain	45	42	38	35	29	27
198	Camden - Sumter	5	11	9	9	13	10
199	Charleston	47	27	28	44	30	29
200	Columbia	58	150	202	43	91	124
201	Florence	10	12	14	19	17	15
202	Greenville - Spartanburg	29	33	39	46	39	40
203	Greenwood	2	3	3	8	6	6
204	Georgetown	16	27	34	14	19	23
207*	Eastern Tennessee - SW Virginia	611	791	749	253	326	296
208	Middle Tennessee	777	440	419	171	171	166
209	Western Tennessee	4	9	13	25	22	22
TOTALS		8584	8914	9177	3898	4484	4627

*Includes a portion outside Region IV

AIR QUALITY CONTROL REGIONS IN REGION IV

AQCR	AQCR NAME
1	ALABAMA AND TOMBIGBIE RIVER
2	COLUMBUS - PHOENIX CITY
3	EAST ALABAMA
4	MT. DIORAMA
5	MOBILE - PENSACOLA - PANAMA CITY - SOUTHERN MISS.
6	SE ALABAMA
7	MISSISSIPPI RIVER VALLEY - COLUMBIAN MISS.
16	MT. ALPHIS
18	CENTRAL FLORIDA
19	JACKSONVILLE - BRUNSWICK
50	SE FLORIDA
51	SW FLORIDA
52	WEST CENTRAL FLORIDA
53	AUGUSTA - ALBU
54	CENTRAL GEORGIA
55	CHATTANOOGA
56	MT. ATLANTA
57	SE GEORGIA
58	SAVANNAH - DECATUR
59	SW GEORGIA
60	PACIFIC - LAIRO
61	EVANSVILLE - OMAHA - WISCONSIN
62	LINCOLN
63	MT. LINCOLN
64	APPALACHIAN
112	BUFFALO
113	HUNTINGTON - ASHLAND - POWERS - BRIGHT
114	SOUTH CENTRAL KENTUCKY
115	SOUTH CENTRAL KENTUCKY
116	MISSISSIPPI DELTA
117	SE MISSISSIPPI
118	NORTHERN PIEDMONT
119	EASTERN PIEDMONT
120	MT. CHARLOTTE
121	SOUTHERN COASTAL PLAIN
122	SANDHILLS
123	SOUTHERN COASTAL PLAIN
124	WESTERN PIEDMONT
125	CAMPDEN - SUMMIT
126	CHARLESTON
127	COLUMBIA
128	FLORIAN
129	GREENVILLE - SPARTANBURG
130	GREENWOOD
131	GEORGETOWN
132	EASTERN TENNESSEE - SW VIRGINIA
133	MIDDLE TENNESSEE
134	WESTERN TENNESSEE

Figure 4-9

Air Quality Control Regions (AQCRs) in Region 4

CLASS I AREAS - REGION IV.

Figure 4-10. Class I areas in Region IV.

(Cronan and Schofield, 1979). NO_x is also a factor in increased ozone levels found in selected areas of the Southeast.

Particulate emissions can cause problems due to the presence of undesirable trace elements, such as arsenic, cadmium, fluorine, and selenium, and trace organics such as benzopyrene (Vitez, 1976). Emissions of selenium, in particular, are expected to increase with additional coal combustion because it is volatile and cannot be easily controlled. Also, because coal contains trace amounts of uranium, thorium, and their decay products, increased levels of radioactivity in the atmosphere may result from burning more coal.

Local Air Quality Assessment

The following data were provided by ANL on a county-by-county basis, where available: utility and industrial SO_2 and TSP emissions for 1975, 1985, and 1990; 1975 ambient air quality for SO_2 and TSP and projections for 1985 and 1990; and an air quality impact assessment. The BNL long-range transport data were used for the 1985 and 1990 projections. The emissions assumptions were: State Implementation Plan (SIP) compliance by 1983 for existing sources, Energy Supply and Environmental Coordination Act (ESECA) conversions included; 90% SO_2 control for new utility sources; existing New Source Performance Standards (NSPS) controls for new industry sources; and 99% TSP control for new sources. PSD Class I areas are shown in Fig. 4.10. The air quality (AQ) impact assessments are based on the following criteria: incremental AQ changes are compared with allowable PSD increments for Class I or Class II areas, as appropriate; ambient AQ levels for 1985 and 1990 are compared with appropriate NAAQS; and percentage increase in emissions is calculated if no ambient data are available, and counties are noted if the increase is greater than 25%.

Factors not included in the analysis are: contributions from long-range transport, subcounty siting factors in large counties, changes in emissions from sectors other than utility and industrial fuel combustion, real distribution of metallurgical coal, local air quality regulations, contributions from rural fugitive dust, and cross-county impacts.

Table 4.4 summarizes the ambient air quality (AAQ) and incremental air quality (IAQ) results by listing the number of counties in each state for which nonattainment occurs or where there are PSD incremental violations. For Region IV, only 229 of the region's 736 counties, including 10 nonattainment counties in Class I areas, can be studied, because air quality in the remaining counties has not been studied by EPA. In 1975, 7 counties were in nonattainment for SO_2 and 24 counties for TSP. The corresponding numbers are 3 and 19 in 1985, and 4 and 13 in 1990. In 1985, there will be three counties with PSD increment violations for SO_2 and six counties for TSP. In 1990, the corresponding numbers are five and three. Because our present laws state that there will be no nonattainment areas in 1990, the counties listed here represent potential trouble spots which will have to be corrected by that date. Only two of the Class I counties are in the nonattainment category (both for TSP) in 1985 or 1990. Figures 4.11 to 4.13 indicate the corresponding AQCRs involved. Figures 4.14 to 4.16 show the SO_x emissions in the AQCRs of Region 4 for the three years.

Table 4-4

Number of counties in each state with violations in ambient and incremental air quality for the period 1975-1990^a

Number of counties			Number of counties with violations of air quality standards by year and pollutant type										
State	Total	With data ^b	Number of PSD Class I counties	Ambient air quality 1975		Ambient air quality 1985		Ambient air quality 1990		Incremental air quality 1985		Incremental air quality 1990	
				SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP
Alabama	67	24		1	4			1		1			
Florida	67	39	5		1	1	1 ^c	1	1				
Georgia	159	29		1	1	1		1			3		1
Kentucky	120	30		4	6		6		5		1		
Mississippi	82	17			1							1	
North Carolina	100	40	3		4		4 ^c		3 ^c	1	1	2	1
South Carolina	46	27	1		2	1	2	1	1	1		2	
Tennessee	95	23	1	1	6		5		3		1		1
Totals	736	229	10	7	25	3	18	4	13	3	6	5	3

^a County data provided by Argonne National Laboratory.

^b A number of counties in each lack historical data for predicting changes in air quality. This number reflects the total number of counties with existing air quality data.

^c Includes one county in a PSD Class I area.

AQCR'S IN REGION IV WITH ONE OR MORE COUNTIES
SHOWING NON-ATTAINMENT FOR TSP

Figure 4-11

AQCRs with One or More Counties Showing Nonattainment
for TSP 1975, 1985, 1990

AQCR'S IN REGION IV WITH ONE OR MORE COUNTIES EXCEEDING NAAQS OR PSD INCREMENTS IN 1985

Figure 4-12

AQCRs with One or More Counties Exceeding NAAQS or PSD
Increments in 1985

Table 4.5 summarizes the air quality impact assessment for 1985 and 1990. In addition to noting counties for nonattainment or increment violations, any county that will experience a greater than 25% increase in emission but has no 1975 AAQ data is noted for further investigation. The numbers for nonattainment are similar to those in Table 4.4. Also included are counties where NAAQS or the PSD Class II increment is exceeded.

Long-Range Transport Assessment

Data on the long-range transport of SO₂ were obtained from BNL. Table 4.6 lists total fuel consumption, electrical generation, and SO₂ emissions for Region 4 for each of the scenarios. Coal is the predominant fuel for utility use during the entire period. The following data for both SO₂ and sulfate (SO₄) were provided for each state: area, population, concentration of pollutant (maximum, minimum, average, and population-weighted average), and exposure (product of population and population-weighted average concentration). This information forms the basic input to the health impact assessment.

Water Quality and Availability

Water for energy will be a major concern for energy development throughout Region 4. However, widespread water shortages are generally not apparent at the aggregated subarea (ASA) level. Figure 4.17 illustrates the ASAs used in the analysis of Region 4. Figure 4.18 highlights the primary areas of concern for water availability in Region 4. Although the region's total runoff is the greatest in all the eastern United States, most of the load centers (including Birmingham, Alabama; Atlanta, Georgia; and Charlotte, Greenville, and Winston-Salem, North Carolina) are situated in inland headwater areas where low-flow problems result from periodic droughts. None of these headwater rivers is capable of supporting numerous large facilities, and, even in combination, they cannot serve all the demands of nearby load centers.

Severe water shortages in southern Florida are associated with minor energy development in competition with large irrigation and urban waste demands.

Substantial local water supply problems not evident at the ASA level are likely to be created by energy development on individual tributaries. Localized problems are also projected for energy during seasonal low-flow periods in the Roanoke-Cape Fear area (ASA 301) of eastern North Carolina and the upper Ohio Basin (ASA 502) in Kentucky.

Few water quality changes at the ASA level are anticipated to result from the energy scenario. The projected water quality impacts are illustrated in Figs. 4-19 to 4-21.

AQCR'S IN REGION IV WITH ONE OR MORE COUNTIES
EXCEEDING NAAQS OR PSD INCREMENTS IN 1990

■ NAAQS EXCEEDED ■ PSD CLASS I EXC'DED ■ PSD CLASS II EXC'DED

Figure 4-13

AQCRs with One or More Counties Exceeding NAAQS or PSD
Increments in 1990

1975 SO_x EMISSIONS IN REGION IV (tons/mi²)

Figure 4-14

SO_x Emissions in 1975

1985 SO_x EMISSIONS IN REGION IV (tons/mi²)

Figure 4-15
SO_x Emissions in 1985

1990 SO_x EMISSIONS IN REGION IV (tons/mi²)

Figure 4-16

SO_x Emissions in 1990

Table 4-5

Air Quality Impact Assessment^a
(Number of Counties Involved)

State	PSD Class I increment exceeded		Nonattainment continues for SO ₂		Nonattainment continues for TSP		National ambient air quality standard exceeded		PSD Class II increment exceeded		No 1975 air quality data, >25% increase in SO ₂ emissions		No 1975 air quality data, >25% increase in TSP emissions	
	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990
Alabama									1	1	1	2		
Florida	1		1		1	1	1	1	2		5	6		
Georgia			1	1					3	1	6	8	2	1
Kentucky					5	5	1				1	3		
Mississippi										1	1	3	1	
North Carolina	1	2			3	2						2	1	1
South Carolina		1			2			1			4	4		
Tennessee					5	3			1	1	2	2		
Totals	2	3	2	1	16	11	2	2	7	4	20	30	4	2

^aCounty data provided by Argonne National Laboratory.

Table 4-6. Fuel consumption, electric generation, and SO₂ emission in Federal Region

Scenario	COAL			OIL			TOTAL		
	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr
<u>1975</u>									
Utilities	5439	.779	2.269	432	.261	.766	5871	1.040	3.055
Industries	566		.302	564		1.259	1130		1.561
<u>1985</u>									
Utilities (85%) ^d	4040	1.503	4.431	798	.352	1.038	4838	1.855	5.470
Utilities (90%) ^d	3987	1.503	4.432	798	.352	1.038	4785	1.855	5.470
Industries	377		.551	463		1.431	840		1.982
<u>1990</u>									
Utilities (85%) ^d	4452	2.005	5.911	699	.280	.825	5151	2.285	6.736
Utilities (90%) ^d	4231	2.005	5.911	699	.280	.825	4930	2.285	6.736
Industries	498		.682	623		1.625	1122		2.307

^aEmission in 1000 tons/year^bElectric output (1 quad = 10¹⁵ Btu)^cTotal fuel use^dAssumed percent control of SO₂ emissions for plants built after 1982

AGGREGATED SUBAREAS IN REGION IV

Figure 4-17

Water Resources Council Aggregated Subareas in Region 4

1990 WATER-FOR-ENERGY QUANTITY IMPACTS REGION IV Mid-Range Projection Series C Scenario

Figure 4-18

Water-For-Energy Quantity Impacts in 1990

1975 WATER QUALITY IMPACTS IN REGION IV

Figure 4-19

Water Quality Impacts in 1975

1985 WATER QUALITY IMPACTS IN REGION IV

Figure 4-20

Water Quality Impacts in 1985

1990 WATER QUALITY IMPACTS IN REGION IV

Figure 4-21

Water Quality Impacts in 1990

In southern and central Florida, utility plant effluents will aggravate existing violations of total dissolved solids and phosphorus criteria. Ash disposal resulting from increased use of coal in Florida and other coastal areas underlain by shallow aquifers may increase the risk of groundwater contamination.

Compliance with coal mining and washing effluent guidelines and surface mine reclamation standards in mining areas should prevent violations and may cause some water quality improvement at the aggregated subarea level. In mountainous areas, however, complete control will be difficult to achieve, and accidental releases and local problems are likely to occur.

Land Use, Ecology, Solid Waste

Land Use

No major regional land use impacts are predicted for power plant siting requirements to the year 1990. However, major land use impacts are predicted to continue to result from coal mining activities, predominantly surface mining. This is especially true for the state of Kentucky which is predicted to have 175,000 acres directly affected by strip mining by 1990. Alabama and Tennessee expect to have 27,000 and 21,000 acres impacted, respectively (Fig. 4.22).

Ecology

From the information supplied by Argonne National Laboratory, it appears that major significant environmental impacts will come from coal-related energy technologies. The primary impacts are the result of coal mining and air pollution (Davis, 1978). Within Region 4 the soybean growing areas of Mississippi, Tennessee, and Kentucky on the Mississippi River floodplain and the tobacco growing areas of eastern Kentucky, Tennessee, North Carolina, and Virginia (Fig. 4.23) are the most important in terms of potential impacts. In addition, surface mining may affect a variety of endangered species in Alabama (Cahaba shiner, goldline darter), Kentucky (Indiana bat, Virginia Big-Faced bat), and Tennessee (Slender chub, yellowfin madtom, Plateau Musky).

A note of concern also should be expressed relative to the environmental impacts of air pollutants, e.g., SO_2 , sulfates, NO_x , and ozone on both crops and natural vegetation. This document only deals with the counties where power plants are located and does not take into account the synergistic problems associated with downwind air pollution from multi-county sources. As indicated in the National Coal Utilization Assessment for the South (Davis, 1978), the apparent effects of SO_2 on crops and forests are greater in counties not containing coal-fired power plants. This is because of atmospheric effects distributing pollutants beyond the host county.

Solid Waste

Solid waste disposal does not involve a significant scenario impact in Region 4. Of all energy-related activities, strip mining consumes the most land in disposing of a solid waste, in this case, overburden. The scenario estimate of solid waste production from strip mining supplied by Brookhaven National Laboratory (BNL) shows that states in Region 4

IMPACTS ON LAND USE IN REGION IV COUNTIES Mid-Range Projection Series C Scenario

Figure 4-22

Impacts on Land Use

SO₂ IMPACTS ON VEGETATION-ECOLOGY IN REGION IV AQCR'S Mid-Range Projection Series C Scenario

Low Impacts
 Medium Impacts
 High Impacts

Figure 4-23

Impacts of SO₂ Emissions on Vegetation-Ecology in 1975, 1985, 1990

actually may foresee a decrease in the amount of land disturbed annually over the period 1975 to 1990 due to depletion of resources and shifts to other coal regions.

Potential impacts from increased strip mining may be mitigated by adherence to contour and reclamation requirements of the new strip mine law (PL 98-87, Federal Surface Mining and Control Act of 1977). Because it appears that the federal government is serious in implementing the provisions of the strip mine bill, it can be assumed that strong enforcement may preclude serious long-term damage to the environment in this area.

Solid waste resulting from the production of energy in power plants and coal conversion facilities is not likely to constitute a major constraint on the deployment and operation of such facilities. BNL projections at the county level show increases in all states but at levels which constitute minimal land impact.

The largest increase in land utilized for solid waste disposal per year occurred in Kentucky. By 1990, 589 acres/year will be consumed by the utility sector for solid waste disposal, an increase of 249 acres/year. Review of the projected siting pattern change between 1985 and 1990 makes this increase seem improbable. More plants are sited on the Kentucky side of the Ohio River than on the Ohio side. Nine plants are projected for Kentucky, most on the Ohio River; only two small plants (one on the Ohio) are projected for Ohio. Apparently the problem is the result of using local siting patterns to satisfy regional demand required by the scenario. Regional demand projections do not recognize the impracticability of siting nine plants on one side of the river and one small plant on the other. In reality, less plant construction is expected in Kentucky and more in Ohio, with resulting smaller solid waste problems in Kentucky.

In any case, the impact of utility solid wastes at the county level will not be severe. The average county in this country has roughly 0.25 million acres, and a power plant is not likely to consume more than 20 acres/year of this. An interesting comparison is one between utility scrubbers which are expected to produce approximately 1 million tons of sludge by 1990 and other activities generating sludge wastes such as municipal sewage which will produce 55 million tons of sludge in 1990 or taconite mining, which generated 55 million tons of waste in 1971.

BNL reviewed recent utility planning reports and found that utilities apparently can assemble sites with sufficient acreage for future waste disposal needs (BNL, 1978). Sites available to utilities have the basic attributes needed for onsite storage. Furthermore, most existing plant sites are sufficiently large to accommodate increased solid waste storage in the event that scrubber systems are required by state regulatory agencies. In effect, it should be possible for utilities to find the land needed to dispose of larger amounts of solid waste in the future.

The existence of sufficient land, however, may not mean the land is available to the utilities. If EPA classifies utility solid waste as hazardous under the Resource Conservation and Recovery Act, utilities will have to overcome public opposition to the presence of hazardous substance in local environments. Concern generated by incidents such as the Love Canal and the Kepone episodes has created a national issue nonexistent a few years

ago, and the possibility exists that the public also will be concerned about utility siting. Siting of commercial hazardous waste facilities for the industry use also may be resisted by local groups and could become embroiled in local politics. The situation for a large utility may be different. Utility disposal sites are normally part of the larger site occupied by the plant, under direct control of the utility, and used exclusively by the utility. Furthermore, ash ponds are a recognized accessory to power plants. They do not elicit images of danger in the minds of the public.

Although BNL did not supply information on solid waste generation by coal conversion facilities, the facilities are very similar to coal burning electrical generating plants in their solid waste production and can be lumped with power plants. For example, a solvent-refined coal process coal liquefaction plant of 50,000 bbl/day requires 20 acres/year for solid waste disposal. This is roughly equivalent to a large electrical generating plant (TRW, 1978). Ten such plants might be on line by 1990, contributing little additional solid waste impact.

Solid waste production from the increased use of coal by industry is small compared to utility output but can create local economic impact and environmental issues and frustrate the mandated conversion to coal. Small industries and industries with insufficient land or land unsuited to waste disposal traditionally ship their waste to commercial disposal facilities or release liquid waste directly into the sewer system or a natural water-course. If industries choose to ship the increased wastes generated by conversion to coal, they will experience relatively high transportation costs. Industry relocations may be hastened by the conversion process, and local economic hardships can be anticipated, particularly in areas that have lost industry in recent times. If industry relies on liquid systems, then they must negotiate with the receiving sewer system over increased loads of dissolved solids. Finally, if solid waste from industrial boilers and pollution control equipment is classified as hazardous waste, the added costs of handling hazardous waste will increase structural and location impacts in local areas.

In summary, solid waste problems stemming from the energy fuel cycles will result in local economic adjustments and produce local political issues. However, solid waste and its associated problems do not pose a significant constraint on acquiring, transforming, and delivering energy at the regional level.

Social, Economic, and Institutional Regional Impacts

Social Impacts

Under the Series C Scenario, energy development is projected to occur in 79 of the 736 counties of the 8-state Region 4 by 1990. This development is varied and includes 17 nuclear plants, 43 coal plants, 6 oil plants, and coal mining activity in 20 counties. All of the nuclear plants and the majority of the coal and oil plants should be over 500MWe in capacity. Twenty of the counties with anticipated energy development are expected to experience significant socioeconomic impacts; their population will increase at least 10% from temporary, in-migrant workers and dependents during the construction period as a result of the insufficient supply of

skilled labor within commuting distance of the project. Although there are many localized impacts, there should be very little statewide impact during the construction phases of this development. Consequently, no significant regional impacts are expected.

Kentucky is the only state recognized as having the potential for statewide impacts. This potential results from the large portion of the state's present and future economic base generated by coal, not from the effects of a large number of in-movers. Alabama is the only state with no projected significant local impacts. In the region as a whole, only a few localized socioeconomic impacts are expected during the operating phase of these energy developments, primarily as a result of projected increased public spending on services and facilities totaling approximately \$1,900,000 annually. The operations phase impacts on either statewide or regional levels should be insignificant, with 6 counties experiencing population increases of approximately 4000 people. The absence of significant regional impacts does not reduce the potential severity of impacts on the local communities to be impacted by energy facilities by 1990.

Direct Economic Impacts

Under the Series C Scenario, the direct economic impacts of the construction and operation of energy facilities in Region 4 cannot be established from data made available for the region. Instead, pertinent data for a larger area, the 14-state southern region, was assigned to ORNL by DOE: Region 4 plus Arkansas, Louisiana, Oklahoma Texas, Virginia, and West Virginia. Because Region 4 is a large portion of this area, considerable direct economic impact from construction and operation of energy facilities is assumed to occur in Region 4, as in the southern region.

From financial, employment, and materials standpoints, the construction and operation of energy facilities located in the South constitute almost half of all such activities occurring in the United States. Table 4.7 lists southern energy facility costs as a percentage of total U.S. energy facility costs.

Table 4.7 Total annual costs of constructing and operating energy facilities in the South, as a percentage of total U.S. energy facility costs

	1975	1976-1980	1981-1985	1986-1990
Construction				
Capital	47	46	46	48
Manpower	47	45	44	45
Resource (materials)	49	48	47	49
Operation				
Costs	51	50	58	46
Manpower	49	48	46	44
Resource (materials)	48	47	45	43

Another means of comparing the South's energy role with that of the rest of the country is on the basis of various energy types, as measured by estimated 1975 operating expenses. Such a comparison again indicates the 14-state region's predominance in either generating or supplying energy to the rest of the United States. The South's proportional use of each fuel is depicted in Fig. 4.24. These result in a combined total of 51% of the nation's output. It should be noted that this includes costs of recovering, processing, and transporting energy outside the South.

An additional basis for assessing the energy picture in the South is the region's current and future energy mix as measured by operating costs and employment requirements. Table 4.8 indicates that, under the Series C Scenario, coal, nuclear, and other fuel cycles will undergo expansion, while oil and gas will experience contraction relative to their previous degrees of utilization. In oil, the relative decrease measured in operating costs is moderate, and indeed, on an absolute basis, oil usage actually increases approximately 15% from 1975 to 1990. With gas, the relative decrease measured in operating costs is approximately 31% over 15 years, and the absolute decrease in gas utilization is approximately 12%.

Table 4.8. The South's energy mix, listed by operating costs (OC) and manpower requirements (MR)

Fuel cycle	1975 OC/MR	1976-1980 OC/MR	1981-1985 OC/MR	1986-1990 OC/MR
Coal	23/31	26/34	29/37	32/39
Oil	33/31	32/29	31/28	29/26
Gas	29/23	27/21	23/17	20/15
Nuclear	4/1	5/2	5/2	6/3
Other	10/14	11/15	12/16	14/18
Total	99/100	101/101	100/100	101/101

Two additional important issues for the South are raised by projections of the Series C Scenario. These issues are the availability of skilled construction and operations personnel and the availability of the large amount of capital required to construct projected energy facilities. The scenario calls for a 27% increase construction in man-years and a 36% increase in operating man-years by the 1985-1990 period as compared to 1975 requirements. In respect to financial considerations, the 1985-1990 projections call for increases in both construction capital and operating funds amounting to 30% over 1975 totals. These increases are, in themselves, significant. Assuming continuation of the serious escalations which have been occurring in manpower and financial requirements for energy facilities, it is apparent that potential shortages of skilled employees and national as well as utility-specific constraints on availability of capital could constitute serious barriers to implementation of the Series C Scenario in the South.

THE SOUTH'S 1975 SHARE OF ENERGY PRODUCTION MEASURED BY OPERATING EXPENSES AND FUEL TYPE

Figure 4-24

The South's 1975 Share of Energy Production Measured
by Operating Expenses and Fuel Type

Indirect Economic Impacts

In the scenario, construction of energy facilities throughout the United States would have indirect economic impacts on industrial activity in Region 4. These impacts can be assessed to a limited degree from the data for the 14 state southern region. The economic activity created by such construction will be heavily concentrated in a few sectors of the regional economy. The ten industrial categories most affected (in absolute dollars of gross output) and the approximate gross output in millions of 1977 dollars for 1976-1980, 1981-1985, and 1986-1990 are indicated in Table 4.9.

Table 4.9. Indirect impacts on Region 4 of the nationwide capital and manpower expenditures for construction of energy facilities

Ten leading industrial sectors		Gross output (millions of 1977 dollars) ^b		
Sector No.	Sector description	1976-1980	1981-1985	1986-1990
1601	Broadwoven fabric	143 (1.0)	162 (1.2)	177 (1.3)
2701	Industrial chemicals	150 (1.5)	170 (1.7)	186 ^a (1.9)
3701	Blast furnace, basic steel	209 (7.2)	238 (6.7)	250 (7.1)
4004	Fabricated structural steel	165 (15.3)	172 (16.0)	189 (17.6)
4006	Fabricated plate	445 (42.3)	468 (44.4)	532 (50.5)
6901	Wholesale trade	353 (1.9)	395 (2.1)	420 (2.3)
6902	Retail trade	337 (1.2)	384 (1.3)	420 (1.5)
7102	Real estate	331 (1.9)	374 (2.1)	415 (2.3)
7301	Miscellaneous business services	239 (3.3)	271 (3.8)	302 (4.2)
7303	Miscellaneous professional services	373 (8.3)	423 (9.4)	484 (10.8)
Total - top 10 sectors		2745	3057	3375
Total - 368 sectors		7225	8099	8799
Concentration top 10 sectors, %		38.0	37.7	38.4

^aGross output data provided by Lawrence Berkeley Laboratory.

^bNumbers in parentheses indicate gross output as a percentage of that sector's total regional gross output in 1972, measured in 1977 dollars.

The degree of concentration of the indirect impacts is clearly evidenced in the projections that between 37.7 and 38.4% of the Region 4 increase in gross output caused by nationwide energy development will occur in the ten sectors in each of the three time periods. Six of these sectors (broadwoven fabric, wholesale trade, real estate, miscellaneous business services, retail trade, and miscellaneous professional services) are not related directly to the energy industry, whereas the remaining four categories (industrial chemicals, basic steel, structural steel, and fabricated plate) are related because they produce components for energy facilities. Note that not a single sector is clearly identifiable as an energy industry. Four sectors - basic steel, fabricated structural steel, fabricated plate, and miscellaneous professional services - will experience particularly significant growth rates.

Of particular note is the fabricated plate category, which will experience an increase in demand of 42.3 to 50.5% of 1972 output. The new output expansion would be distributed fairly uniformly over all the states of Region 4, but such an increase could well be beyond the industry's ability and could jeopardize fulfillment of the scenario. Some potential difficulties of this type, although of a lesser magnitude, could also arise from increased demand for fabricated structural steel, amounting to 15.3 to 17.6% of 1972 gross output.

Finally, the coal mining industry in Region 4 is well down the list of affected categories in absolute dollar terms and will experience only a modest growth of 2.3 to 2.8% over the actual 1972 gross output during the period of 1976 to 1990.

Institutional Issues

Some institutional concerns affect most or all of the states in the federal region. Many were identified at a recent meeting of the Regional Energy Advisory Board of the Southern Governor's Conference. Therefore, rather than repeating them in each state summary, they are listed here, and the more state-specific issues are listed in the state summaries. A few of the general issues appear also in the state summaries when state officials considered the problem especially acute.

- o Federal-state-local infrastructure - The relationships among the federal, state, and local governing bodies and the federal regulatory agencies and the efficiency with which they work together are vital to resolving energy problems within the region. Regulatory agencies and state energy offices' roles are being redefined with new legislation. Federal legislation now demands more citizen participation and local input on industrial siting decisions as well as local initiative in many applications for federal funds. Many states do not have effective mechanisms for informing and helping local officials on such decisions. For example, the use of PSD increments can affect economic development in an area for many years, but local communities do not have sufficient air quality information to make informed choices (SINB, 1976 and SSEB, October 1978).

- o Federal control - Many regulatory areas that were previously state concerns are now controlled by the federal government. This has created problems within the states as to when the limit of federal power will be reached (Boercker and Davis, 1978a).

- o Conflict in priorities and regulations between the national commitment to produce energy and the desire to preserve environmental quality - For example, a conflict exists between the coal conversion sections of the NEA and the Clean Air Act Amendments of 1977 (SINB, 1976; SSEB, October 1976; Boercker and Davis, 1978a). There is also the possibility that surface mining regulations may bring about decreases in coal production (Boercker and Davis, 1978a and SSEB, October 1978).
- o Attitude of officials and citizens and existence of pressure groups within the states toward growth vs. no growth, both economic and population - This attitude influences the acceptability and expansion of energy production facilities in the state (ORNL Staff discussion).
- o Inadequate funding for state energy conservation programs (SSEB, October 1978).
- o Nuclear licensing reform - Concern exists about the time delays in nuclear plant licensing. The Southern Governors' Conference and the National Governors' Association have said that the "states, cooperating in a regional framework, are better qualified than the Federal government to perform environmental review, forecast need for power and site energy facilities." (Boercker and Davis, 1978a and SSEB, October 1978).
- o Need for information by industries on the choice of new technologies and technical and economic problems encountered in converting from gas or oil to coal (Boercker and Davis, 1978a).
- o Comprehensive federal regulatory overview needed for all energy facility siting - The suggestion was made that an agency other than DOE (e.g., EPA or the Department of Transportation) take the lead in developing comprehensive siting plans. Also included is the problem of nuclear waste management which will require new types of federal-state cooperation (Boercker and Davis, 1978a and SSEB, October 1978).
- o Transportation of coal - The adequacy and safety of railroads, coal haul roads and bridges, and barge facilities is of concern. Although this problem is more acute in the coal-producing states, it is mentioned as a concern for those states with lignite deposits and those turning to coal for electric power generation (Lema, et al., 1977; Boercker and Davis, 1978a; and SSEB, October 1978).
- o Standards for solar equipment inspection and installation (Boercker and Davis, 1978a).
- o The development of the outer continental shelf - The aesthetic, community, and environmental impacts on the coastal states in the region will have to be examined (Boercker and Davis, 1978a and SSEB, October 1978).
- o Radiological hazards from coal - Although not considered a health hazard at this time, recent data have shown that the airborne radiation from some coal-fired plants exceeds the allowable radiation from nuclear plants, which operate under another set of regulations. The solid waste disposal potentially poses greater problems and is of concern to the states and the coal industry (McBride, et al., 1977; Boercker and Davis, 1978a).

Health and Safety

Table 4.10 summarizes estimated health effects of air pollution of the scenario for all states in Region 4 as projected by BNL. Only a range of possible risk or death is indicated, and the numbers should not be interpreted to be absolute. The range of uncertainty is great.

Employees of Kentucky's numerous energy industries will suffer the greatest occupational death and injury risk in the Southeast. This is largely because of high production from the coal extractive industry and coal-fired steam plants. In addition, the general populace of the state will receive the highest pollutant exposure in the region from combustion of fossil fuel, principally coal. Similar health hazards from fossil fuel combustion are expected to occur in Tennessee, Alabama, and Georgia. Of less importance, but still significant, are deaths and injuries projected to occur among Mississippi's workers in the oil and natural gas fields and oil refineries.

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Table 4-10. Estimated mortality resulting from population exposure to fossil fuel combustion products.^a

State	Population x 10 ⁶			Population weighted concentration g/m ³			60% confidence limits Range of estimated total deaths per year		
	1975	1985	1990	1975 ^b	1980 ^c	1990 ^c	1975 ^{b,d}	1985 ^{c,d}	1990 ^{c,d}
Alabama	3.6	3.9	4.1	9.7	7.1	8.0	170 - 2800	140 - 2300	160 - 2600
Florida	8.4	10.0	11.0	2.2	2.2	2.1	92 - 1500	110 - 1800	120 - 900
Georgia	4.9	5.6	6.1	8.9	8.0	8.6	220 - 3500	220 - 3600	260 - 4200
Kentucky	3.4	3.8	4.0	21.0	10.0	12.0	360 - 5700	190 - 3000	230 - 3700
Mississippi	2.4	2.4	2.5	3.1	3.8	4.7	36 - 580	45 - 730	59 - 940
North Carolina	5.5	5.1	6.5	7.3	5.9	6.4	200 - 3200	180 - 2900	210 - 3300
South Carolina	2.8	3.0	3.2	7.1	6.2	6.6	100 - 1600	93 - 1500	100 - 1700
Tennessee	4.2	4.9	5.2	14.0	9.6	10.0	300 - 4800	230 - 3700	270 - 4400

^a Mortality projections developed from Brookhaven National Laboratory damage functions.

^b 1975 SO₄ utility and industrial.

^c 1985 and 1990 SO₄ utility (85% control) and industrial.

^d Confidence limits based on health damage function only.

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STATE ASSESSMENTS

The state assessments provide specific details of the possible impacts of the Mid-Range Projection Series C Scenario in contrast to the regional impacts discussed in the previous section. Figures 4.25 to 4.28 illustrate the relative changes in electrical generating capacity by state for 1975, 1985, and 1990. Each state section begins with a summary of the impacts identified for all issue categories. Any major findings are presented at the beginning of each topic by state. Discussion of the institutional/political issues is presented first followed by discussions of the socioeconomic, water quality and availability and the land, air, and health impacts. Changes resulting from conditions in the scenario are discussed in relation to present conditions within the state. Annotated graphics are used where possible to enhance the readers' understanding. Finally, matrices summarizing the magnitude of impacts for each state are found in the Appendix.

Opinions from state officials have been used to help identify potential institutional and political issues. A complete sample of officials was not obtained due to the financial and time constraints of the project. The opinions used may not express the general opinion of all officials, nor the position of the state administration.

ALABAMA

Increased combustion of coal in Alabama will have adverse effects on air quality, public health, and possibly vegetation in some parts of the state. The projected switch from surface to deep mining of coal will increase coal mining injuries and deaths. With the exception of these impacts, Alabama should have few other problems in accommodating the changes projected by the Mid-Range Projection Series C Scenario.

Institutional/Political Issues

o Development of additional nuclear power by a private utility will be mainly dependent on satisfactory adjustment of the electric rate structures by the state.

Existing Conditions

Electricity in Alabama is generated mainly from coal-fired plants, with some assistance from hydro and nuclear plants. The state used 1.61×10^{15} Btu's of energy in 1975, and about 9% was in the form of electricity delivered to end users. Coal accounted for 44% of the total energy consumed in Alabama in 1975. Alabama does not have a power plant siting law. However, a utility must obtain from the Public Service Commission a "certificate of conversion and necessity" which may contain restrictive provisions.

Air quality regulations are of concern to Alabama. Officials of the Alabama Air Pollution Control Commission say that the models used by EPA for pollution control from coal-fired plants are not applicable at times in Alabama and state models are not acceptable to EPA. This has created a problem for the state in advising about pollution control measures. These officials also say that the federal regulations regarding ambient air quality

in surface mining areas were proposed without consulting the state and may be too restrictive.

Scenario-Induced Changes

The scenario projects generating capacity in Alabama to more than double by 1990 (from 13,000 MWe in 1975 to 29,200 MWe in 1990) with the increase in nearly equal parts of coal steam, oil peaking, and nuclear (Figs. 4-15 to 4-29). The scenario predicts more coal and oil peaking capacity by 1990 than do the utilities. The scenario and ORNL data on utility projections for nuclear capacity are essentially the same. However, Alabama Power Company has stopped construction on the second unit (860 MWe) of its Farley nuclear power plant, because of a dispute over the allowed rate structure. The Tennessee Valley Authority is continuing to build its nuclear facilities. Some opposition is growing to nuclear siting, but in general the legislature has accepted nuclear plants. The impact of the nuclear accident at the Three Mile Island plant on future siting and construction is unknown and the question of transporting nuclear wastes within the state has not risen.

Alabama is a coal-producing state and expects to increase its production by 1985 and 1990. Transportation of the coal is already a problem, and an estimated 30 to 48 bridges and 282 to 359 miles of roadway are expected to be inadequate for coal transportation by 1980. Cost of bridge replacement (1977 dollars) is estimated to be \$16,500,000 to \$21,450,000; cost of roadway construction and rehabilitation is estimated to be \$112,215,000 to \$174,820,000. Because numerous sites are available, siting new coal-fired facilities will not be difficult, according to some state officials.

Socioeconomic Issues

- o No serious impacts are expected at the projected level of growth.

Background

Under the Series C Scenario, energy development is expected to occur in eleven Alabama counties. These counties vary widely in socioeconomic characteristics, although the majority are rural with low population densities and substandard housing. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-movers. A county is classified as significantly impacted if it is expected to have one year or more of at least 10% growth in population. This increase is caused by an insufficient supply of basic labor within commuting distance of the plant.

Scenario-Induced Changes

None of the eleven Alabama counties receiving energy development are expected to experience significant impacts. That is, none of these counties should experience energy-related growth rates of over 10% from either construction of a coal or nuclear plant or coal mine development. Many of the counties with large developments, however, should experience increases in the cost of providing public services and facilities.

One county in the Birmingham BEA region is projected to receive project-related population growth of approximately 2,900 during the operating

COAL STEAM CAPACITY IN REGION IV

EXISTING 1975 CAPACITY
PROJECTED 1985 AND 1990 CAPACITY

Figure 4-25

Change in Coal Steam Electric Capacity by State

NUCLEAR CAPACITY IN REGION IV

EXISTING 1975 CAPACITY
PROJECTED 1985 AND 1990 CAPACITY

Figure 4-26

Change in Nuclear Electric Capacity by State

ORNL DWG 79-14422

OIL STEAM CAPACITY IN REGION IV EXISTING 1975 CAPACITY PROJECTED 1985 AND 1990 CAPACITY

Figure 4-27

Change in Oil Steam Electric Capacity by State

GAS STEAM CAPACITY IN REGION IV

EXISTING 1975 CAPACITY
PROJECTED 1985 AND 1990 CAPACITY

Figure 4-28

Change in Gas Steam Electric Capacity by State

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN ALABAMA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	8,658	11,810	11,810	13,810	11,754
Oil Peaking	88	2,989	50	4,682	0
Gas Steam	38	0	38	0	38
Gas Peaking	444	444	444	444	444
Nuclear	2,128	6,096	7,309	7,309	7,309
Hydro	2,472	2,956	2,956	2,956	2,956
TOTAL	13,828	24,295	22,607	29,201	22,501

*ORNL's Data from utility data file.

Figure 4-28

Comparison of Mid-Range Projection Series C Scenario and
Utility Construction Plans in Alabama

period. Increases in the annual cost of public facilities and services of approximately \$1.3 million is expected.

Water Quality and Availability Issues

Major Findings

o Although the national water quality model anticipates no major changes, the scenario indicates that surface mining in the state will end between 1985 and 1990. This should reduce water quality impacts in the northern Alabama coal counties where steep slopes and abundant, intense rainfall combines to make control of erosion and sedimentation a major problem in active and inactive surface mines.

o No water quantity problems are evident at the Aggregated Subarea (ASA) level. However, localized problems resulting from periodic drought are likely in headwater areas, particularly around Birmingham, where low-flow levels may limit water availability for consumptive uses.

Existing Conditions

Major drainage regions for the U.S. have been delineated by the Water Resources Council. These basins, called Aggregated Subareas (ASAs), are shown for Region 4 in Fig. 4.17. Alabama contains parts of four ASAs. The Lower Tennessee River (ASA 602) crosses northern Alabama, and the Apalachicola (ASA 306) runs along the southern half of its eastern border. The Alabama River and several smaller coastal rivers (combined within ASA 307), including the Choctawhatchee and Conecuh Rivers, drain central Alabama. The Tombigbee and its major tributary the Black Warrior (ASA 308) drain western Alabama.

No existing water availability problems are indicated in Alabama in 1975. Surface waters of Alabama are generally soft (less than 60 milligrams per liter (mg/liter) calcium carbonate) except for moderately hard water (61-120 mg/liter) in the Tennessee River drainage in northern Alabama. Dissolved solids levels are low (less than 120 mg/liter) except in the Black Warrior basin, where they are 120-350 mg/liter (Geraghty et al., 1973). Suspended solids levels are low (less than 50 mg/liter) in all areas except the Tombigbee-Black Warrior and Alabama river basins, where they are slightly higher (51-100 mg/liter) (Briggs and Flick, 1977).

The Black Warrior River (within ASA 308) drains most of Alabama's coal mining areas, and its waters have been affected by the mining. Water quality problems include acidification by acid mine drainage, usually a local problem in tributary streams; high dissolved solids levels, which often accompany acid mine drainage; and high suspended solids levels resulting from erosion during storms (U.S. Army Corps of Engineers, 1974). Both acid mine drainage and sedimentation occur in inactive as well as active mines. Alabama has also reported high suspended solids levels from erosion accompanying silviculture and pesticides from agricultural runoff (U.S. Environmental Protection Agency, 1977).

Scenario-Induced Changes

Mobile-Tombigbee-Black Warrior River Basins (ASA 308). No major changes in water quality, and only minimum increases in water-for-energy, are expected in ASA 308. The scenario shows a shift from surface to deep mining in Alabama, accompanied by a reduction of suspended solids levels in the Tombigbee-Black Warrior drainage. The national water quality model indicates that total dissolved solids concentrations from all energy activities may increase 126%, with most of the increase attributed to electrical utilities. The resulting stream concentrations will not violate the public water supply criterion (250 mg/liter).

Lower Tennessee River Basin (ASA 602). No significant impacts are expected in the Lower Tennessee Basin. (See discussion under Tennessee.)

Alabama River Basin (ASA 307). The scenario shows few changes in levels of energy activities in the Alabama River drainage, and the accompanying water quality changes are small. Total dissolved solids from electrical utilities will increase slightly, but will remain well below concentrations that would violate the public water supplies criterion (250 mg/liter).

Appalachicola River Basin (ASA 306). No significant impacts are expected along the mainstream of the Appalachicola River in Alabama. However, problems may exist along upstream tributaries. (See discussion under Georgia.)

Air Quality and Visibility Issues

Major Findings

- o Air quality will be improved in some instances under to the scenario.

Existing Conditions

Most of Alabama's current air quality problems occur in the northern part of the state. Parts of the Huntsville metropolitan area violate primary NAAQS for both SO₂ and TSP. In addition, the Birmingham area and northeastern Alabama each have one county in violation of the primary standard for SO₂. In the southern part of the state, only the Mobile area violates the primary SO₂ standard.

Scenario-Induced Changes

One county in the Birmingham AQCR is expected to violate the PSD increment for SO₂ in 1985 and 1990. Slight reductions are forecast for utility contributions of SO₂ and SO₄ in 1985 and 1990. There is a two-fold reduction in industrial SO₂ from 1975 to 1985, with a slight increase from 1985 to 1990.

The Sipsey Wilderness area (Fig. 4.10) will be moderately impacted by plume blight from one of the coal units in the seven adjacent counties. The impact is measured as the percent change from 1975.

Land and Ecological Issues

Major Findings

- o Land cover and agriculture may be moderately impacted under the scenario, although other analysis indicates that acid rain may be significant by 1990.

Existing Conditions

Alabama is primarily divided into three ecological regions: the outer coastal plain in the southern part of the state, the southeastern mixed forest in the central region, and the eastern deciduous forest, including the mixed mesophytic and oak-hickory forest in the north (Bailey, 1978). All three regions contain a number of dominant tree species that are highly susceptible to injury from SO₂, ozone, and other coal-fired derived pollutants. There exists in the state approximately 1,290,000 acres of land classified as National Parks, forests, refuges, or other natural areas. At present, there are approximately 72,000 acres in need of reclamation from prior surface mining activities. For additional information concerning the present and predicted future impacts of coal mining in the state of Alabama, see Haynes et al. (1979).

Scenario-Induced Changes

Under the scenario, in 1975 environmental impacts in Alabama from SO₂ are predicted in only one county (Jackson), which has substantive amounts of soybeans, Irish potatoes, and wheat, and contains significant acreage in mixed mesophytic forest. The impact is expected to decline in 1985 and 1990 as SO₂ levels are to be reduced by more than 50%. However, ORNL's analysis in the National Coal Utilization Assessment (Davis, 1978) indicates sizable areas of this state may be impacted due to increased levels of SO₂, most notably areas of commercial forests and agricultural crops (soybeans). The level of impact has not yet been determined.

Surface mining will have an impact on Alabama with approximately 25,000 acres being affected in 1985 and 27,000 acres in 1990. Two endangered species of fish, the Cahaba shiner and goldline darter, are known to inhabit counties where strip mining will occur. These species may be seriously affected by changes in water quality resulting from surface mining activities. Surface mining of lignite in southern Alabama is predicted to increase dramatically beginning in 1980 (Haynes et al., 1979) and is expected to account for most of the increase in surface mining.

Health and Safety Issues

Major Findings

- o Accidental deaths and injuries as well as occupational disease incidence in the coal mining industry will be the major occupational health and safety problems. As the surface mining industry decreases, and the more hazardous underground mining industry increases, these health problems will become more serious.

ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG ALABAMA COAL MINERS
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

NEGLIGIBLE MORTALITY
 0.0 TO 99.9
 100.0 TO 499.9
 500.0 TO 999.9
 1000.0 AND GREATER

1975

1985

1990

Figure 4-30

Estimated Mortality due to Occupational Accidents Among
Alabama Coal Miners

- o Expansion of coal electric generation will produce a moderate increase in public health hazard resulting from exposure to fossil fuel combustion products.

Existing Conditions

The coal extraction and electric power generation industries present the largest occupational health and safety problem in the state. Of greatest magnitude is underground coal mining, with 1.5 to 5.5 estimated annual deaths and 170 to 620 annual injuries (60% confidence limits). Figure 4.30 shows the estimated distribution of risk from all coal mining in Alabama. Public health effects from exposure to fossil fuel combustion products are considered to be a moderate risk.

Scenario-Induced Changes

Deep mining occupational hazard is greater than surface mining hazard by a factor of 2 in 1975 (1.5 to 5.5 annual deaths vs 0.9 to 3.0 deaths), rising approximately 5 times by 1985 as strip mine production declines. Figure 4.30 shows the resulting risk for each county. Underground coal mining is the sole source of coal production in 1990. Alabama is second to Kentucky in the region for all coal extraction hazards. Exposure to pollution from fossil fuel combustion is estimated to result in 140 to 2800 annual deaths to the public. This is considered a moderate health risk (Starr, 1976).

FLORIDA

The availability of water may limit the energy developments projected by the scenario in southern Florida and, possibly, along the Gulf coast of the peninsula. Increased use of coal in Florida may strain the state's transportation system, increase the risk of groundwater contamination, and in central Florida, reduce fruit and vegetable yields.

Institutional/Political Issues

Major Findings

- o Nuclear generating capacity predicted by the scenario may not be achieved because of utility uncertainty about the costs and construction time.
- o There may be equipment and environmental problems associated with the transportation of coal required by the scenario.

Existing Conditions

Most of Florida's electricity is generated by oil-fired plants, with assistance from coal, nuclear, and oil peaking facilities. In 1975 the state used 1.8×10^{15} Btu's of energy, and about 13% of this energy was in the form of electricity delivered to end-users. The state is heavily dependent on oil, and in 1975 only 9% of the total energy used was from coal.

Florida air quality regulations are more restrictive than federal regulations, and utilities and the private sector have complained because they cannot purchase adequate amounts of the low-sulfur oil required under cur-

rent air quality regulations. Because of oil shortages, some state officials think Florida air regulations may have to be relaxed to allow further growth.

Florida enacted a power plant siting law in 1973 which grants the Department of Environmental Regulation the authority over issuance of power plant siting certificates, with the governor and his cabinet acting as final authority.

Although some communities in Florida have decided to limit growth, there is not a strong movement statewide to limit growth, and thus energy demand will continue to rise. However, because of realization of the fragile nature of the environment, more care is being taken by the utilities in siting. A continuing concern is the availability of water and the priorities established for its use.

Florida is moving toward use of solar energy in homes and businesses. As a step toward consumer protection in the use of solar energy, the state has established a center for testing and labeling solar system components. A new law will set mandatory solar standards starting in January 1980.

Scenario-Induced Changes

The scenario estimates a doubling of electric generating capacity between 1975 (17,800 MWe) and 1990 (37,500 MWe) with the major increase being from coal-fired plants (2,800 MWe in 1975 to 9,300 MWe in 1990). The scenario predicts more total electric generation by 1990 than do the utilities, and exceeds the utility projections in coal, nuclear (Figs. 4.25 to 4.28), oil peaking, and combined cycle (Fig. 4.31).

Problems identified as a result of the scenario already have been anticipated by the state. The state's transportation, environmental, and coastal zone management agencies are involved in energy facility siting decisions and no major restrictive legislation is anticipated. There has been no strong support for banning nuclear plants. However, utility projections do not match those of the scenario, and additional nuclear capacity has not been planned because the utilities will not gamble on the delay and cost uncertainties. The impact of the nuclear accident at the Three Mile Island plant on the additional scheduled nuclear capacity is unknown.

State energy officials note that energy problems also include the environmental impacts such as increased coal dust and coal combustion, the problem of acid runoff from coal storage piles, and acid rain eating into Florida's limestone base. These issues were not integrated into the scenario.

Transportation of coal and oil may be a problem. The rail beds, particularly those in adjoining states, may not be adequate for increased shipment of coal. A bill may be introduced into the state legislature providing for right of eminent domain for coal slurry pipelines, to ease the burden on rail and ports. Oil spills in ports and the Florida straits could cause major damage to the commercial fishing and tourist industries. In the opinion of state officials, the ports have fairly good contingency plans in case such spills do occur.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN FLORIDA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	2,780	4,934	7,738	9,341	8,183
Oil Steam	9,843	13,544	13,699	12,514	13,799
Oil Peaking	3,648	5,896	4,253	6,939	4,253
Gas Steam	195	0	150	1,030	128
Nuclear	1,332	3,761	3,761	4,901	3,761
Hydro	30	30	30	30	30
Comb. Cycle	0	2,734	484	2,734	484
TOTAL	17,836	30,899	30,135	37,489	30,638

*ORNL's Data from utility data file.

Figure 4-31. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Florida.

Socioeconomic Issues

Major Findings

- o Significant socioeconomic impacts from the construction of energy facilities are projected for one Florida county. This impact would be the result of an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. This county would experience a strain on public and private services and facilities because of the influx of large numbers of construction workers.

Background

Energy development is expected to occur in 17 Florida counties under the scenario. Approximately one-half of these counties are very rural with low population densities while many of the others are highly urbanized. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Of the 17 counties expected to receive energy development, only one county, in the Tallahassee BEA region, is expected to experience significant impacts (Fig. 4.32). This county should experience at least one year of population growth greater than 10% from the construction of a coal plant and experience a projected peak work force requirement of approximately 1,800 and a total of approximately 1,800 in-migrants, including dependents. The other 16 counties are not expected to experience significant impacts.

The highly impacted county should experience, at construction peak, an increase in the cost of providing public services and facilities of approximately \$950,000. Many of the other counties also should have large increases in these costs.

One county, in the Orlando BEA region, is projected to experience project-related population growth of approximately 256% during the operating period. Increases in the annual cost of public facilities and services of approximately \$140,000 are also expected.

Water Quality and Availability Issues

Major Findings

- o Effluents from the utility and industrial sectors may aggravate existing water quality problems (total dissolved solids, phosphorus) in central and southern Florida (ASAs 304 and 305). The projected tripling of utility coal use between 1975 and 1990 will increase the risk of groundwater contamination from coal handling and ash disposal, a serious consideration because the state is largely underlain by shallow limestone and unconsolidated sand and gravel aquifers.

- o Southern Florida (ASA 305) has shortages during low-flow periods due to extensive irrigation, and any increase in water consumption is likely to conflict with current needs. The flat terrain and permeable soil preclude

PROJECTED POPULATION GROWTH RATES FOR IMPACTED FLORIDA COUNTIES (Dashed Line = BEA Boundary)

Figure 4-32. Projected population growth rates for impacted Florida counties.

reservoir construction in most of the area, and excessive pumping of groundwater tends to reduce surface flow or cause intrusion of salt water into aquifers. Cooling with saline water is preferred, but coastal areas are highly valued for recreational, residential, and ecological purposes and use of this technology is expensive.

- o Possible low-flow problems are also indicated in the St. Johns-Suwannee area (ASA 304), although no major energy developments are projected. Conflicts in obtaining water for energy facility siting presently exist in the St. Johns Basin, and similar problems may hinder development elsewhere in the state.

Existing Conditions

Florida contains all or part of five ASAs, though each of these areas is drained by a number of separate streams rather than one major river. The western panhandle (ASA 307) receives drainage from southern Alabama, and contains the mouths of the Choctawhatchee and Conecuh Rivers and other smaller streams. The eastern part of the panhandle (ASA 306) receives the Appalachicola River from western Georgia and smaller coastal drainages. Northern Florida (ASA 304) is drained by the St. Johns River to the east and the Suwannee River to the west, although numerous other streams drain both sides of the central peninsula. The St. Mary's drainage is included with the Savannah River (ASA 303). The southern Florida area (ASA 305) has no single major drainage.

Peninsular Florida's water quality is different from that of the other south Atlantic states. It ranges from moderately hard in the north to very hard (181 to 250 mg/liter calcium carbonate) in the south. Although dissolved solids levels in the Florida panhandle are generally less than 120 mg/liter, in southern Florida they range from 250 to 500 mg/liter, and in the St. Johns River they can reach 500 to 1000 mg/liter. Suspended sediment levels are low throughout the state, generally less than 50 mg/liter (Briggs and Ficke, 1977).

Background levels of total dissolved solids in peninsular Florida often equal or exceed the 250 mg/liter limit suggested for public water supplies. Nitrogen and phosphorus levels are also high throughout the state. Sources of pollution include municipal and industrial wastes as well as drainage from agricultural areas and urban runoff (U.S. Environmental Protection Agency, 1977).

Florida's coastal waters have been polluted by dredge-and-fill operations in wetlands. Some electrical generation in Florida uses salt water for cooling, adding thermal pollution to the other impacts caused by the high population densities along the coast.

Scenario-Induced Changes

Appalachicola (ASA 306) and Alabama (ASA 307) River Basins. The Panhandle area (ASAs 306 and 307) contains the mouths of several large-to-medium-sized rivers. The activities forecast by the scenario are not expected to cause any significant water quality or availability impacts.

St. Johns River-Suwannee River-Tampa Bay (ASA 304). The emissions to water in ASA 304 come almost entirely from electrical generation facilities. Very little increase in generating capacity or change in water quality is predicted for the Suwannee River Basin. Utility plants sited in the area drained by the St. Johns River and in the Tampa Bay area, where most of the new facilities are expected in Florida between 1975 and 1990, will face both physical and institutional water availability conflicts. The already high total dissolved solids concentrations from energy facilities may increase from 169 mg/liter in 1975 to 422 mg/liter in 1990. Phosphorus concentrations from energy facilities may rise as much as 18%, from 0.16 mg/liter to 0.18 mg/liter. Existing background violations of both constituents would be increased.

Southern Florida (ASA 305). Projected increases in industrial fuel use alone may cause significant increases in total dissolved solids and phosphorus levels, which already violate water quality criteria for the surface waters of southern Florida (ASA 305). Utility use of fresh water for cooling would cause additional water quality problems, but the water supply is so limited, and competition by irrigation and urban uses so severe, that additional ocean cooling may be the only option available. Ocean cooling, however, also poses problems because coastal areas are highly valued for other purposes, and siting new generating facilities on the coastline of peninsular Florida will require great care.

Air Quality and Visibility Issues

Existing Conditions

Air quality is good over most of Florida. The SO₂ levels in the Tampa, Jacksonville, and Orlando areas are high, but the EPA has cited only one county, in the Tampa area, for nonattainment of the primary SO₂ standard. Parts of these three urban areas also violate the secondary standard for TSP.

Scenario-Induced Changes

One county in the Miami area is expected to exceed the PSD Class I increment in 1985, and two counties in the Jacksonville and Palm Beach areas are expected to exceed the PSD Class II increment. The NAAQS will be exceeded in only one county, in the Tampa area, in 1985 and 1990.

The Chassahowitzka Wilderness (Fig 4.10). will experience a low plume blight impact from oil steam units in 1985 and 1990 located within the county. One of five adjacent counties will produce a high plume blight impact from oil steam in 1985 and 1990. A similar situation exists in the Everglades National Park. Oil steam and oil peaking units in adjacent counties (two of the three adjacent counties) and a park county will produce a low to high plume blight impact in 1985 and 1990. There are no significant regional haze impacts projected to affect Class I areas in Florida in 1985 or 1990.

Land and Ecological Issues

Existing Conditions

Most of Florida lies within the outer coastal plain forest ecoregion dominated by the beech, sweetgum, magnolia, pine, and oak forest; the everglades province occupies the southern tip of the state (Bailey, 1978). A number of forest tree species in the coastal plain forest are sensitive to SO₂ and sulfates. The agricultural lands of the state are well documented as being a large source of citrus fruits and vegetables. There currently exists no energy resource extraction in Florida, aside from uranium by-product extraction involved in the phosphate mining located in the western central region of the state.

Scenario-Induced Changes

Florida has three counties expected to be impacted from SO₂ pollution (Duval, Hillsborough, and Polk). The crops which are expected to be impacted are berries, vegetables, melons, and (possibly) orchards. Southern mixed forest can also be expected to be impacted with no significant changes in SO₂ levels occurring between 1975-1990. Within these counties a number of endangered or threatened species are known to be present. These include the manatee (whose critical habitat occurs within the region), American alligator, and red-cockaded woodpecker. The short-tailed snake, a species currently being reviewed as potentially endangered, also inhabits the region. It is not known how SO₂ may affect these species. However, one can speculate that SO₂ pollution may possibly affect the red-cockaded woodpecker as it requires old, mature pine trees for its nesting sites.

Health and Safety Issues

Major Findings

- o Occupational injuries and accidental deaths among oil production workers are expected to increase dramatically with the projected expansion in oil production.

Existing Conditions

Annual deaths and injuries from oil production in Florida (0.6 deaths, 55 injuries) and Mississippi (10.7 deaths, and 62 injuries) were the highest in the region in 1975. Estimated occupational hazards from oil electric generation in the region were highest for Florida workers (0.12 annual deaths and 11.2 annual injuries). With no coal use in 1975, health effects from coal electric generation are among the lowest in the region.

Scenario-Induced Changes

Estimated annual deaths and injuries from oil production in Florida are among the highest in the region in 1975, but gradually fall to third position by 1990 as Mississippi and Alabama oil fields fulfill their projected expansion.

Florida and Mississippi's natural gas production is projected to remain high through 1990. Projected death and injury rates parallel production (0.1 deaths and 9 to 12 injuries for Florida, and 0.1 to 0.2 deaths and 8 to 20 injuries for Mississippi).

Estimated occupational hazard from oil-fired electric generation parallels increases in capacity for Florida. Health effects in Florida and Mississippi resulting from fossil fuel combustion should remain the lowest in the region through 1990 (92 to 1900 and 26 to 940 annual deaths, respectively).

GEORGIA

New utility construction in southern Georgia will have significant socioeconomic impact upon five rural counties in that part of the state. Water availability in headwater streams near Atlanta may limit urban and energy growth by 1990. Otherwise, the scenario will have little significant impact on Georgia's water resources.

Institutional/Political Issues

Major Findings

- o Institutional/political issues are not expected to restrain energy development in Georgia.

Existing Conditions

Georgia currently generates most of its power from coal, with some hydro, nuclear, oil peaking, and oil and gas steam (Fig. 4.28). In 1975 the state used 1.3×10^{15} Btu's of energy, and about 11% was in the form of electricity delivered to end users. Georgia does not have a power plant siting law, although a study/committee of the state legislature has examined the possibility of such action to simplify the laws and regulations which currently pertain to siting.

The state has little fossil fuel reserves and consequently has encouraged development of solar demonstration projects including biomass. However, if more use is made of solar power, state officials anticipate problems arising as to impacts on utility rate structure and on the construction industry.

State officials believe that the federal and state authorities have a reasonable working relationship. There are few state and local government problems in energy matters. Local governments have a great deal of authority in land use under the Georgia "Right of Local Home Rule" legislation.

Scenario-Induced Changes

The scenario projects an increase in electric generation from 11,700 MWe in 1975 to 29,000 MWe in 1990. The major increase will be in coal, nuclear, and oil peaking facilities (Figs. 4.25 to 4.28). The total generation projected by the scenario is considerably greater than that of the utilities. The differences are mainly in projections for coal, nuclear, and oil peaking capacity (Fig. 4.33).

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN GEORGIA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975	1985		1990	
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	7,520	12,612	11,891	14,612	12,716
Oil Steam	446	827	546	827	546
Oil Peaking	1,095	3,752	1,095	4,784	1,095
Gas Steam	333	0	333	0	233
Nuclear	786	2,389	2,753	4,689	3,903
Hydro	1,479	1,991	1,741	1,991	1,741
Comb. Cycle	0	450	0	450	0
Pumped Stor.	0	887	1,137	1,668	1,137
TOTAL	11,681	22,908	19,518	29,021	21,373

*ORNL's Data from utility data file.

Figure 4-33. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Georgia.

The opinion of some state officials is that siting of new coal-fired power plants may be influenced by air quality constraints. Large installations also require a surplus water permit issued by the state. A new law regarding state permits for radiological wastes also exists. The impact of the accident at Three-Mile Island on future nuclear plant construction is unknown.

Because coal generating capacity is predicted to almost double between 1975 and 1990, state officials anticipate some problems with trucking and railroads for delivering coal. New state legislation requires permits and advance notice for shipments of nuclear materials. The intent is not to restrict nuclear shipments but to reassure the populace.

Socioeconomic Issues

Major Findings

o Significant socioeconomic impacts from the construction of energy facilities are expected for five counties in Georgia (Fig. 4.29). These impacts should result from an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Under the scenario, energy development is expected in six Georgia counties. These counties are predominantly rural and therefore have a low assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Significant impacts from nuclear plant construction are expected in one county in the Augusta BEA region and one county in the Savannah BEA region (Fig. 4.34). Coal plant construction should cause significant impacts in one county in the Macon BEA region and two counties in the Savannah BEA region.

In these counties, the projected non coincident peak work force requirements range from approximately 1600 to 3600 people. Immigration, including dependents, will range from 1800 to 6000 people during the peak construction year.

One county in the Atlanta BEA region is not expected to experience significant impacts from the construction of a coal plant. This county's projected population increase during construction is less than 10%.

Two counties planning nuclear plants should experience, at construction peak, large increases in the cost of public services and facilities of approximately \$1.9 and \$3.1 million. The other significantly impacted counties should experience increases from approximately \$1.0 to \$1.7 million.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED GEORGIA COUNTIES (Dashed Line = BEA Boundary)

Figure 4-34. Projected population growth rates for impacted Georgia counties.

No county is expected to encounter impacts during the operation phase of these plants.

Water Quality and Availability Issues

Major Findings

- o No major water availability constraints or quality changes are apparent at the ASA level. However, Atlanta is situated at the headwaters of several small rivers which are currently experiencing local water quality and low-flow availability problems. Even in combination, these upstream tributaries will not be able to support all of the city's needs near the load center.

Existing Conditions

Most of the state is drained by four major river systems originating in the mountains of northern central Georgia (Fig. 4.17). From east to west, they include the Savannah, along the eastern border, and the Altamaha (both are combined with the St. Mary's in ASA 303); the Flint and the Chattahoochee, which join to form the Appalachicola (ASA 306); and the Coosa in the headwaters of the Alabama-Choctowhatchee system (ASA 307). The Suwannee River (combined with the St. John's in ASA 304), which originates in the Okefenokee Swamp, drains southern central Georgia. A small portion of northern Georgia drains into the Upper Tennessee River (ASA 601).

State waters presently are low in dissolved solids (less than 120 mg/liter calcium carbonate) and generally soft (less than 60 mg/liter). Suspended sediment levels are usually less than 50 mg/liter, except in the Altamaha basin, where they range from 50 to 100 milligrams per liter (Briggs and Ficke, 1977 and Geraghty et al., 1973).

Georgia has noted significant water quality improvements in several major river basins following construction of municipal and industrial treatment plants, particularly in the Savannah, the Ocmulgee, the Conasauga, and the Chattahoochee. The state of Georgia estimates that natural conditions, including low dissolved oxygen, low pH, and high temperatures, will prevent 5% of its streams from meeting EPA water quality criteria for fishing and swimming (U.S. Environmental Protection Agency, 1977). These streams, primarily in swampy areas of southern Georgia, presently contain fish and are swimmable.

In 1975 the major water quality problems were in the South, the Flint, and the Chattahoochee Rivers downstream from Atlanta, and the urban areas surrounding it. Violations were usually low dissolved oxygen and high fecal coliform levels (U.S. Environmental Protection Agency, 1977).

Correspondingly, the limited quantities of water available from these headwater streams in the Atlanta metropolitan area pose water supply problems in meeting both consumptive use and instream quality needs. Utilities are considering transferring water from larger river systems in more sparsely populated areas of the state to meet the water demands at facility sites nearer the load center.

Scenario-Induced Changes

Chattahoochee (ASA 306) and Savannah-Altamaha River Basins (ASA 303). Although almost all of the projected increases in utility capacity and industrial fuel use occur in the Chattahoochee (ASA 306) and Savannah-Altamaha (ASA 303) river basins, no water availability problems or quality violations attributable to energy are shown at the ASA level. Both areas will experience increased water consumption and concentrations of total dissolved solids, sulfates, and potassium, caused almost entirely by electrical utilities.

The siting analysis shows most of the increased generation to be downstream in the Altamaha basin, and upstream, near Atlanta, in the Chattahoochee. Because the upstream flows will be less than those used by the national water quality model, local increases in TDS and sulfates in the Chattahoochee may be greater than the 14 mg/liter and 2 mg/liter, respectively, predicted by the water quality analysis. Further reduction of flows to account for consumption by energy, urban, and other sources will also increase these concentrations. Auxiliary measures to maintain water supplies during critical flow conditions may be necessary to serve the projected demands near the Atlanta load center.

Air Quality and Visibility Issues

Existing Conditions

Several counties in Georgia have high SO₂ levels (20-40 micrograms (mg) per cubic meter (m³)) but none have been cited by the EPA for nonattainment. Parts of the Chattanooga, Atlanta, and Savannah metropolitan areas do not meet the primary standard for TSP, and photochemical concentrations are high for the Atlanta region.

Scenario-Induced Changes

An additional county in the Atlanta area and one on the Georgia coast are expected to exceed PSD Class II increments for 1985. Still another county in the Atlanta area is expected to exceed these increments for both 1985 and 1990.

The Wolf Island Wilderness (Fig. 4.10) will experience a high impact from plume blight in 1990 from coal units in one of four adjacent counties. In both 1985 and 1990 the Cohutta Wilderness will experience a moderate impact from regional haze.

Land and Ecological Issues

No significant impacts on land or ecosystems are expected from the energy technologies in the scenario.

Health and Safety Issues

Major Findings

- o Health hazards from exposure to fossil fuel combustion products are expected to present a moderate risk to the public.

Existing Conditions

Georgia's principal energy industry is coal electric generation. Thus, the greatest energy-related occupational and public health hazards in this state are suffered by workers in steam plants (0.7 deaths and 24.1 injuries annually) and by the populations exposed to combustion products (220 to 3500 deaths annually, 60% confidence limits). Negligible oil electric generation and no nuclear electric generation existed in Georgia for 1975.

Scenario-Induced Changes

Occupational deaths and injuries from coal electric generation peak in 1985 and decline to values slightly in excess of 1975 figures by 1990. Occupational injuries from oil electric generation double between 1975 and 1985 (from 0.54 to 1.0 injuries annually), where they remain until 1990. Public health hazard from exposure to combustion products parallels this trend. Occupational and public health hazard from nuclear electric generation gradually increase from the zero value of 1975 to 0.55 accidental deaths, 0.91 to 3.6 accidental injuries, and 0.27 cancer deaths annually to the public by 1990.

KENTUCKY

The projected increases in coal mining and combustion in Region 4 will have the greatest impact on Kentucky, the nation's leading coal producer. Where other states in the region may suffer severe impacts in one or two categories, Kentucky will bear severe impacts in most categories. Current problems in the transportation of coal by truck will worsen. Five rural counties will experience significant socioeconomic impacts from the construction of new coal-fired power plants. Surface mining of coal will cause at least local water quality problems, and energy development may cause water supply problems in the Upper Ohio Basin. Air quality problems in much of the state will remain severe relative to the rest of the nation, and these problems will have severe effects on crops in the western and northern parts of the state. Mining accidents and diseases will claim more lives in Kentucky than in any other state in the region.

Institutional/Political Issues

Major Findings

o Current problems in the transportation of coal by truck will be aggravated because of increased coal production and inadequate roads and bridges.

Existing Conditions

Kentucky is the nation's leading coal producer and most of its electricity is generated by coal-fired plants. In 1975 the state used 1.2×10^{15} Btu's of energy and about 13% of this energy was in the form of electricity delivered to end users. Coal accounts for over 50% of the energy used.

Kentucky enacted a power plant siting law in 1974 that permits the Department of Natural Resources and Environmental Protection, or any local pollution control district exercising concurrent jurisdiction with the

department, to issue siting certificates. The final authority over approval rests with the Public Service Commission.

Coal production in Kentucky has increased in spite of the federal strip mining laws which at times are more stringent than Kentucky regulations, or in conflict with them. Some state officials think that the new federal laws will require new mining technologies and the consolidation of small mining operations into larger ones, especially in the mountains in eastern Kentucky. Some jurisdictional questions are still to be resolved in federal/state water quality control efforts for the mining operations.

The transportation of coal by truck is seen as a major problem. In 1974, 80% of all eastern Kentucky coal was moved by a combination of truck and rail. Over 2,400 miles of coal haul roads and between 262 and 343 vehicle bridges are projected to be inadequate by 1980. The estimated cost of bridge replacement on the coal haul roads (1977 dollars) is \$144,650,000 to \$188,100,000; estimated cost of roadway reconstruction and rehabilitation is \$950,415,000 to \$1,220,695,000. A portion of the state coal severance tax goes toward road maintenance, but the state would like additional federal assistance as citizens feel the entire region benefits from the coal production and should share in the public costs. The state also anticipates some transportation problems on the Green River with additional barging being planned.

Labor management disputes are of concern to both public and private agencies because the disputes can significantly cut coal production and impact the economy of the state. The internal dissension in the United Mine Workers Union is a contributing factor in the problems.

Because of air quality problems in Louisville, officials foresee some difficulties for industries converting to coal or expanding their operations. Officials want to see improvements in technologies such as fluidized bed combustion which would allow high sulfur coal to be used without adverse environmental effects.

Scenario-Induced Changes

The Series C Scenario projects a continued coal economy for Kentucky with a tripled generating capacity (from 12,200 MWe in 1975 to 35,300 MWe in 1990), most of the increase coming from coal steam plants (Figs. 4.25 to 4.28 and Fig. 4.35). The total generating capacity projected by the scenario in 1990 is almost double that planned by the utilities. Both sources project increases in coal steam generation, and the scenario also predicts some increase in oil peaking capacity.

State officials do not see major problems in siting generating plants currently planned by utilities except for some air and water quality problems on the Green and Ohio Rivers. They feel there should be more state participation in the Environmental Impact Statement process.

If the scenario is realistic, it will aggravate present and anticipated problems in the state which have been described above, because it is an extension of current activities.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN KENTUCKY

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	10,583	17,576	17,289	29,251	18,639
Oil Steam	655	542	113	605	113
Oil Peaking	113	2,680	243	4,102	243
Gas Peaking	110	110	110	92	110
Hydro	771	771	771	771	771
Comb. Cycle	0	401	0	401	0
TOTAL	12,172	22,080	18,526	35,222	19,876

*ORNL's Data from utility data file.

Figure 4-35. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Kentucky.

Socioeconomic Issues

Major Findings

- o Significant socioeconomic impacts from the construction of energy facilities are projected for five Kentucky counties. This impact should be the result of an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.
- o Kentucky is the nation's leading producer of coal. Coal mining is one of the state's major industries and the primary source of employment for many communities. The energy development projected for the state is entirely coal-related. Therefore the statewide impacts of this development are considered significant. This significance relates to the even greater role of coal mining in the state's economy rather than a low assimilative capacity for in-moving workers.

Background

Energy development is expected to occur in 18 Kentucky counties under the Series C Scenario. The majority of these counties are rural with low population densities and substantial amounts of substandard housing. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Of the 18 counties expected to receive energy development, five are expected to experience significant impacts (Fig. 4.36). These five counties are located in the Paducah, Louisville, and Cincinnati BEA regions. These five counties should experience at least one year of population growth greater than 10% from the construction of coal plants.

The other 13 counties are not expected to experience significant impacts as a result of minimal energy-related population increases. Many of these counties will receive coal mining development.

The five significantly impacted counties should experience, at construction peak, increases in the cost of public services and facilities of approximately \$1.3, \$1.3, \$0.444, \$0.660, and \$0.974 million.

One county, in the Evansville BEA region, is projected to experience project-related population growth of approximately 144 during the operating period. Increases in the annual cost of public facilities and services of approximately \$70,700 are also expected.

Water Quality and Availability Issues

Major Findings

- o Erosion control during and after surface mining will be difficult in the mountainous portions of the state. If the discharge levels specified for mining are attained, the national water quality model indicates some

PROJECTED POPULATION GROWTH RATES FOR IMPACTED KENTUCKY COUNTIES (Dashed Line = BEA Boundary)

No Counties
 One County
 Two Counties
 Three Counties

Figure 4-36. Projected population growth rates for impacted Kentucky counties.

improvement in most of the state. However, unanticipated releases, as well as erosion and mine drainage from existing problem areas, will probably continue to create at least local problems in all mining areas. In the Upper Ohio Basin (ASA 502) combined mining and utility effluents may violate criteria for total dissolved solids in 1985 and 1990 and phosphorus in 1985 only.

o The Ohio River basin contains one of the major concentrations of economic activity in the nation, and it is the area most likely to experience future energy growth because of its large coal reserves and proximity to major load centers. In Kentucky, potential water supply problems are evident at the ASA level in the Upper Ohio (ASA 502). The distortion inherent in ASA level analyses makes it likely that problems during low-flow periods will also occur downstream along the Ohio River. Local water shortages associated with energy production exist along the Green River and may hinder other similar mine-mouth developments in tributary areas.

Existing Conditions

The state of Kentucky contains portions of five ASAs. The Upper Ohio Basin (ASA 502), including the Big Sandy River, drains the northeastern corner of the state. Northwestern Kentucky is drained by the Ohio mainstem and its tributaries, the Licking, Kentucky, and Green Rivers (all included in ASA 505). Parts of southern Kentucky are drained by the Cumberland River (ASA 507) and smaller parts are in the Tennessee River (ASA 602) and Mississippi River (ASA 801) drainages.

Background levels of most water quality constituents vary among the different river basins. Water is hard (121 to 180 mg/liter calcium carbonate) in the Green, Salt, and parts of the Upper Ohio basins, moderately hard (60 to 120 mg/liter) in the rest of the state. The areas with harder water also have higher levels of dissolved sulfates and total dissolved solids, but the highest levels of suspended sediments (up to 200 mg/liter) are found in the Kentucky and Licking River basins, as well as in the upper end of the Ohio main stem drainage (Briggs and Ficke, 1977; Geraghty et al., 1973).

Kentucky's major water quality problems are caused by coal mining, in both the eastern and western coal fields, and by municipal and industrial discharges. The areas most heavily affected by mining are the Big Sandy River and its tributaries in the Upper Ohio Basin (ASA 502), the Kentucky and Licking River basins, which are tributary to the lower Ohio River (combined within ASA 505), and the Cumberland River Basin (ASA 507).

The effects of mining observed in these areas include high levels of dissolved solids, sulfates, and trace chemicals including iron, manganese, and chlorides, and often low pH's (U.S. Environmental Protection Agency, 1977).

Water-for-energy quantity problems are exemplified on the Green River (within ASA 505) in western Kentucky, where electric generation must often be curtailed during the summer low-flow period due to insufficient streamflow. Similarly, during low-flow periods, water quality conditions in the Big Sandy and other tributary basins are exacerbated by reduced streamflow.

Scenario-Induced Changes

Upper Ohio River Basin (ASA 502). Based on its large coal reserves and proximity to major load centers, energy development in the Upper Ohio Basin (ASA 502) is projected to increase substantially. Water consumption by energy, based on average monthly generation, grows from 45 million gallons per day in 1975, to 133 million gallons per day in 1985, and 197 million gallons per day in 1990. During conditions of maximum base load generation, these water-for-energy demands range up to 93 million gallons per day for the 1975 baseline, with 209 million gallons per day for 1985 and 292 million gallons per day for 1990 projected by the Series C Scenario. The combined water demands by all sectors would consume about 30% of the estimated critical surface supply in 1990, with energy accounting for up to one-quarter of total water consumption - classifying the area as a potential water-for-energy quantity problem area. Such a reduction of flow by future consumptive use was not accounted for in the national water quality model, but would certainly result in raising the calculated pollutant concentrations.

The national water quality model indicates that meeting the standards of the federal surface mining laws could reduce the suspended sediment levels in this drainage by 150 mg/liter by 1985 and the iron levels by 8 mg/liter at the same time. However, mining levels are high throughout this period. Erosion control will be difficult in the mountainous terrain, and existing abandoned surface and deep mines will continue to degrade water quality unless reclaimed. Improvements will probably be evident in the large rivers and streams with problem areas remaining and recurring on some tributaries, particularly where there is increased consumptive use that reduces the quantity of streamflow available for pollutant dilution during low-flow periods.

In the Upper Ohio (ASA 502), total dissolved solids from energy facilities are predicted to increase a total of 33% during the period of this analysis, from 451 mg/liter in 1975 to 560 mg/liter in 1985, to 603 mg/liter in 1990. About one-third of the increase is attributed to mining. The rest comes from increased generation of electricity using wet cooling towers.

Lower Ohio River Basin (ASA 505). Several tributaries, including the Kentucky, Licking, Green, and Salt Rivers are contained in ASA 505 as well as the Lower Ohio mainstem. The Kentucky, Licking, and Green rivers all contain coal mining areas where improvements, primarily lower levels of suspended solids, iron, and manganese, should be evident. The Salt River Basin and the Ohio main stem area have the highest population densities in the state, and the siting analysis indicates that most of the new generating capacity will be in these areas. There, the predicted increase in total dissolved solids by utilities would cause background levels of TDS to violate water supply standards in the Ohio mainstem by 1990.

At the aggregate level, no water-for-energy quantity problems were detected for the Lower Ohio (ASA 505); however, consideration of the amount of distortion inherent in ASA level analyses (Shepherd, 1979) indicates that the potential low-flow problems identified for the Upper Ohio Basin should continue along the middle Lower Ohio until the confluence of the Cumberland River.

Existing water availability problems along the Green River (within ASA 505) and other tributaries remain, but are not exacerbated by scenario conditions because no new facilities were sited where previous problems existed.

Cumberland River Basin (ASA 507). No major water quality or availability impacts are expected in the Cumberland River Basin (ASA 507).

Air Quality and Visibility Issues

Existing Conditions

The air quality in Kentucky is among the worst in the Southeast. The EPA has cited seven counties in the Paducah, Louisville, Ashland, and Evansville (Indiana) areas for nonattainment of the primary SO_2 standard. Parts of these metropolitan areas and parts of the Cumberland Plateau in the southeastern part of the state do not meet the primary TSP standards. Surface mining of coal contributes much of the violation on the plateau.

Scenario-Induced Changes

Of the eight counties that currently do not meet TSP standards, four are expected to meet standards in 1985 and 1990. Most of these are on the Cumberland Plateau, and the improvement appears to result from the new federal surface mining law. One additional county, in the Cincinnati (Ohio) area, will not attain the TSP standard in 1985 and 1990. One county in the Paducah area will violate NAAQS in 1985.

The Mammoth Cave National Park (Fig. 4.10) will experience no significant impacts from plume blight through 1990, but it will be highly impacted by changes in regional haze between 1975 and 1985 or 1990. The haze will result from the additional coal-fired power plants that are expected in the region.

Land and Ecological Issues

Major Findings

- o Surface mining is expected to clear 123,000 acres by 1985 and 175,000 acres by 1990. Much of this will occur in areas of steep slopes and high precipitation, which are adverse conditions for controlling erosion and acid drainage.

Existing Conditions

The state of Kentucky lies solely within the eastern deciduous forest ecoregion (Bailey, 1978). It is dominated by oak-hickory forest in the western half of the state, and the mixed mesophytic forest and Appalachian oak forest in the eastern half of the state. Grain farming - corn, soybeans, barley, and wheat - predominates in the western section of the state, and burley tobacco (a crop highly sensitive to SO_2) and alfalfa are the major crops in the central and northcentral regions (Koepper and Snipes 1976). Kentucky's production of more than 200,000 acres of tobacco is second in the South behind North Carolina. Approximately 2.2 million acres are contained in national parks and forests, wildlife refuges and natural areas,

predominantly in the eastern section of the state in the Cumberland and Appalachian Mountains.

Scenario-Induced Changes

Kentucky appears to be the most heavily impacted state in the southern region. Strip mining is scheduled to clear an estimated 123,000 acres by 1985 and 175,000 by 1990. Deep mining will affect 5000 acres on the surface by 1990. The Indiana bat and Virginia big-eared bat, both listed as federally endangered species, are known to inhabit counties where surface mining of coal is now occurring or expected to occur.

Mining occurs in areas with steep slopes and high annual precipitation. These environmental conditions will make control of adverse conditions especially difficult. Much of the bituminous coal has a high sulfur content and the overburden is often pyritic in nature. The potential for both erosion and acid drainage is high and has been a continual problem in the region.

Three counties (Jackson, McCracken, and Muhlenberg) were all severely affected by 1975 SO₂ levels on soybeans, Irish potatoes, vegetables, corn, orchards, and berries. None of these three counties are expected to be impacted in 1985 and 1990.

Boone and Mason Counties will be impacted by SO₂ in 1985 and 1990. Additionally in 1990, three other counties will be impacted (Oldham, Meade, and Trimble). These five counties have significant commodities of berries, wheat, tobacco, hay, orchards, and Irish and sweet potatoes. No known federally endangered or threatened species inhabit these counties.

Health and Safety Issues

Major Findings

- o Employees of Kentucky's numerous energy industries will suffer the greatest occupational death and injury risk in the region. This is largely due to high production in the coal mining and coal electric generation industries.
- o General public will receive the largest exposure to fossil fuel combustion products in the region.

Existing Conditions

No other state in Region 4 contains such a large number of impact categories. The combined total impact of deaths, injuries, and occupational diseases suffered by workers in this state greatly exceeds that for any other state in the region. The greatest number of occupational hazards exist in the coal mining industry, where accidental deaths are estimated to be 4.1 to 14 annually and 13 to 47 deaths annually for surface and deep mining, respectively. Annual injuries reflect the same trend, with 220 to 820 estimated annual injuries for surface mining and 1400 to 5300 injuries for all coal mining. Figure 4.37 is a map of expected risk of accidental death from all coal mining for each county in 1975, 1985, and 1990.

Although not included in the figure, occupational disease deaths for this industry are also significant.

Estimated risk to the general public from exposure to fossil fuel combustion products is considered greater than moderate. Occupational hazard in oil production and electric generation, natural gas production, and uranium enrichment is negligible.

Scenario-Induced Changes

The most serious hazards occur in the coal extraction industry. At the upper bound of the 60% confidence limits, underground mine accidents and occupational disease could claim as many as 51 and 38 lives annually in the peak production years of 1985 and 1990, respectively. Total injuries sustained by deep miners exceed those of surface miners by an approximate factor of 6.5. The projected numbers of injuries for 1985 are 230 to 830 for surface and 1500 to 5800 for underground mining.

The number of accidental deaths suffered by both surface and underground coal miners employed in the coalfield counties of eastern Kentucky was estimated as the product of projected coal Btu mined under the scenario conditions (assuming 13,100 Btu/lb) (McCormack, 1975) and the hazard multipliers developed at BNL. This estimated annual mortality was then divided by the calculated miner population (based on 3000 miners/quad surface mined and 14,200 miners/quad deep mined) to develop occupational death risk from accidents. Figure 4.37 illustrates the resulting risk distributions.

Deaths from coal workers' pneumoconiosis and associated respiratory disease were not included in the present analysis, because historical workplace exposure is considered necessary for induction of lung damage.

MISSISSIPPI

Two counties in Mississippi are likely to suffer high socioeconomic impacts from power plant construction. Vegetation in one county may be adversely affected by SO₂. Increased coal use in the state will raise the risk of groundwater contamination. With these exceptions, the Series C Scenario will have only low or moderate impact on Mississippi.

ESTIMATED MORTALITY DUE TO OCCUPATIONAL ACCIDENTS AMONG KENTUCKY COAL MINERS Mid-Range Projections Series C (Values Given as Deaths per Million Miner Population)

☐ NEGLIGIBLE MORTALITY
 ☒ 0.0 TO 99.9
 ☒ 100.0 TO 499.9
 ☒ 500.0 TO 999.9
 ☒ 1000.0 AND GREATER

Figure 4-37. Estimated mortality due to occupational accidents among Kentucky coal miners.

Institutional/Political Issues

Major Findings

- o Institutional/political issues are not expected to restrain energy development in Mississippi.

Existing Conditions

Mississippi's electricity generation is mainly (and almost equally) from oil-, gas-, and coal-fired plants. In 1975 the state used 0.8×10^{15} Btus of energy, and about 7 1/2% of this energy was in the form of electricity delivered to end-users. Mississippi is heavily dependent on oil and natural gas. Natural gas accounted for 32% and coal accounted for only 5% of all energy consumed in 1975.

Mississippi does not have a power plant siting law; however, the Public Service Commission has authority to grant a "Certificate of Public Convenience and Necessity."

State officials think the coal conversion sections of the NEA will cause economic problems for utilities and industries. The industrial sector requires up-to-date knowledge of the best technologies for industries converting to coal and the subsequent costs of such conversion. In general, Mississippi will be sympathetic to the industries' problems and is concerned that economic growth might be stunted because of the regulations.

Some state officials see a general lack of coordination for energy programs as a problem in Mississippi. This includes lack of communication and planning between utilities and different state agencies, and between DOE and the state officials. The state officials say they have little or no input into major DOE programs, and do not always know ahead of time what programs DOE will be implementing in the state.

Scenario-Induced Changes

The total generating capacity assumed in the Series C Scenario for Mississippi will more than triple, from 4,600 MWe in 1975 to an estimated 16,500 MWe in 1990 (Figs. 4.25 to 4.28 and Fig. 4.38). In 1990 more total generating capacity is predicted by the scenario than by the utilities. The scenario predicts about three times the coal and thirty times the oil peaking capacity than do the utilities. The utilities predict about twice the nuclear capacity in 1990 as that assumed by the scenario.

Concern has been expressed about the impact of the increased need to transport coal into the state on the rail lines. The scenario projection of a larger amount of coal-fired electric generating capacity may further aggravate the problem. State officials are also concerned in general about the environmental effects of increased use of coal.

Officials say that disposal of nuclear wastes will be a problem in siting nuclear plants. There are proposals in the state legislature concerning nuclear disposal and storage and some are restrictive. Although federal regulations distinguish nuclear wastes hazardous from other hazardous wastes, the Mississippi law being drafted combines the two. This may

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN MISSISSIPPI

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975	1985		1990	
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	1,604	4,240	2,287	8,852	2,987
Oil Steam	1,046	48	1,372	225	1,372
Oil Peaking	99	1,876	99	2,913	99
Gas Steam	1,800	1,175	1,977	1,175	1,977
Gas Peaking	50	50	50	50	50
Nuclear	0	1,250	5,033	2,500	5,033
Other	0	750	0	750	0
TOTAL	4,599	9,389	10,818	16,465	11,518

*ORNL's Data from utility data file.

Figure 4-38. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Mississippi.

present a conflict in application between the two sets when both are on the books. The Mississippi regulation is anticipated to be more stringent than the federal laws.

Socioeconomic Issues

Major Findings

o Significant socioeconomic impacts from the construction of energy facilities are expected for two counties in Mississippi. These impacts should be the result of an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Under the scenario, energy development is expected to occur in seven Mississippi counties. The majority of these counties are rural with low population densities and substantial amounts of substandard housing. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Of the seven counties with predicted energy development, only two are expected to experience significant impacts. Construction of a nuclear plant in the Jackson BEA region and a coal plant in the New Orleans BEA region should result in at least one year of population growth greater than 10% for these counties (Fig. 4.39).

For the above counties, respectively, the projected noncoincident peak work force requirements are 2,200 and 2,087. These counties are also projected to experience total immigration, including dependents, of 2,715 and 2,649 during the peak construction year.

The other five counties are not projected to experience significant impacts as a result of minimal energy-related population increases.

The two significantly impacted counties should experience, at construction peak, large increases in the costs of public services and facilities of approximately \$1.2 million each. The other five counties should experience smaller increases in these costs.

None of the counties are projected to encounter impacts during the operating phase of these developments.

Water Quality and Availability Issues

Major Findings

o No major water quality changes are expected as a result of direct energy effluents. However, the scenario shows electric utilities beginning to use large amounts of coal between 1975 and 1990. Because the entire state is underlain by unconsolidated aquifers, controlling groundwater

PROJECTED POPULATION GROWTH RATES FOR IMPACTED MISSISSIPPI COUNTIES (Dashed Line = BEA Boundary)

Figure 4-39. Projected population growth rates for impacted Mississippi counties.

contamination from coal handling and ash disposal facilities may become a problem.

- o No significant water-for-energy problems can be detected in supporting the level of energy development projected for Mississippi.

Existing Conditions

The western half of Mississippi is drained by the lower Mississippi main stem (ASAs 801, 802, 803). The northeastern portion is part of the Tombigbee River Basin (ASA 308), and the southeastern portion contains the Pascagoula and Pearl River basins (ASA 309).

The waters of Mississippi are soft (less than 60 mg/liter calcium carbonate) and low in dissolved solids (less than 120 mg/liter) except along the Mississippi main stem where levels are slightly higher (120 to 350 mg/liter). Suspended solids levels are more variable. The highest concentrations are found in the Yazoo River basin in the northwestern part of the state where levels range from 200 to 500 mg/liter. Lowest levels (less than 50 mg/liter) occur in the Pascagoula basin, and the rest of the state has intermediate concentrations (50 to 200 mg/liter) (Geraghty et al., 1973) (Briggs and Ficke, 1977).

Urban pollution is not a major problem in Mississippi except along the eastern Gulf Coast. Agricultural runoff, including pesticides, has affected streams in the northwestern part of the state, and industrial pollution is a local problem in other areas. Naturally high temperatures and low pH keep some undisturbed streams in southern Mississippi from EPA meeting water quality criteria (U.S. Environmental Protection Agency, 1977).

Scenario-Induced Changes

Yazoo-Mississippi Basin (ASA 802). New electric utility generation may increase TDS levels in the Yazoo-Mississippi area 25% by 1985 and 40% by 1990. The resulting concentrations will be less than 200 mg/liter, below the water quality criterion for TDS, but high enough to indicate possible local violations if generating capacity is concentrated near urban areas.

Mississippi Delta (ASA 803). Although water availability is not a problem along the Mississippi River, concern exists that water consumption upstream may reduce the flow at the mouth sufficiently to change the extent of tidal saltwater intrusion.

Air Quality and Visibility Issues

Existing Conditions

Although five counties in Mississippi have annual average TSP concentrations of more than 50 micrograms per cubic meter, only one of these (in the Hattiesburg AQCR) has been cited for nonattainment of the primary TSP standard. Two counties in the state have average annual SO₂ concentrations of 20 to 35 micrograms per cubic meter.

Scenario-Induced Changes

One county near Memphis, Tennessee is expected to exceed the PSD Class II increment for 1990.

The state has no Class I areas.

Land and Ecological Issues

- o No significant impacts are forecasted.

Existing Conditions

Mississippi is similar to its neighboring state of Louisiana in that it is subdivided into the southeastern mixed forest; the southern flood plain forest; and the beech, sweetgum, magnolia, oak, and pine forest ecoregions. Over 50 percent of the state is in forest, with the greatest majority of that being commercial forest. Approximately 25 percent of the state is employed as cropland, with almost 3.7 million acres in soybeans and over a million acres in cotton.

Scenario-Induced Changes

Only one county (Jones) will be impacted by SO₂, although the levels will decline significantly from 1975 to 1985 and then start to rise by 1990. Besides having crops of grain, hay, orchards, and berries, commercial forest accounts for 260,000 acres of the county.

Health and Safety Issues

Major Findings

- o The general public will sustain a moderate risk from exposure to fossil fuel combustion products.

Existing Conditions

Oil refinery and natural gas production workers were estimated to sustain between 20 and 51 annual injuries in 1975. Mortality for each industry was estimated to equal 1 per year. Health effects from oil and nuclear electric generation are considered negligible.

Scenario-Induced Changes

Occupational hazards from coal electric generation in Mississippi are among the lowest in the region (0.2 to 0.7 deaths and 5.3 to 24.3 injuries). Although the electric power output from oil-fired plants is comparable to that from coal-fired plants, the hazard is five times less. In addition, oil electric generation in Mississippi is approximately one order of magnitude less than that generated by Florida. Health effects of fossil fuel combustion in Mississippi and Florida are the lowest of any in the Southeast. (See previous discussions on Florida for comparable technology effects figures.)

NORTH CAROLINA

Eastern North Carolina may experience low-flow supply problems under the conditions of the scenario, and local water shortages are possible elsewhere in the state. One county is expected to experience significant socioeconomic impacts. Air quality will be a problem in the western part of the state, and it may affect vegetation there.

Institutional/Political Issues

Major Findings

- o Institutional/political issues are not expected to restrain energy development in North Carolina.

Existing Conditions

North Carolina electricity generation is mainly from coal-fired plants with some assist from hydro and nuclear. In 1975 the state used 1.4×10^{15} Btus of energy, and about one-eighth of this energy was in the form of electricity delivered to end users.

Industries use natural gas as an irreplaceable feedstock for textile, fertilizer, and ammonia production, and they will be greatly affected by its supply and price. Natural gas deregulation will help the state's industries because they are willing to trade an increase in cost for an assured supply. With the increased availability of natural gas, state officials do not foresee industries converting to coal in the near future. The allocation of natural gas has been a major problem, and the state filed "No. 76-2102, State of North Carolina and North Carolina Utilities Commission, Petitioners versus Federal Energy Regulatory Commission, Respondent" with the United States Court of Appeals for the District of Columbia Circuit. The court opinion pointed out that there are defects in the implementation of the current curtailment procedures. First, the implementation plan allocates gas on the basis of out-of-date base period data. Secondly, some customers are totally dependent on one pipeline supplier and others are supplied by several pipelines, some of which have fewer curtailments. The Court of Appeals ruled that the Federal Energy Regulatory Commission curtailment procedures were inequitable and must be revised.

Officials see room for improvement in federal-state relations. Three main areas were cited: lack of flexibility in the state use of federal energy and environmental funds; lack of local relevance in federal energy guidelines; and inadequate attention to the problems of implementation and enforcement (including cost) of the federal energy programs by the states.

Scenario-Induced Changes

The Series C Scenario requires a doubling of generating capacity from 14,800 MWe in 1975 to 29,700 MWe in 1990 (Fig. 4.40). The major increases will be in coal, nuclear, and oil peaking capacity (Figs. 4.25 to 4.28). The total generating capacity required by the scenario is somewhat greater than that of the utilities' projections. The scenario requires more coal and oil peaking generation than the utilities project; and the utilities project almost twice the nuclear capacity in 1990 as that required by the scenario.

North Carolina does not have a power plant siting law. However, several state agencies must certify elements of plant construction under direction of the State Utilities Commission at an informal one-stop proceeding. The state officials do not see much difficulty in siting these new generating plants, but environmental control agencies foresee some environmental impact associated with the increased use of coal. No concerns were expressed as to the adequacy of rail and road systems to transport the coal.

There has been support from the governor's office for nuclear installations. A bill limiting the transport of nuclear materials was defeated in the legislature, but the impact of the accident at Three Mile Island on future nuclear plant development in the state is unknown.

The scenario calls for combined cycle facilities, and state legislation has been introduced for cogenerating facilities.

Socioeconomic Issues

Major Findings

o Significant socioeconomic impacts from the construction of energy facilities are projected for one North Carolina county. This county should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Under the scenario, energy development is expected to occur in four North Carolina counties. Two of these counties are rural with low population densities and substantial amounts of substandard housing, while the others are urban. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of inmoving workers.

Scenario-Induced Changes

Of the four counties expected to receive energy development, only one county, located in the Wilmington BEA region, is expected to experience significant impacts (Fig. 4.41). This county should experience at least one year of population growth greater than 10% from the construction of a coal plant.

The one significantly impacted county is projected to have a peak work force requirement of 2,280 and a total of 3,024 in-migrants, including dependents.

The other three counties are not projected to receive large energy-related population increases.

All four counties should experience, at construction peak, large increases in the cost of public services and facilities of approximately \$1.6, \$2.7, \$0.527, and \$0.930 million.

None of the four counties should receive impacts during the operating phase of the developments.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN NORTH CAROLINA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975 SERIES C	1985 SERIES C	1985 UTILITY*	1990 SERIES C	1990 UTILITY*
Coal	10,333	14,003	12,905	16,626	12,905
Oil Steam	588	623	0	0	0
Oil Peaking	755	4,153	735	6,137	735
Nuclear	790	3,971	4,871	3,971	8,851
Hydro	2,232	2,238	2,304	2,238	2,304
Comb. Cycle	135	765	0	765	0
TOTAL	14,833	25,753	20,815	29,737	24,795

*ORNL's Data from utility data file.

Figure 4-40. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in North Carolina.

Water Quality and Availability Issues

Major Findings

- o Water-for-energy development is projected to generate low-flow supply problems in eastern North Carolina (ASA 301 Roanoke-Cape Fear) by 1990. Possible local water shortages resulting from periodic droughts may also occur in meeting demands in inland headwater areas near the load centers of Charlotte, Greenville, and Winston-Salem. None of the rivers along the Carolina Piedmont is capable of supporting numerous large facilities; even in combination, they cannot serve all of the demands near the load centers.
- o No major water quality issues or constraints are anticipated at the ASA level.

Existing Conditions

The eastern North Carolina coastal plain drains to the Atlantic through the Roanoke, Tar, Neuse, and Cape Fear rivers (ASA 301). The center of the state, the Piedmont region, drains southward, through the Pee Dee and Santee Rivers (ASA 302). Mountainous western North Carolina drains westward to the Tennessee River system (ASA 601). The waters of the state are soft (less than 60 mg/liter calcium carbonate) and low in both dissolved solids and suspended sediments (Briggs and Ficke, 1977).

The water quality issues are different in each of the three major drainage regions of the state. The greatest water quality problems occur in the Piedmont region (ASA 302), where population and industry are densest. The warmer, slower rivers of the coastal plain (ASA 301) have less ability to assimilate wastes, though the loadings are lower.

Scenario-Induced Changes

Roanoke-Tar-Neuse-Cape Fear River Basins (ASA 301). The national water quality analysis indicates that the levels of dissolved solids attributable to energy facilities in ASA 301 might be increased by as much as 117% by 1990. Though this represents a 60% increase from the total background levels in 1975, no violations of water quality criteria are anticipated at the ASA level.

This conclusion may be misleading, however, considering that the ASA discharge is actually distributed among several rivers, and that most of the new generating facility sites are in upstream reaches nearer the energy demand centers of Charlotte, Greenville, and Winston-Salem.

Furthermore, high water-for-energy demands combined with water use by other sectors are calculated to reduce the critical surface supply estimated to be available for the entire ASA by between 19 and 27 percent. This reduction would increase the likelihood of higher concentrations of pollutants than was calculated by the national water quality model in the more densely populated area of the Carolina Piedmont.

Pee Dee-Edisto River Basins (ASA 302). See discussion under South Carolina.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED NORTH CAROLINA COUNTIES (Dashed Line = BEA Boundary)

No Counties
 One County
 Two Counties
 Three Counties

Figure 4-41. Projected population growth rates for impacted North Carolina counties.

Upper Tennessee River Basin (ASA 601). The siting analysis shows little change in levels of energy activities in the North Carolina portions of the Upper Tennessee Basin (ASA 601).

Air Quality and Visibility Issues

Existing Conditions

All of North Carolina meets primary standards for SO₂, although four counties have annual average concentrations in the range of 40 to 60 micrograms per cubic meter. Background levels of TSP are generally below 30 micrograms per cubic meter, but 21 counties have annual average concentrations ranging between 50 and 95 micrograms per cubic meter. Two counties in the extreme western portion of the state and two in the Piedmont Basin were in nonattainment for TSP in 1975.

Scenario-Induced Changes

Nonattainment will continue in 1985 in all but one of the western counties, with one of the Piedmont counties attaining the standard in 1990. One county in the extreme west will exceed the PSD Class I increment in 1985 and 1990.

A high impact from plume blight on the Linville Gorge Wilderness (Fig. 4.10) is projected from coal units in one of seven adjacent counties through 1990. Coal units in another adjacent county are projected to produce low impacts through 1990. The Great Smoky Mountains National Park, the Joyce Kilmer-Slickrock Wilderness, and the Swanquarter Wilderness will each experience moderate or high impact from projected changes in regional haze since 1975. By 1990 only Shining Rock's haze level impacts will become low, while Swanquarter's will change from high to moderate.

Land and Ecological Issues

Existing Conditions

The eastern 80 percent of the state lies within the southeastern mixed forest ecoregion, and the westernmost mountainous section of the state lies within the Appalachian oak forest (Bailey, 1978). It is in this westernmost section that the impacts are predicted to occur. This ecoregion is dominated primarily by white and northern red oak with northern hardwoods (maple, beech, birch, and hemlock) and spruce and fir in the higher elevations. Most of this region is national forests land, with a significant portion along the Tennessee border included in the Great Smoky Mountains National Park. Relatively little commercial farming is done in this section compared to the rest of the state. A large proportion of the acreage is in commercial forests.

Scenario-Induced Changes

Buncombe and Haywood counties in the westernmost part of the state will be impacted by SO₂, with levels of the pollutant rising through 1990. Perhaps the most serious impact will occur on the commercial forests, which account for over 390,000 acres. Additionally, crops such as Irish potatoes, sweet potatoes, hay, and berries will also be affected. This

appears to be the only significant impact occurring in the state as forecast by the Series C Scenario.

Health and Safety Issues

Major Findings

o North Carolina and Kentucky share the distinction of possessing the greatest total occupational hazard from coal electric generation in the Southeast.

Existing Conditions

Occupational and public health effects from oil electric generation, nuclear fuel fabrication, and nuclear electric generation are estimated to be negligible. Coal electric generation is estimated to result in 34 occupational injuries and 1.0 occupational deaths per year. However, exposure of the general public to combustion products of this industry is estimated to produce between 200 and 3200 excess deaths, (60% confidence limits).

Scenario-Induced Changes

In the Southeast, North Carolina shares with Kentucky the greatest total occupational hazard from coal electric generation. As a direct result of the large coal-fired plants' emissions in these two states, between 1975-1990 1.0 to 1.6 annual deaths and 34 to 54 annual injuries are projected to occur in each state. In contrast, occupational hazard and health effects from oil electric generation and fossil fuel combustion are moderate for the region. Occupational hazard from nuclear fuel fabrication in North Carolina is estimated to equal 15.9% of the U.S. total (0.54 annual occupational deaths).

SOUTH CAROLINA

Apart from high socioeconomic impacts in one county, and the possibility that uncertainty over nuclear power may delay construction of the new nuclear plants projected by the scenario, the energy development projected for South Carolina should cause little difficulty in the state.

Institutional/Political Issues

Major Findings

o Institutional/political issues are not expected to restrain energy development in South Carolina.

Existing Conditions

Coal and nuclear plants accounted for 60% of the electric generating capacity in South Carolina in 1975, with the rest coming mainly from hydro and oil. In that year, the state used 0.8×10^{15} Btu of energy, and 12.5% was in the form of electricity delivered to end users.

Industries in South Carolina are dependent on natural gas as a fuel and as a feedstock for major textile industries. The supply and price of gas will have an impact on the state economy. The increase in gas supply has eased problems in the state, and South Carolina has a new propane piping storage system. There are no serious problems at present with industries converting to coal. When conversion becomes necessary, it is hoped that advanced technologies such as fluidized bed combustion will be available. For industries using gas as a feedstock, deregulation will mean an increase in materials cost.

South Carolina enacted a power plant siting law in 1973 granting the Public Service Commission authority to coordinate state agency review and issue approval. South Carolina works with the states of North Carolina and Virginia (when appropriate) in determining need for power and making plans for siting plants. The state permitting agencies work with utilities in solving problems as they arise.

South Carolina is projected to be heavily dependent on nuclear power by 1990. State and utility officials are concerned about the length of time needed for licensing nuclear plants and about the problems of nuclear waste disposal. Some state officials would like to see the licensing procedure reformed, in part, through the elimination of redundant hearings, and they foresee a continuing problem in that legislation is drafted at the national level and then applied broadly to all situations. They would prefer that the process include more response to local situations.

Although additional hydro power is not predicted in the scenario, or in listed utility plans, interest in more hydro power has been expressed. One site was previously blocked by environmentalists, but it may be considered again.

Scenario-Induced Changes

The Series C Scenario requires South Carolina to be very dependent on nuclear power by 1990 (Figs 4.25 to 4.28 and Fig 4.42). Of its estimated doubling of electric generating capacity (10,300 MWe in 1975 to 22,900 MWe in 1990), 7,100 MWe is to come from nuclear. The scenario and utility projections match closely, with the scenario requiring a little more total capacity and more capacity from oil peaking and coal plants than the utilities project.

The length of time necessary for licensing nuclear plants may be a problem in meeting scenario and utility projections. The ultimate impact of the nuclear accident at the Three Mile Island electric plant is unknown, but shortly after the accident the governor of South Carolina indicated support for continuing the nuclear construction in the state. Some officials say that if the nuclear option is lost, a major investment must be made in railroads to transport the coal which will be needed for other generating plants, but good sites are available for coal-fired facilities.

Socioeconomic Issues

Major Findings

- o Significant socioeconomic impacts from the construction of energy facilities are projected for one South Carolina county. This county should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Under the scenario, energy development is expected to occur in six South Carolina counties. These counties are, in general, rural with similar socioeconomic characteristics. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Of the six counties expected to receive energy development, only one county in the Greenville BEA region is expected to experience significant impacts (Fig. 4.43). This county should experience at least one year of population growth greater than 10% from the construction of a nuclear plant.

The one significantly impacted county has a projected peak work force requirement of 4,973 and a projected total of 7,803 in-migrants, including dependents. The other five counties are not projected to receive large energy-related population increases.

The one significantly impacted county should experience, at construction peak, an increase of \$4.1 million in the cost of providing public services and facilities. Many of the other counties also should have increases in these costs, some of which are large.

One county in the Charleston BEA region is projected to experience project-related population growth of approximately 68 during the operating period. Increases of approximately \$44,450 in the annual cost of public facilities and services are also expected.

Water Quality and Availability Issues

Major Findings

- o No major water quality issues or constraints are anticipated at the ASA level.
- o Although no water shortages resulting from energy development can be identified at the ASA level, this does not preclude water availability as a major concern for energy facility siting in South Carolina. Potential problem areas exist both within the Pee Dee-Edisto Basin (ASA 302), which is projected to experience the nation's greatest increase in water consumption for energy, and within the Savannah River Basin (ASA 303).

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN SOUTH CAROLINA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	3,222	3,502	4,212	5,502	4,212
Oil Steam	1,053	959	903	959	903
Oil Peaking	1,188	2,144	1,772	2,537	1,772
Nuclear	3,278	5,331	7,764	10,376	10,324
Hydro	1,027	1,027	1,027	1,027	1,027
Comb. Cycle	0	750	196	750	196
Pump. Stor	610	1,090	1,090	1,728	1,090
TOTAL	10,378	14,803	16,964	22,879	19,524

*ORNL's Data from utility data file.

Figure 4-42. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in South Carolina.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED SOUTH CAROLINA COUNTIES (Dashed Line = BEA Boundary)

Figure 4-43. Projected population growth rates for impacted South Carolina counties.

Existing Conditions

Though almost the entire state of South Carolina lies within ASA 302, that one aggregated subarea is drained by three separate rivers, the Pee Dee, the Santee, and the Edisto. The Savannah River, in a separate ASA (303), drains the western edge of the state.

South Carolina's rivers are naturally soft (less than 60 mg/liter CaCO_3) and low in dissolved and suspended solids (Briggs and Ficke, 1977). Water quality in the state is generally good. Nonpoint source pollution has been identified as a problem near urban areas in the Santee-Cooper, Edisto, Pee Dee, and Savannah basins. Coastal areas suitable for shellfish are recognized as valuable and ecologically sensitive and are given special protection (U.S. Environmental Protection Agency, 1977).

Scenario-Induced Changes

Pee Dee, Santee, and Edisto Rivers (ASA 302). In terms of water quality, background concentrations of total dissolved solids, sulfates, and potassium may increase by approximately 125% each, mainly from concentration by cooling towers at electrical generating facilities. However, no widespread water quality criteria violations are detected at the ASA level.

The Pee Dee-Edisto Basin (ASA 302) is projected to contain the nation's greatest increase in water consumption by energy. This consumption will exceed 282 million gallons per day for maximum base load generation in 1990, giving ASA 302 the third largest water-for-energy total (behind ASA's 704 and 502). Despite this consumption, no aggregate level water availability problem is apparent.

However, the area's flow is actually divided among three distinct drainage basins, and the distribution of energy facilities is primarily in the upper upstream reaches of these streams. Thus, there is a potential for energy-related water problems to occur within the state, although they are not evident at the ASA level.

Air Quality and Visibility Issues

Existing Conditions

Background concentrations of TSP average less than 25 micrograms per cubic meter. Fourteen counties have annual average TSP concentrations in the range of 50 to 95 micrograms per cubic meter and two of these, in the Charleston area, have been cited for nonattainment. Annual average SO_2 concentrations do not exceed 17 micrograms per cubic meter, and the entire state meets the SO_2 standards.

Scenario-Induced Changes

Nonattainment for TSP is forecast to continue along the coast in 1985. The PSD Class I increment will be exceeded in one county in 1990. This county is also in the Charleston area.

Two of five counties adjacent to the Cape Romain Wilderness (Fig. 4.2) are projected to produce low plume blight impacts through 1990 from oil, coal,

and oil peaking units. There are no significant regional haze impacts projected.

Land and Ecological Issues

Existing Conditions

South Carolina predominantly lies within the southeastern mixed forest ecoregion, with the westernmost tip of the state in the Appalachian oak ecoregion and the eastern section of the border with Georgia in the southern floodplain forest ecoregion (Bailey, 1978). Within the southeastern forest ecoregion, where the anticipated impacts from air pollution are forecast to occur, there exist five major vegetation types (Kuchler, 1964). These are, in decreasing order of abundance, oak, hickory, pine forest, southern floodplain forest, Pocosin (a pine-holly association), southern mixed forest, and live oak-sea oats. The southern floodplain forest and live oak-sea oats association has been classified as resistant, the southern mixed forest as sensitive and the remainder as intermediate to SO₂ pollution (Argonne National Laboratory data).

The counties immediately adjacent to those located along the Atlantic Coast are the top grain producing counties in the state (corn, soybeans, wheat, and barley) (Bell, 1976).

Scenario-Induced Changes

Georgetown and Dorchester counties will be impacted by SO₂ under the Series C Scenario in 1985 and 1990. The only major crop is sweet potatoes; however, 278,000 acres of commercial forest are also present. In contrast to this scenario, the NCUA scenario indicated a potential SO₂ impact on the heart of South Carolina's grain producing region and also a greater potential impact on softwood forests in other areas of the state (Davis, 1978).

Health and Safety Issues

Major Findings

- o The general public will sustain a moderate risk from exposure to fossil fuel combustion products.

Existing Conditions

Coal electric generation was estimated to result in 10 occupational injuries and 0.3 occupational deaths in 1975. Exposure to combustion products of this and the small oil electric generation industry is estimated to produce between 100 and 1600 excess deaths (60% confidence limits). Health effects of uranium hexafluoride (UF₆) conversion, nuclear fuel fabrication and reprocessing, nuclear waste management, and nuclear electric generation are considered negligible.

Scenario-Induced Changes

South Carolina has the largest nuclear support industry in the region. Occupational deaths and injuries from each nuclear industry will be ¼1 until

the peak year (1990), when 1.1 radiation-induced cancer deaths are expected to occur annually from exposure during fuel fabrication. Occupational hazard and health effects from fossil fuel combustion are moderate for the region through time. Oil electric generation and the resulting health effects are an order of magnitude less than those of Florida. (0.01 projected deaths and 0.7 projected injuries for 1975 to 1985. No production in 1990.)

TENNESSEE

Tennessee's coal transportation system may be strained by increased coal production, and four rural counties in the state are likely to experience significant socioeconomic impacts from new nuclear power plant construction. Coal mining may affect water quality in some localized areas. Exposure to combustion products of fossil fuels may cause 230 to 4800 deaths per year.

Institutional/Political Issues

Major Findings

- o Coal haul roads, bridges, and railroads in the mountainous sections of East Tennessee will require upgrading.
- o Institutional/political issues are not expected to restrain energy development in Tennessee except in terms of the public's reservations concerning nuclear power.

Existing Conditions.

In 1975, most of Tennessee's electricity was generated by coal-fired plants, with assistance from hydro-powered plants. In that year, the state used 1.5×10^{15} Btu of energy, and about 14% of it was in the form of electricity delivered to end users. Coal accounted for 43% of the total energy consumed in 1975.

The presence of two very large federal agencies in the state (the Department of Energy, which is represented primarily by the Oak Ridge installations, and the Tennessee Valley Authority, which provides the electric power for the state) complicates energy planning by the state agencies. Unlike most states in the southern region, Tennessee has neither a plant siting review process by the Public Service Commission nor a power plant siting law. Although the sites and fuel cycles chosen are TVA rather than state decisions, the state has generally concurred. The administration decision to stop construction of the breeder reactor has met with vigorous opposition in Tennessee.

The combination of the Clean Air Act and Coal Conversion Sections of the National Energy Act may slow economic growth in Tennessee. Consequently, the state is considering providing general data (especially air quality information) indicating acceptable areas of growth for new industries to aid industrial growth.

Scenario-Induced Changes

The scenario requires that electric generating capacity in Tennessee will increase from -12,200 MWe in 1975 to -33,500 MWe in 1990 (Figs. 4.25 to 4.28). The scenario and utility projections almost coincide, with the major difference being that there is no oil peaking capacity in the utility projections (Fig. 4.44). Two-thirds of the increase (-13,200 MWe) is predicted to be in new nuclear capacity. The impact on these plans of the nuclear accident at the Three-Mile Island plant is unknown.

Tennessee's production of coal is increasing, and it is required to increase under the Series C Scenario. Coal haul roads, bridges, and railroads in the mountainous sections of East Tennessee will require upgrading to be adequate to the demands placed on them. An estimated 292 to 517 miles of coal haul road will be inadequate by 1980, with an estimated cost (in 1977 dollars) of \$80,415,000 to \$179,210,000 to reconstruct and rehabilitate them. An estimated 27 to 60 bridges on these roads will also be inadequate, and the estimate to replace them (in 1977 dollars) is \$14,000,000 to \$33,000,00.

Socioeconomic Issues

Major Findings

o Significant socioeconomic impacts from the construction of energy facilities are expected for four counties in Tennessee. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Energy development is expected to occur in eight Tennessee counties. These counties are all rural and therefore have a low assimilative capacity for impacts from substantial amounts of in-moving workers.

Scenario-Induced Changes

Significant impacts from nuclear plant construction are expected in one county in each of the Bristol, Chattanooga, and Nashville BEA regions. Another county in the Nashville region is expected to receive significant impacts from coal mining development (Fig. 4.45).

For the above four counties, respectively, the projected noncoincident peak work force requirements are approximately 4800, 3800, 5500, and 900. These counties are also projected to experience the following numbers of total in-migrants, including dependents of approximately 6300, 5400, 9600, and 600 during the peak construction year.

The other four counties are not expected to experience significant impacts as a result of minimal energy-related population increases. These counties will be the site of coal mining development.

The three counties receiving nuclear plants should experience, at construction peak, large increases in the cost of public services and facilities of approximately \$2.8, \$2.4, and \$4.3 million. The other

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN TENNESSEE

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975	1985		1990	
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	9,241	9,241	9,241	9,241	9,241
Oil Peaking	0	3,216	0	5,094	0
Gas Peaking	1,808	1,808	1,808	1,808	1,808
Nuclear	0	4,650	14,515	13,215	14,515
Hydro	2,194	2,194	2,194	2,194	2,194
Pump. Stor.	0	1,300	1,300	1,950	1,300
TOTAL	13,243	22,409	29,058	33,502	29,058

*ORNL's Data from utility data file.

Figure 4-44. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Tennessee.

significantly impacted county should experience a smaller increase in costs, \$.265 million.

The significantly impacted county receiving coal mine development is projected to experience project-related population growth of approximately 600 during the operating period. Increases in the annual cost of public facilities and services of approximately \$.257 million are also expected.

Water Quality and Availability Issues

Major Findings

- o If discharge standards are met, no water quality constraints are expected. However, surface mining is expected to increase in the Appalachian coal fields where erosion control is difficult, and continuing problems will occur, with at least local impacts.

- o No major water supply problems are foreseen for energy development even during critical supply periods within Tennessee, primarily because of TVA's ability to regulate streamflow. Severe drought periods in the past, however, have caused TVA to reduce generation at individual power plants.

Existing Conditions

North-central Tennessee is drained by the Cumberland River (ASA 507) and the extreme western part of the state is drained by the Mississippi (ASA 801). The rest of the state is in the drainage of the Tennessee River (ASAs 601 and 602).

Waters of the Cumberland basin and parts of the central and upper Tennessee Valley are moderately hard and have levels of dissolved solids (120 to 350 milligrams per liter) somewhat higher than the rest of the state. The other basins in the state have soft water. Suspended sediment levels are low (less than 50 milligrams per liter) except in extreme west Tennessee, where they range from 100 to 200 milligrams per liter (Briggs and Ficke, 1977).

Water quality in the state is generally very good. Local pollution problems exist near some major urban areas. Surface mines in the Cumberland River basin and in the Clinch River basin have also caused water quality problems. The steep terrain and heavy rainfall of the mining areas make erosion control extremely difficult (U.S. Environmental Protection Agency, 1977).

Scenario-Induced Changes

Cumberland River Basin (ASA 507). If the erosion control standards of the federal surface mining regulations are met, the national model indicates that suspended solids from mining could be reduced 99% by 1985. Total dissolved solids (TDS) from mining will also decrease slightly, although the predicted TDS increase from new generating capacity will overwhelm that small decrease. The national model shows that background TDS levels may be doubled, from 100 to 220 mg/liter, by 1990. Electrical utilities account for 112 mg/liter of the increase, their discharges growing 40% from 1975 to 1985, and 172% between 1975 and 1990. The expected concentration will

PROJECTED POPULATION GROWTH RATES FOR IMPACTED TENNESSEE COUNTIES (Dashed Line = BEA Boundary)

No Counties
 One County
 Two Counties
 Three Counties

Figure 4-45. Projected population growth rates for impacted Tennessee counties.

not violate the domestic water supply criterion (250 mg/liter), but it is close enough to that criterion to indicate possible local problems.

Upper Tennessee River Basin (ASA 601). Few changes are anticipated in the upper Tennessee basin (ASA 601). Total suspended solids from mining are expected to decrease 99% by 1990, but they represented only 10% of the suspended solids measured in 1975. Dissolved solids from energy facilities, mainly electrical utilities, will increase 135% between 1975 and 1990, but the total increase is less than 17 mg/liter and should be insignificant.

Lower Tennessee River Basin (ASA 602). As in the Upper Tennessee basin, in the Lower Tennessee basin, changes in concentrations of pollutants will be slight. Suspended sediment, caused primarily by mining, will decrease by 99% by 1990, and dissolved solids, mainly from electric utilities, will increase 122% at the same time. Actual concentrations involved are low, however, and the changes are only 4 milligrams per liter (TSS) and 20 mg per liter TDS.

Air Quality and Visibility Issues

Existing Conditions

Three counties have annual average SO_2 concentrations in the range of 35 to 50 $\mu\text{g}/\text{m}^3$, with one in the Nashville (Humphreys) AQCR being cited by the EPA for nonattainment. Background concentrations for TSP generally average less than 30 $\mu\text{g}/\text{m}^3$, but fourteen counties have annual TSP average concentrations in the range of 50 to 105 $\mu\text{g}/\text{m}^3$. Six counties, in the Memphis, Nashville, Knoxville, Chattanooga, and Bristol areas, do not meet the primary standard for TSP.

Scenario-Induced Changes

In all but one of the counties in the Knoxville AQCR, TSP violations are expected to continue in 1985. The PSD Class II increment will be exceeded for one county (Stewart) in the Nashville AQCR in 1985 and 1990. One of ten counties adjacent to the Great Smoky Mountains National Park (Fig. 4.10) is projected to produce impacts from low plume blight through 1990 from oil peaking units. Changes in regional haze in the Great Smoky Mountains and in the Joyce Kilmer-Slickrock Wilderness are expected to cause impacts through 1990.

Land and Ecological Issues

Existing Conditions

The state of Tennessee is primarily dissected into four ecoregions: the Appalachian oak forest and the mixed mesophytic in the eastern third of the state; the oak-hickory in the central and western portions; and the southern floodplain forest in the extreme west (Bailey, 1978). The southeastern mixed forest also makes a slight incursion into the south-central section of the state.

The financially most important crops in the state are soybeans and cotton (western section), tobacco (northcentral and northeastern sections), and

corn (throughout the state). The total income from these crops in 1975 was approximately \$210, \$65, \$140, and \$100 million dollars, respectively (Hobson, 1976).

Scenario-Induced Changes

Surface mining of coal in northeast Tennessee will increase to a total of 21,000 acres from 1975 to 1990. The regions impacted by surface mining lie within the mixed mesophytic forest and Appalachian oak forest with steep topography and abundant rainfall (50 to 60 inches/yr). As a result, many of the impacts associated with coal mining in east Kentucky can be anticipated to occur in Tennessee. Three known endangered fish species occur within the counties where surface mining activity will take place - the slender chub, the yellowfin madtom, and the Plateau musky. These species may suffer serious consequences if the water quality is impaired.

Knox County, a producer of tobacco, hay, sweet potatoes, vegetables, melons, and corn will be impacted by SO₂ levels in 1985 and 1990. Roane County, producing only hay crops, will be impacted in 1975 and 1985. Only Shelby County will be impacted from 1975 to 1990, with berries being the major crop. Sumner County will be affected for 1975 to 1990, with major crops of grain, hay, and berries.

Knox (Knoxville), Shelby (Memphis), and Sumner (Nashville) counties all are centers of, or adjacent to, rapidly expanding metropolitan areas. As a result, there probably exists a greater potential impact on the natural and agricultural ecosystems from urban sprawl than from air pollution. However, again as indicated in Davis (1978), the agricultural crops in the entire western section of the state may receive serious impacts from air pollution due to expanding coal-fired generating plants.

Health and Safety Issues

Major Findings

- o Tennessee's public shares top ranking with Kentucky in magnitude of impacts from exposure to fossil fuel combustion products. It is estimated that the public will sustain a greater-than-moderate health risk from this exposure.

Existing Conditions

Coal mining and coal electric generation are estimated to present the greatest energy-related workplace hazards in the state. Approximately 1 to 4 deaths and 98 to 360 injuries are expected to occur annually from coal mining accidents (Figure 4.46 has a map of estimated risk by county for 1975). Between 0.5 and 1.7 deaths and 28 to 33 accidents should occur annually in coal-fired steam plants. The concentration of combustion facilities in the area should produce a greater-than-moderate health risk to the public from exposure to combustion products. Health hazards from the remaining energy-related facilities are estimated to be negligible.

Scenario-Induced Changes

Tennessee is second only to Kentucky in its number and diversity of impact categories and in hazards from coal electric generation (0.8 to 0.9 deaths and 25 to 30 injuries annually) and fossil fuel combustion (230 to 4800 deaths annually). Figure 4.46 shows the estimated risk from all coal mining by county for 1985 and 1990. Tennessee is third in the region for all coal extraction hazards. Because oil production is so low, no deaths and only one injury per year per 10^6 Btu are estimated to occur through 1990. By contrast, the Tennessee public shares top place with Kentucky in suffering the region's largest number of health effects from fossil fuel combustion (a greater-than-moderate value). The total of occupational hazards from uranium enrichment and nuclear fuel fabrication is expected to result in less than one death annually between 1979 and 1990.

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**ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG TENNESSEE COAL MINERS**
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

□ NEGLIGIBLE MORTALITY ▨ 0.0 TO 99.9 ▩ 100.0 TO 499.9 ■ 500.0 TO 999.9 ■ 1000.0 AND GREATER

Figure 4-46. Estimated mortality due to occupational accidents among Tennessee coal miners.

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FEDERAL REGION 5

ARGONNE NATIONAL LABORATORY

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Program Manager	Stephen W. Ballou
Air Quality	Michael Senew David Streets
Water Quality	Michael P. Torpy Phillip Coop
Solid Waste	Susan Barisas Shen-Yann Chiu
Ecology/Land Use	Katrina Robeck Marian Gabriel Patricia Irving
Socioeconomics	David South Thomas Baldwin Danilo Santini
Health and Safety	John Gasper
Computer Assistance	Charles Comer Mary Snider

FEDERAL REGION 5

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REGIONAL OVERVIEW - REGION 5

In 1977, the states in Region 5 had a population of 45 million people and an average density of approximately 148 people per square mile. The population densities of Illinois, Indiana, Michigan and Ohio range from 144 to 260 people per square mile; Wisconsin and Minnesota have 81 and 48 people per square mile, respectively. The average annual increase in net population has slowed significantly in the last several years. In the 1950-60 period it was 1.6%, in 1960-70 it was 1.1%, and from 1970-76 it declined to 0.3%. Although these states have not experienced a large migration rate relative to population growth, the development of new households slowed, and there is an older median age (27.4).

The median income in the region is \$10,376 and there is a high average per capita income of \$6,594 (1976), which is 102.4% of that for the United States. The primary industries in this region are farming, with employment ranging from 26,500 to 48,800 workers, and manufacturing, which employs 107 persons per thousand population (1975).

Coal use is a central energy issue in Federal Region 5. Extensive reserves of high sulfur coal exist in Indiana, Illinois and Ohio, and historically these have been the preferred sources of fuel for much of the industry in the region. However, the 1970 Clean Air Act, required the use of low sulfur coal or the installation of desulfurization devices. This has led to concern about massive unemployment in the coal mining areas, particularly in Ohio, and to a growing solid waste problem as increasing amounts of sludge from flue gas desulfurization systems require disposal. Mandated control of SO₂ emissions is expected to improve the air quality in many areas of Region 5. In 1975, areas around Minneapolis/St. Paul, Gary, Peoria, Indianapolis, Lansing, and most of the industrial urban centers in Ohio were in nonattainment for SO₂. This potentially affects not only human health, but vegetation as well. Damage induced by SO₂ exposure can result in decreased productivity and yield: soybeans, wheat, small grains, vegetables, and fruits and berries are major crops of all or part of the region and are particularly sensitive to high SO₂ levels. The coniferous forests of the northern part of the region are also sensitive to SO₂. Increases in atmospheric levels of SO₂ in the last 20 years have also contributed to the formation of acid rain; precipitation in much of Region V is below pH of 5. Acid rain has significant agricultural ecological implications because it increases the mobility of nutrients and metals in soil.

Federal emissions regulations and the trade-off policy could make it difficult to locate new coal-fired electric generating plants in the urban areas of the region, where both energy demand and pollutant emissions are highest. As one of the most important alternatives to coal in electric utility baseload generation, nuclear generation has been growing very quickly. Since the Sixties, nuclear baseload units had gained wide acceptance among utilities in the Midwest where Commonwealth Edison of Illinois owns much

Much of the material in this section is excerpted from the Regional Energy-Environmental Data Book (draft) for the Midwest Region (Argonne National Laboratory, October, 1978).

of the nuclear plant capacity. The disposal of radioactive and other hazardous wastes is becoming a serious environmental issue in the region, however, and representatives from several major utilities have expressed the concern that the development of nuclear power cannot continue until an environmentally acceptable waste disposal method has been found. The state of Wisconsin has a legislated moratorium on the construction of nuclear plants.

Region 5 lies primarily in the Ohio, Great Lakes, and Upper Mississippi drainage basins. The major water quality problems in this area result from municipal and industrial loadings that often exceed the assimilative capacity of the stream. The Ohio River and its tributaries have experienced particularly severe industrial pollution, including thermal pollution from power plants. Streams in Ohio, Illinois, and Indiana are often excessively polluted by acid mine drainage from abandoned coal mining operations.

The Upper Mississippi River Basin is predominantly agricultural and runoff from agricultural land contributes large amounts of sediment as well as nutrients and pesticides to receiving streams. Reducing the discharge of nutrients, particularly phosphorus, into the lakes is a major goal of Great Lakes planning agencies. The mesotrophic status of some deep water parts of Lake Michigan and the advanced eutrophic state of some shorelines and bays are the major water quality problems. The water in many parts of central and northern Minnesota and Wisconsin is considered to be of good or superior quality, and is a valuable resource to the entire region.

Historically, water availability has not been a major problem in Region 5: the Great Lakes and the Mississippi, Ohio, Illinois and Wabash Rivers have provided plentiful supplies for utilities and industry. Large withdrawals in the Chicago area, however, have led to a U.S. Supreme Court ruling limiting withdrawals by Illinois. Allocations could be extended to other states if activities requiring large amounts of water continue to expand. Activities that may affect water quality and water supply in the Great Lakes are also subject to international agreements. These considerations, as well as state shoreline development policies and Coastal Zone plans, may affect the siting of large energy or industrial facilities along the Great Lakes.

Though the region is one of the most industrialized in the U.S., most of this development is limited to Ohio and the southern shores of the Great Lakes. Extensive forests remain in the northern parts of Michigan, Wisconsin, and Minnesota, and large acreages of Federal and state recreational lands can be found in these areas. Both sport and commercial hunting and fishing are economically significant, but the dominant land use in Region 5 is agriculture. The major crop areas are in Illinois and Indiana and in the southern parts of Wisconsin and Minnesota, where the original prairie vegetation was easily converted to cropland. The region is one of the most important producers of corn and soybeans in the nation, with nearly 30 million acres devoted to corn and 19 million acres to soybean crops in 1974.

The counties in the region can be categorized by socioeconomic assimilative capacity (a classification technique employing a multivariate clustering algorithm, developed at Argonne National Laboratory/Energy and Environmental Systems Division). The categories (high, moderate, low, and extra-low assimilative capacity) in this classification method are rough

measures of the adequacy of public services, facilities, and infrastructure of a county and thus of its ability to absorb population growth induced by energy or other local developments. The factors that are most influential in determining the assimilative capacity are population density, proximity to an urban center and basic economic activity.* Within Illinois, Indiana, and Ohio the distribution of counties having high and moderate assimilative capacities is predominantly in the northern and central sectors. The south counties have primarily low and extra low assimilative capacity. This distribution is reversed for the states of Wisconsin, Michigan and Minnesota which have population centers in the southern parts of the state. The finding that counties in all assimilative categories are distributed evenly throughout the region is consistent with the fact that 75% of the population in 1975 was estimated to be urban.

THE REGIONAL SCENARIO

The energy supply and demand scenario for Federal Region 5 is summarized in Table 5-1 and these projections were the basis for the county-level utility (Figures 5-1, 5-2, and 5-3), industrial, and mine siting patterns (developed by ORNL, BNL, and MITRE), which, in turn, provide the basis for the impact assessments.

PROJECTED ELECTRICAL GENERATING CAPACITY BY TECHNOLOGY
REGION 5

REGIONAL ASSESSMENT

NATIONAL OR MULTIREGIONAL ISSUES WITH REGIONAL IMPACTS

A number of issues cannot be limited to state or even regional boundaries because they are effectively the product of national or multi-regional

*Stenehjem, E.J., Argonne National Laboratory, unpublished information.

	1975	1985	1990
<u>ELECTRICAL GENERATING CAPACITY (10^3 MW)</u>			
Coal	63.9	79.5	86.9
Oil	15.5	22.0	26.2
Gas	2.4	4.7	4.1
Nuclear	9.7	24.3	34.5
Combined Cycle	0.2	0.2	5.6
Hydro	3.1	3.1	3.2
Solar	0	0.1	0.6
Geothermal	0	0	0
Other	<u>0</u>	<u>2.2</u>	<u>2.2</u>
TOTAL	94.8	136.1	163.3
<u>COAL PRODUCTION (10^6 tons)</u>			
Deep Mines	476.6	629.8	669.9
Surface Mines	<u>839.1</u>	<u>851.7</u>	<u>795.3</u>
TOTAL	1315.7	1481.5	1465.2
<u>INDUSTRIAL FUEL USE (10^{12} Btu)</u>			
Coal	16.3	1056.7	1109.4
Oil	296.3	459.3	531.8
Gas	<u>0.4</u>	<u>0.3</u>	<u>0.3</u>
TOTAL	313.0	1516.3	1641.5

Table 5-1

Projected Electrical Generating Capacity, Coal
Extraction, and Industrial Fuel Use - Region 5

1975 Electrical Generating
Capacity - Region 5
PIES Mid-Mid Scenario

Figure 5-1

1985 Electrical Generating
Capacity – Region 5
PIES Mid-Mid Scenario

Figure 5-2

1990 Electrical Generating
Capacity -- Region 5
PIES Mid-Mid Scenario

Figure 5-3

developments. Issues included in this category are national socioeconomic impacts, long-range transport of pollutants, and interregional natural water systems. National issues are of great importance because individual regions may bear disproportionately both the impacts and the cost of proposed remedies. Regional impacts from these broad range issues are shown in Table 5-2.

Long Range Transport, Visibility

Although states have traditionally established and enforced regulations restricting the placement and character of air pollutant sources, the Federal government has expanded its role in the establishment of national programs that have impact on development of new major sources across the country. Most of the national issues that have local and regional impacts have been dealt with in the Clean Air Amendments of 1977. Such issues include the establishment and promulgation of National Ambient Air Quality Standards (NAAQS), Prevention of Significant Deterioration (PSD) Class I Federal areas, visibility protection for clean and pristine areas, Federal New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAPS) and requirements for new state implementation plans (SIPs) in nonattainment areas, i.e., areas that have not attained national air quality standards.

Total exposure of population to concentrations of SO₂ and sulfate is high in Region 5—average SO₂ and sulfate concentrations due to long range transport rank third in the nation. Long range transport of these pollutants adds to the impact of local emissions on local air quality, and the contributions to ambient air quality from long range transport increments of SO₂ and sulfate could make areas with marginal air quality into nonattainment areas. The number of "marginal attainment" areas in Region 5 is large enough so that long range transport should be considered in attainment planning, though it is not likely that long range transport will have severe impact on energy development in the Midwest.

Another interregional impact of long range transport is that on local visibility. Congress has taken steps toward assuring visibility protection in Class I areas. Although EPA regulations will not be promulgated until 1980, it is safe to assume that significant plume blights or significant decreases in visibility will not be permitted in Class I areas. Region 5 has two states where visibility protection regulations could influence proposed fossil siting. In northeastern Minnesota, approximately one-seventh of the proposed coal growth could be subject to visibility protection regulations. In northern Michigan, small increases in oil, coal and combined cycle generating capacities are projected for counties adjacent to protected areas, and may be subject to visibility standards.

National Socioeconomic

The national socioeconomic impacts described here are those projected to occur in the Midwest as a whole (Federal Regions 5 and 7). The national analysis was not conducted on a Federal Region basis.

Capital costs associated with the construction of the energy facilities are expected to increase by an annual average of 0.8% through 1990. The

Table 5-2: Disaggregation of National Impacts to Regional Level: FEDERAL REGION 5

Air Quality				
	Visibility	Long Range Transport	National Socioeconomics	Water Resources
Coal:				
- Electric	L	L ¹	L	L ²
Oil	L	L	L	
Gas	L	L	L	
Nuclear	L	L	L	L
Solar:	L	L	L	

High - Large degree of certainty that conflict will arise at several facilities with no or little opportunity for cost effective mitigation.

Medium - Specified concern could occur at few facilities, but potential cost effective mitigation strategies available.

Low - Conflicts unlikely to occur.

¹ Long range transport of pollutants may become an issue in local areas where ambient levels for criteria pollutants are near standards. While the average contribution from long range transport may be small, it may, nevertheless, be sufficient to "push" ambient levels over national standards.

² Water allocation issues may arise for proposed utility or industrial facilities located along the Great Lakes.

principal increases in capital expenditure are calculated to be in the construction of low-Btu coal-fired power plants, oil refineries, gas distribution facilities, light water nuclear reactors, and electricity distribution facilities. The largest capital expenditures are associated with nuclear reactor construction, for which annual investment is expected to be \$2.8 billion (1977 dollars), or 20% of the total annual cost for all energy facilities.

Manpower requirements during the construction phase are expected to exceed 1.2 million man-years between 1976-90, and to be concentrated in the same sectors as the large capital investments. Annual labor demand is projected to increase during the construction phase and to be primarily composed of demand from the gas distribution facility, light water reactor and electricity distribution facility sectors. These three sectors will require 50% of the total construction manpower needs through 1990.

The operating costs of the energy facilities will increase at an annual rate of 2.0% reaching a peak of \$4.2 million in 1990. The sectors that have the greatest operating expense include underground coal mining, coal transportation, oil refineries, oil tank trucks, gas distribution and electricity distribution facilities. These sectors will account for 63% of the total annual operating costs attributable to the energy facilities.

Manpower requirements will increase in the operating phase from 1.2 to 1.8 million man-years. The greatest manpower demands will be concentrated in the sectors with the most significant operation costs are identified. These sectors comprise 75% of the annual manpower requirements during the years 1976-1990.

Since the Midwest is heavily industrialized, the manpower and resource requirements will not negatively affect the existing industries, but instead may have significant indirect impacts. The increased demand throughout the states for equipment, goods and services from both the development inside and outside the region may slow the loss of businesses from this region. Any problematic impacts could be mitigated through interstate cooperation and effective regional planning.

Inland and Coastal Water Resources

The water quality of the Great Lakes is a matter of international treaty between the United States and Canada and adverse impacts from energy-related activity could be addressed by the two countries. Therefore, effluent discharges from energy activity to the lakes are expected to be closely monitored and movement of energy activity away from the Lakes may be necessary.

Water levels of Lake Michigan are a subject of regional concern. Energy activity withdrawals sufficient to affect lake levels may create interstate conflicts in Wisconsin, Michigan, Illinois, and Indiana.

REGIONAL ISSUES

The issues described below are summarized in Table 5-3.

	Air	Water	Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:		Regional water quality/availability impacts were not identified with certainty for the regions. However, because of upstream consumption and pollutant loading from all future economic activities, the impact on downstream basins could become an issue, based on best basin management practices.							
-Coal	M					L	L		
-Oil	M					L	L		
-Gas	L					L			
-Nuclear	L					L	L		
-Combined Cycle	M								
-Solar									
-Hydro									
General:									
-Utility	M		L	M	L	L	L		
-Industry	H				M		L		
-Mining	L		M	M		L			

¹ Criteria for ranking of impacts are defined in the appendix. Blank entries mean either no impact or impact not addressed.

² Includes ground water.

³ Criteria are not provided for socioeconomic issues because their extreme localized nature cannot be reflected in the aggregated analysis.

Table 5-3

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the Regional Level - REGION 5

Local Air Quality, Visibility

In Region 5 Michigan, Wisconsin and Ohio are the states most likely to experience regulatory impediments as a result of the scenario-projected energy development. Michigan's primary air quality problems are expected to be in the eastern portion of the state where utility coal growth is projected to occur in nonattainment areas. Wisconsin has similar problems in the southeastern and central portions of the state. Additional emission offsets and improved control efficiencies will not significantly mitigate air quality problems in these areas. Nearly 30% of the projected utility coal growth in Ohio could be restricted because air quality regulations primarily NAAQS.

Projected growth of utility oil capacity in nonattainment areas appears to be greatest in the industrial states of Illinois, Indiana, and Ohio. Mitigation of impacts through fuel purchasing practices could greatly reduce the air quality impact from these facilities. Specific areas, such as the four county nonattainment areas surrounding Chicago, might require special attention.

Industrial growth projected by the scenario could be restricted by nonattainment air quality regulations in industrialized areas like Chicago, St. Louis, Detroit, and Cleveland. Specific restrictions will depend upon fuel selection and available emission offsets in each locality.

Water Quality/Availability

The utility activities analyzed for water-related impacts were coal, gas, oil, combined cycle (assuming coal type) and nuclear. Of these categories, 8.8% of the projected incremental increase in utility activity up to 1990 was identified as having a potential water related impact (assuming that effluent treatment beyond statutory point source requirements is implemented and/or that the 7 day-10 year low flow is maintained). This fraction represents 2.1% of the total utility activity projected by 1990 for Region 5.

Initiatives to improve water quality in the Great Lakes involving waste load reductions and limitations on additional loads, particularly to Lake Erie and Lake Michigan, are likely to be an issue in realizing the projected increases in utility activity. Technologies with phosphorus effluents (primarily coal-fired utilities and industries) will conflict with efforts to slow eutrophication in Great Lakes bays and shorelines and advanced waste treatment involving phosphorus loading reductions of 80-90% may be required. A United States Supreme Court ruling that limits water withdrawals from Lake Michigan in Illinois will constrain energy development on the Illinois shoreline. Projected increases would result in further allocation of withdrawals and may create regional water use conflicts.

Solid Waste

Disposal of all kinds of solid waste has become an important issue nationally. Historically, solid waste disposal has not been a constraint on new development; however, inexpensive dumping at nearby locations is a thing of the past.

Although all regions face the challenge of disposing of ash, sludge and other wastes in an environmentally acceptable manner, Region 5 will have more problems because of the large amount of waste involved.

Industrial disposal requires a large number of small sites. Some industries have their own disposal sites and others have municipal facilities. In crowded urban and industrialized areas, finding available land can be a problem; however, the institutional constraints associated with siting a new disposal facility can be an even greater problem. In most areas, technically feasible and environmentally acceptable sites can be found, but local opposition may block the construction of new landfills in those areas.

Industrial ash and sludge disposal problems are part of a larger general solid waste problem that affects the region. A report prepared by the Solid Waste Council of the Paper Industry says that the quantity of municipal solid waste generated nationally is expected to increase 30% from 1977 to 1990, and that the 150 largest U.S. metropolitan areas will account for two-thirds of that waste.¹

In general, disposal of ash and sludge from a coal-fired utility does not present as many problems as disposal of those wastes from industry, even though the quantities for the former are much greater. However, existing utilities that have to transport waste to off-site disposal areas often have to go further to find a site because of the high degree of industrialization and urbanization in many areas of the region.

The quantity of residuals generated from industrial coal use is the highest in the nation (3.7 million tons in 1975). Industrial coal usage is projected to increase 38% by 1990; however, land requirements for solid disposal are expected to grow by nearly 400% because the application of gas desulfurization (FGD) systems will increase the amount of solid generation.

Large quantities of waste are also produced by the utilities in this region. Coal-fired utility capacity is estimated to increase by nearly 40% for the period 1975-1990, to 88,000 MW. Application of FGD systems will increase the amount of waste generated.

The Resource Conservation and Recovery Act (RCRA) will regulate solid waste disposal. Although the strictest controls will exist for hazardous wastes, the Act will have a profound effect on all waste disposal. Currently, ash and sludge have a "special waste" status. The Act provides for an inventory and upgrading of existing landfills. At many waste-disposal facilities, upgrading will not be practical and their closure will result in at least a temporary shortage of landfills in the region.

There are still uncertainties about the RCRA program and the ability of both state and Federal governments to implement it. The EPA's solid waste program has been small with no regulatory responsibilities and most states have limited solid waste management programs. When the 1970 Clean Air Act and the 1972 Water Pollution Control Act were enacted, there already existed extensive pollution control programs operated on a state and regional basis by both EPA and well-staffed state agencies. The implementation of this ambitious new regulatory program will be an extremely important issue in this region.

Ecology/Land Use

The large acreages disturbed by surface mining activities present the greatest possibility for adverse ecological and land use impacts in the region. Mining in the region is projected to occur in central and southern Illinois, southwestern Indiana, and eastern Ohio, areas where the present land use is a mix of forested tracts and row crop agriculture. State and Federal (Office of Surface Mining) regulations require that mined lands be returned to their original productivity and land use.³ Reclamation costs in Region 5 will be high since mining in most of the region is most likely to disturb row crops or forested land. Mining in forested areas will have additional ecological impacts since restoration of the original ecosystem, if it occurs at all, would have to occur naturally over a long period of time.

Levels of SO₂ are projected to decrease below damage thresholds throughout the region in 1985, but in some urban-industrialized areas they are projected to increase again in 1990, primarily due to industrial coal use. Levels would be high enough in these areas to cause damage to regionally important crops such as soybeans, wheat, and fruit trees.

Figure 5-4

COAL MINING AREAS & POTENTIAL SO₂-INDUCED VEGETATION DAMAGE

Socioeconomic

Facilities of more than 70,000 MW of new generating capacity are sited for Region 5. The scenario indicates that the majority of these new facilities are to be located in low and extra-low assimilative capacity counties (see section on REGIONAL OVERVIEW). Depending on the proposed timing of the developments, size of the facilities, and the types of technologies to be sited, adverse socioeconomic impacts (resulting from a population increase greater than a 10% during only one year) will occur in many of these counties. There are other sited energy developments throughout the region that will incur adverse impacts, but the negative effects encountered will be overshadowed by increases in employment, growth in local income and tax base and other beneficial socioeconomic effects. These counties possess a moderate or high assimilative capacity and, because of their economic and demographic characteristics, the projected population growth due to the employment and capital requirements of the site development(s) did not exceed 10% of the baseline population.

Severe socioeconomic impacts are projected in counties absorbing 25% of the region's proposed coal capacity increases, 23% of the nuclear increases, 7% of the oil increases, 21% of the combined cycle increases, and 20% of the new mine workers. These capacity increases represent from 1% to 8% of total regional generating capacity. This conservatively estimated range indicates the percentage of the megawatt capacity increases projected for the region that would cause socioeconomic and societal impacts if the present siting distribution is realized. There are seven counties in Region 5 that would experience rapid population increases, extensive economic growth, sociocultural impacts, and institutional problems. These counties are expected to incur more of the negative adverse consequences of resource development since their existing workforce and infrastructure are insufficient to satisfy the manpower demands during the construction phase(s) and therefore require the in-migration of a transient labor force. In Indiana, Illinois and Wisconsin the negative effects of development are primarily attributable to coal and nuclear facility construction. The states of Michigan and Minnesota are not projected to incur severe negative impacts; Ohio has the potential of a larger than marginal impact if demands for the state's high sulfur coal are increased beyond the scenario specification.

The effects of the energy developments are projected to be pervasive within the seven susceptible counties. It is expected that the communities in these areas will experience shortfalls in facilities and services needed to house and provide for the in-migrants and that the frustrations caused by an overburdened social infrastructure will tend to increase turnover at the workplace with increasingly frequent in- and out-migration. Such experiences are not uncommon in these situations and often lead to social dissolution and deterioration.⁵⁻⁷ Such impacts and their effects on energy development cannot be aggregated to a regional level and, therefore, must remain a component of site-specific analysis.

REGION 5 ADVERSE SOCIOECONOMIC IMPACT AREAS

The affected counties are expected to experience a population increase of 30,000 new permanent employees and their dependents by 1990, or 0.07% of the current regional population (1976). This estimate of the extent of immigration is conservative since it is based on a projected population growth profile of the region that did not incorporate a detailed skill classification category. The exclusion of this variable may understate the true external workforce requirements for the affected sub-regions, and consequently, the region as a whole.

Health and Safety

Large amounts of energy related activities, ranging from extraction to electricity generation, occur in Region 5. Extraction, (specifically coal extraction) presents the highest risk of occupational health impacts. Occupational impacts of deep mining — injuries, disease, and deaths — are historically more severe than those from strip mining because of differences in dust exposure and accident risk.⁸ Illinois, Indiana, and Ohio contain the major coal reserves found in Region 5. Death, injuries, and disease from coal extraction in Region 5 account for approximately three-quarters of all energy-related occupational health impacts. Regional impacts of oil and gas extraction and refining and electricity generation are minimal, although these activities account for a significant percentage of impacts in Michigan, Wisconsin, and Minnesota where coal extraction does not occur.

Figure 5-6

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN REGION 5
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

The scenario projects an overall 11% increase in tons of coal extracted in Region 5, and an increase in the proportion mined underground (from 36% in 1975 to 45% in 1990). This could cause a 20-40% increase in the number of accidental deaths and injuries due to coal mining during the scenario timeframe. Cases of Chronic Respiratory Disease (CRD) and deaths due to CRD could increase 35-40%.

Figure 5-7

RANGE OF POTENTIAL ACCIDENTAL DEATHS IN REGION 5 COAL MINES
DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

Figure 5-8

Figure 5-8

RANGE OF POTENTIAL DEATHS AND CASES OF CHRONIC RESPIRATORY DISEASE (CRD) IN REGION 5 DUE TO COAL MINING OCCUPATIONAL EXPOSURE UNDER THE MID-MID SCENARIO

The public health impacts that will result from fulfillment of increased energy demands are dependent on the amount and type of pollutants released throughout the energy cycle and on the magnitude, age structure, and location of the exposed population. Utility and industrial fossil fuel use is the primary source of energy-related effluents that affect public health in Region 5. Most fossil fuel use occurs near densely populated areas. When fossil fuels are burned near highly populated areas, adverse health impacts increase. Although combustion of fossil fuels produces many effluents, the adverse impacts of sulfur oxides (SO_x) and particulates are best documented. Inhalation of these pollutants can adversely expose populations - most severely the high risk groups such as asthmatics and young children, cardiovascular patients and the elderly.⁹ Fifty to sixty percent of all deaths in Region 5 are attributable to cardiovascular and respiratory diseases, both of which are aggravated by emissions from fossil fuel use.

Public health impacts of sulfates released from industrial and utility fuel combustion in Region 5 are projected to decrease despite an increase in electricity generation of 40% and an increase in industrial fuel use of 240% by 1990. The decrease is primarily due to sulfur emission controls instituted during the assessment timeframe as dictated by the Clean Air Act. Public health impacts, measured in terms of individual risk and potential number of deaths, will drop by 48% and 35%, respectively. However, the magnitude of impact resulting from fossil fuel use will not be insignificant: the projected number of deaths is roughly equivalent to the number of homicides in the U.S. in 1975.¹⁰ The interregional, easterly dispersion pattern and long residence time of sulfate in the atmosphere will increase the adverse health impact in the eastern sections of the region.

Figure 5-9

ESTIMATED RANGE IN DEATHS IN REGION 5 FROM SO₄ EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

ILLINOIS

The scenario projects an additional 14,571 MW of electrical generating capacity in Illinois by 1985 and 21,622 MW by 1990. Coal production is projected to increase from a 1975 value of 59.7 million tons per year to 68.5 million tons per year in 1985 and 70.2 million tons per year in 1990. More than half of the coal is mined underground.

Table 5-4

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - ILLINOIS
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	2665	2794	1231	7840	0	35	14571
1975-1990	5558	4067	1111	8796	0	2090	21622

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Seventy percent of the fuel used in Illinois was imported from out-of-state in 1975, including 25% of the coal, 99% of the natural gas, 77% of the liquid fuels, and all of the uranium. Illinois, which ranks fourth in coal production in the U.S. exports 40% of the coal mined in the state. The sulfur content of Illinois coal is high (3-5%).

The impacts discussed in the following sections are summarized in Table 5-4.

Figure 5-10

ILLINOIS - POTENTIAL AIR QUALITY IMPACT AREAS

Air Quality/Visibility Impacts

- o Air quality should improve throughout Illinois between 1975 and 1990 assuming attainment by existing sources due to the enforcement of SIPs and to improved control technologies.
- o Continued TSP and SO₂ primary NAAQS violations are projected for several areas in Region 5 AQCRs. Forty-three percent of the projected 1990 utility oil increases and 33% of the combined cycle increases sited by the scenario in these areas are subject to review.

- o Over 65% of projected growth of industrial capacity may occur in non-attainment areas. Proper emission offsets may be required in these areas.

Description

Despite its vast coal reserves, Illinois consumes over twice as much fossil fuel as it produces. Illinois produces over $61,500 \times 10^3$ tons of coal annually (second largest producer in the region).¹¹ The majority of Illinois coal is burned locally or shipped to adjacent states. Because of its large and rapidly expanding energy requirements, Illinois must import increasing amounts of scarce fuels. The state currently imports over 740 billion cubic feet of natural gas annually. Faced with an increasing demand for fuel and dwindling supplies of available fuels, pressure to meet fuel demands with local coal production may increase. Expanded use of coal creates a greater environmental problem than might otherwise exist. Illinois coal has an average sulfur content of 3.2%¹² and use of fuel with such a high sulfur content places greater control requirements on new facilities.

Background Issues

- o Illinois air quality problems are most pronounced in the northeastern, central and southwestern portions of the state.
- o In the metropolitan Chicago Interstate AQCR, major industrial centers are prevalent, and nonattainment sites within that area have been designated for TSP standards. With the increasing economic activity, additional demand will be placed on new source development.
- o The air quality in the metropolitan St. Louis Interstate AQCR is characterized by TSP standard violations, and the air quality of Granite City has been ranked the worst of ten sites within the state. Decreases in the occurrence of violations in the area have not been noticeable even with more restrictive air pollution standards.
- o The metropolitan Dubuque Interstate AQCR has displayed an improvement in total particulate emissions with fewer violations of primary particulate standards.

Scenario-Induced Changes

- o Illinois does not have scenario-projected coal utility siting in non-attainment areas of the state. Although new source performance standards, control efficiencies and local regulations must be satisfied, no significant air quality issues exist for utility coal expansions.
- o Over 43% of the proposed utility oil growth is expected to occur in non-attainment areas. The northeastern corner of the state will be most affected by utility oil development. Selective fuel purchasing policies will mitigate air quality problems caused by emissions, but unavailable offsets and non-attainment provisions could constrain development.
- o One-third of the proposed combined cycle capacity could be constrained because of the inability of local areas to attain NAAQS air quality

standards. Fuel selection for these plants will be depend on the availability of appropriate offsets.

o Approximately 2/3 of the proposed industrial growth in Illinois will occur in nonattainment areas. Fuel use, emission limitations, and offset requirements may be necessary for these plants to meet new source review requirements.

Figure 5-11

Water Quality/Availability Issues

o More stringent waste load allocations and/or river basin management will be required to alleviate projected total dissolved solids, copper, chromium, and sulfate violations in the Fox, upper Illinois, and Sangamon Rivers (Illinois River Basin).

o Water availability may restrict projected utility siting in the northern counties because of seasonal low flows of the Rock and Fox Rivers and in central Illinois on the Sangamon River. Water allocation issues may restrict siting in the Lake Michigan basin.

Description

Major increases in utility siting are projected in the upper Illinois River Basin and near tributaries which drain northern and northeastern Illinois. Because of artificial flow reversal of the Chicago and Calumet Rivers, the Illinois basin also receives metropolitan Chicago waste water that would flow to Lake Michigan under natural conditions.

The southern portion of the basin has a large assimilative capacity, diminishing the effect of waste loads from the northern part of the state. However, parts of the southern Illinois River Basin experience mercury, phenol, and Biological Oxygen Demand (BOD) violations below industrialized areas and large municipal treatment facilities.

Background Issues^{13,14}

- o Illinois water quality and water availability issues are most pronounced in the northeastern river basins.
- o The Fox and Sangamon Rivers are frequently unable to assimilate industrial and municipal waste loads because of seasonal low flows.
- o Water removal from Lake Michigan is subject to allocation under Federal mandate. Water from the lake is used for drinking water, process water, and for sewage dilution by many municipalities in northeast Illinois.

Scenario-Induced Changes

- o Increases in total dissolved solids (TDS) and copper concentrations are projected in the Fox River, primarily from utility increases. River basin management and implementation of discharge standards would be expected to reduce the incidence of the copper violations.
- o The assimilative capacity of the Illinois River diminishes the severity of those violations which occur upstream. Although efforts are being made to improve the quality of the upper reaches, TDS levels are expected to increase.
- o Upper reaches of the Sangamon River would experience significant water depletions from increased utility activity, causing TDS, SO_4 , Cu, and Cr violations without flow augmentation and/or discharge management.

High residual concentrations would diminish downstream.

Figure 5-12

Solid Waste Impacts

- o Solid waste residuals are projected to increase by 500%. Indicators show nine counties where solid waste disposal may be a problem.
- o Utilities may have to transport wastes at additional cost, but solid waste problems should not constrain new development.

Figure 5-13

INDEX

1. Significant increase in land requirements for waste disposal along with high population density
2. Significant fraction of municipal wastes due to coal
3. Significant increase in industrial waste due to FGD sludges
4. Significant increase in TDS of municipal sewage due to FGD sludges

Background Issues

- o Illinois has excellent physical characteristics for solid waste disposal sites. Much of the state is underlaid by thick clay deposits.
- o Illinois has one of the most advanced solid waste management programs in the country, yet extensive new regulations proposed under RCRA will require the state to assume significant new responsibilities.
- o Industries are advised to begin looking for alternate sites several years in advance because of the difficulties and delays associated with issuing a permit for a new site.

Figure 5-14

Scenario-Induced Changes

- o Industrial coal use is projected to increase 43% by 1990. Solid waste residuals will increase by nearly 500% because of the application of FGD systems.
- o Land use for industrial waste disposal is estimated to increase to 32 acres per year by 1990.
- o Based on criteria relating to the availability of landfills and the potential impact on municipal sewer systems, nine counties may experience difficulty in disposing of industrial wastes. Disposal will be most difficult in areas constrained by both lack of landfill sites and inadequate sewer systems.

- o Installed coal-fired utility capacity is projected to increase 40% by 1990. The lifetime land requirement for utility wastes is estimated at 4,500 acres.
- o Some existing plants may find it necessary to transport wastes to an off-site disposal area at additional cost. New plants should be able to accommodate on-site disposal with proper planning.

Figure 5-75

PROJECTED 1990 LAND USE CHANGES BY SURFACE MINING
OR UTILITY CONSTRUCTION

Ecological and Land Use Impacts

- o Large amounts of land are projected to be disturbed by surface mining in southern and west central Illinois. Reclamation is known to be difficult in some of these areas, and permanent restoration of pre-mining row-crop productivity or forested ecosystems is likely to be difficult and costly.
- o Projected utility increases may require up to 6,000 acres in affected counties; croplands are most likely to be affected.

Description

Illinois is the most intensely agricultural state in Region 5; croplands cover 70% of the state, and Illinois contains nearly half of the regional acreage of corn, soybeans, and wheat. The southern tip of the state is largely forested with 257,000 acres preserved in National Forest lands. Natural vegetation in the northern two-thirds of the state, originally a mosaic of prairie and forest habitats, remains along streams and rivers and as isolated woodlots and prairie remnants in an agro-urban matrix.

Figure 5-16

Background Issues

- o The predominant land use over Illinois coal is agriculture, and it has been estimated that about 53% of the state's strippable reserve base is covered by land that can be classified as prime farmland.¹⁵
- o Significant acreages of National Forests and Wildlife Refuges are found in the major mining areas in the southern half of the state.
- o Land in the southern tip of Illinois has low natural fertility. This, along with acid drainage problems from abandoned mines, has made reclamation difficult in the area. High priority treatment has been suggested for strip-mined areas in Saline, Williamson, Jackson and Vermilion counties.

- o Soybeans, one of the major crops in Illinois, are highly sensitive to SO₂, as are other important crops such as wheat and small grains.
- o The forested areas in the southern counties are the only major large tracts of natural habitat remaining in the state.

Scenario-Induced Changes

- o Coal mining projected to occur in the state could disturb approximately 3,800 acres per year in 1985 and 3,600 acres per year in 1990. A total of approximately 56,000 acres could thus be disturbed during the scenario timeframe. Twenty-two counties in the state would be affected. Federal regulations require the return of strip-mined land that has been identified as prime agricultural land to its original productivity and land use, or to a higher productivity and better land use.³ Reclamation of mined lands to row crop agriculture is likely to be costly, and restoration of forested habitats in the southern tip of the state is problematic.
- o More than 48,000 acres are projected to be disturbed by surface mining in 8 counties in southern Illinois during the period 1975-1990. Mining activities in this area may be restricted because of the large acreages in National Wildlife Refuges and National Forest lands and the low natural soil fertility in the area that has made reclamation difficult in the past. Approximately 20% of the total surface mined coal output is projected for the 3 counties most severely affected.
- o Short-term SO₂ concentrations are generally projected to decrease, although the analysis shows that they will remain high enough to cause damage to existing vegetation, including soybean and wheat crops, in several areas in the state.

Figure 5-17

POTENTIAL CONSTRAINTS ON SURFACE MINING ACTIVITIES

- o Large utilities projected for the northern part of the state, and the population increases associated with them, could remove up to 6,000 acres of land from other productive uses. Croplands are most likely to be affected.
- o At least 12 species of plants and animals presently considered to be endangered in the U.S. were historically found in Illinois. Only one of these, the Illinois Mud Turtle, is presently known to occur in counties affected by the scenario.

Figure 5-18

Socioeconomic Issues

- o Severe socioeconomic impacts are projected for three scenario-defined sites for energy development in Illinois. The number of available workers in these counties and those adjacent to them may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Description

Illinois has the largest population—11.2 million people—and the highest percentage of urban residents of any state in Region 5. Most of the urban population is concentrated in the northeastern sector of the state or, more specifically, around Chicago. This area strongly influences the average per capita income for the state, \$6,792, since its population and density characteristics contrast sharply with those of the central and southern sectors, where the inhabitants are primarily farmers and miners.

The state economy is very diverse and therefore better able to withstand interruptions to particular segments of the state or national economy than a state dependent on one or two similar industries. Burdensome unemployment and workman's compensation taxes, increases in state government spending, especially for welfare and education, and unreasonable wage demands by labor, together with a unique tax on new plant and equipment investments, have contributed to a recent loss of businesses and manufacturing industries to other regions, particularly to the sunbelt states.¹⁷

Background Issues

o Local socioeconomic impacts are defined by the demographic, economic, and social changes associated with the siting, construction and operation of energy generating facilities. The interdependencies among labor supply, local public capital, and the availability of accessible sources of goods and services, define the most important spheres of socioeconomic impact.

o Characteristic socioeconomic trends attributable to energy developments include:^{18,19}

- Construction of energy facilities creates an almost instantaneous demand for employees.

- If the local labor force is insufficient to fill these demands, new workers and their families create rapid increases in local populations.

- The timing of energy facility construction and operation and the availability of local labor determine the levels of population increase that may be realized in a given county.

- The direct demands of the industry and the increased incomes paid to workers expands wholesale, retail, commercial, industrial, and service employment and, concomitantly, population.

- The larger the demographic differences between the new and existing populations, the more severe are sociocultural problems relating to social organization particular service needs.

- Revenue imbalance arises due to the immediate need for expenditures on services (e.g., schools, sewers, police, fire, utilities, and hospitals) and the delayed collection of revenues during plant construction.

- Shortfalls in public revenues and subsequent inadequacies in the provision of public services may have the undesirable consequence of stimulating population turnover, thereby worsening socioeconomic impacts.

- The provision of public services and facilities determines the quality of life that will be experienced by both the new and existing population in the county.

- If the quality of life decreases enough because of these problems, the productive labor force may leave, resulting in lower productivity in the

energy industry, decreased provision of services, and further social dissolution.

- o Increases in population of 10% or more during any given period are considered severe. Although the literature will ascribe a 7-15% increase range, the 10% figure used in this analysis is based on Gilmore's study¹⁹ which indicates that a 10% population increase is sufficient to result in social problems such as increased crime, divorce, out-migration, and labor turnover.

- o The capacity of counties to assimilate new employment and population growth is a function of base population size and density, manufacturing employment, and distance to the nearest trade center.

- o As a rough guide, counties with different assimilative capacities can absorb, without adverse levels of in-migration, the following types of energy activities:

- extra low assimilative capacity: no commercial scale energy facility or mine.

- low assimilative capacity: Small mining operations.

- moderate assimilative capacity: single plants or mines of moderate size.

- high assimilative capacity: single large-scale facilities or multiple facilities of smaller sizes.

- o The Illinois counties identified as potential sites for future energy generating facilities span the range from low to high assimilative capacity.

- o Within Illinois, there are 32 high assimilative counties, 31 moderate, 26 low and 13 extra low. These correspond to 17% of the high assimilative counties within the region, 19% of the moderate, 26.0% of the low and 19% of the extra low.

Scenario-Induced Changes

- o Most of the proposed developments are sited in counties with high assimilative capacity, where population growth due to in-migration is expected to be negligible.

- o Socioeconomic impacts are expected to be most pronounced in three Illinois counties, Jasper, Ogle and Grundy, where 37% of the scenario-projected capacity increase (in MW) for Illinois is sited. The in-migration of workers and their households into these counties during the construction phase is calculated to be 14,631 people or 17% of their existing population. Only 300 (or 0.6% of their baseline populations) would be required as permanent basic operating workers.

- o When the average regional public costs for the particular size and type counties are calculated, the new permanent residents (570) may incur additional public costs in excess of \$300,000 annually.

Figure 5-19

o During operation of the new generating facilities, two counties, Jasper and Grundy, may require additional in-migrant labor beyond the construction phase. This additional growth could significantly increase public expenditures for water treatment, with marginal increases for all other services analyzed.

o No infrastructures are currently established to mitigate these impacts, and many of the adjacent counties may experience similar energy and mining impacts on a smaller scale. Without proper management, control, and planning there could be adverse impacts in additional counties.

- o Of the scenario-defined increases in electrical generating capacity for Illinois by 1990, Jasper, Ogle, and Grundy counties are projected to absorb 47% of the increased coal-fired capacity, 99% of the oil steam, 25% of the nuclear, and 51% of the combined cycle.

Health and Safety Impacts

- o Estimated deaths from exposure to coal-generated sulfates are projected to decrease 56% because of sulfur control regulations and the location of new coal-fired facilities away from population centers.
- o Occupational health impacts from coal mining will be most severe in the southern portion of the state. Deaths in coal mines are projected to increase by approximately 25%.

Background Issues

- o 85% of the Illinois population currently lives in counties where 70% of the coal-fired electricity generation occurs.
- o Potentially dangerous levels of non-energy related environmental health stressors occur throughout Illinois, e.g., record ozone levels reported in Cook, Lake, and Madison counties in 1978, and NAAQS levels for particulates were exceeded in the Chicago area.
- o High sulfur coal is mined and burned in Illinois.
- o In 1973, 10% of the total deaths in Illinois were due to respiratory disease and 55% to cardiovascular disease; both diseases are susceptible to aggravation by SO_x exposure.²⁰
- o In localized areas, mine drainage²¹ has contaminated drinking water supplies. Saline county is an example.
- o Subsidence from abandoned underground mines remains a hazard in southern areas of the state in Franklin, Williamson, and Jackson counties.²¹
- o Most Illinois coal reserves are accessible only by high-risk deep mining techniques.

Scenario-Induced Changes

- o Potential deaths from surface mining activities are projected to decrease while those from underground mining may increase because of the shift from strip to deep mining techniques. Accidental deaths from mining will increase due to the increase in coal extraction, as well as the high risk associated with deep mining.

Figure 5-20

- o The increased health impact of deep mining will be reflected in the increase in the incidence of and deaths from Chronic Respiratory Disease.

- o Occupational health impacts of oil production and refining, natural gas production, and electricity generation will be minimal compared to impacts from coal extraction under this scenario.

- o Estimated deaths from sulfate exposure resulting from SO_x emissions from coal use may decrease approximately 56%. The decrease, which occurs despite significant increases in coal use, is due to the implementation of sulfur control regulations to be promulgated under the Clean Air Act, and also to the projected dispersion of coal use facilities in Illinois away from population centers.

Figure 5-22

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN ILLINOIS
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

Figure 5-23

ESTIMATED RANGE IN DEATHS IN ILLINOIS FROM SO₄ EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

INDIANA

The scenario projects an additional 5,987 MW of electrical generating capacity in Indiana by 1985 and 9,658 MW by 1990. Coal production is projected to increase from 25.1 million tons per year in 1975 to 27.7 million tons per year in 1985 and 28.7 million tons per year in 1990. More than 90% of the coal will be removed from surface mines. The impacts discussed in the following sections are summarized in Table 5-5.

Table 5-5

PROJECTED INCREASES IN ELECTRICAL GENERATING
CAPACITY (MW) - INDIANA
MID-MID SCENARIO

	PROJECTED INCREASES ¹ IN ELECTRICAL GENERATING CAPACITY (MW) - INDIANA MID-MID SCENARIO						
	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	3878	1535	-71	645	0	0	5987
1975-1990	3835	2127	-71	2905	81	781	9658

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

o Air quality is expected to improve dramatically in most non-attainment areas between 1975 and 1990, although the northwestern portion of the state is expected to continue to have primary NAAQS SO₂ air quality violations.

Figure 5-24

INDIANA - POTENTIAL AIR QUALITY IMPACT AREAS

- o With two exceptions, TSP air quality levels throughout the state are expected to comply with the Federal primary standard by 1990, assuming enforcement of the SIP. Northwestern and southwestern portions of the state may continue to exceed standards.
- o Nearly 25% of the proposed growth in utility oil capacity growth and 33% of the industrial growth is sited in nonattainment areas. Proper emission offsets may be required in these areas.

Description

Coal-fired plants provided over 83% of Indiana's electrical generating capacity in 1975.¹² The major sources of this coal have been Indiana and Kentucky. The average sulfur content of Indiana coal is greater than 3.5%, which has probably contributed to the air quality problems in the state, since that is far above the sulfur level of coal suitable for burning without extensive stack gas scrubbing.

Background Issues

- o Six counties in Indiana have SO₂ and TSP ambient concentrations that are in violation of Federal primary standards.
- o Indiana's air quality problem is most persistent in the northeastern part of the state, which is one of the most concentrated urban/industrial areas in the nation. Sulfur dioxide emissions in this area have resulted in air quality levels exceeding Federal standards by several hundred percent.
- o Though air quality problems exist in the Indianapolis area, primary standards are only marginally violated, and enforcement of the SIP could bring this area into compliance with Clean Air Act provisions.
- o Indiana has no designated visibility protected areas.

Scenario-Induced Changes

- o Indiana does not have scenario-projected coal utility siting in non-attainment areas of the state. Although new source performance standards, control efficiencies, and local regulations must be satisfied, no significant air quality issues exist for projected utility coal expansions.
- o Approximately 35% of the 1985 proposed utility oil growth is expected in nonattainment areas. Central Indiana will be most impacted by utility oil development. Selective fuel purchasing policies will mitigate air quality problems caused by emissions but unavailable emission offsets and nonattainment provisions could constrain development. By 1990, this area is projected to be in attainment.
- o One-third of the proposed industrial growth in Indiana could be restricted, in part, by nonattainment provisions of the Clean Air Act. Fuel use, emission limitation and offset requirements may be necessary for these plants to meet new source review requirements.

- o 1990 sulfur dioxide levels in the northwestern portion of the state may still be in violation of standards even though substantial reduction are projected to occur between 1975 and 1985.

Water Quality/Availability Issues

- o Projected increases in utility activity in the Patoka River Basin of southern Indiana may be constrained by a water availability shortfall.
- o An increase in coal mining activity in the Patoka Basin, projected for 1985 may exacerbate sulfate violations caused by drainage from abandoned strip mines.
- o Projected increases in utility siting in the heavily industrialized northwestern area of Indiana may cause an increase in phosphorus levels in streams tributary to Lake Michigan.

Figure 5-25

Description

Most of Indiana is drained by the Wabash and Ohio Rivers whose flows are sufficient to assimilate heavy waste loads.^{22,23} Small portions of the state lie in basins tributary to Lakes Michigan and Erie. The northwestern industrial corridor discharges wastes to Lake Michigan via the Indiana Ship Channel and to the Illinois River basin through the Calumet Sag Channel.

Water quality in the state is heavily affected by mineral extraction. One-fifth of Indiana contains coal resources.

Background Issues

- o The Patoka River Basin experiences widespread, mine-associated pollution problems. Acid drainage from abandoned strip mines is neutralized by underlying limestone strata resulting in water very high in total dissolved solids.
- o Several cities currently import water from other basins because groundwater and surface water supplies of the Patoka Basin are inadequate.
- o Phosphorus violations in streams tributary to Lake Michigan compound the eutrophication problems of the Lake. By agreement among Lake Michigan states and the EPA, effluent phosphorus loading reductions of 80% are now required.

Scenario-Induced Changes

- o Projected increases in phosphorus concentrations in the Calumet River will compound waste load allocation problems and may constrain the projected utility activity for northwestern Indiana.
- o Increases in sulfate concentrations in the Patoka River Basin will magnify the already severe water quality problems of the basin.

Figure 5-26

Solid Waste Impacts

o Industrial coal use is projected to decline, but solid waste residuals may increase because of application of FGD systems. Indicators show nine counties where solid waste disposal may present problems.

o Solid waste disposal problems should not constrain new utility development; however, additional costs would be incurred if the material has to be transported to an off-site disposal area.

Figure 5-27

Background Issues

o Industrial coal use in Indiana in 1975 was nearly 10 million tons, the second highest in the nation.

- o Finding a suitable disposal site in portions of the southern and northern part of the state is more difficult because of the karst topography of the former and Lake Michigan sands of the latter.

Scenario-Induced Changes

- o Projections based on the Mid-Mid scenario indicate that solid waste residuals will increase to 2.3 million tons per year by 1990 (or by 215% compared to 1975). The increase is due solely to FGD sludge; industrial coal use is projected to decline.

Figure 5-28

- o Land requirements for disposal are expected to increase to about 50 acres per year in 1990 from 16 acres per year in 1975.

- o Based on criteria relating to land availability and sewer capacity, nine counties may have difficulty disposing of industrial wastes. Areas constrained by both lack of landfill sites and inadequate sewer systems will have the most difficulty disposing of the wastes.

- o Installed coal-fired utility capacity is projected to increase to 15,000 MW by 1990 (or by 40% compared to 1975). The lifetime area requirement for solid waste disposal is projected at 3,000 acres.

- o Some existing facilities will have to transport waste off-site at additional cost. New plants should be able to plan for on-site disposal.

GREATEST POTENTIAL FOR ECOLOGICAL IMPACTS - INDIANA

Ecological and Land Use Impacts

o The potential for major land use and ecological impacts is greatest in the southwestern part of the state, where at least 7 major new generating facilities have been sited, and where surface mining is projected to disturb 57,000 acres by 1990. Croplands are most likely to be affected, but the possibility of adversely affecting natural forested habitats by construction, mining, or transmission corridors is high.

Description

The major land use in Indiana is farming with 61% of the state area devoted to croplands. The principal crops are corn and soybeans. Approximately 17% of the state remains forested, including 181,000 acres of National Forest lands in the south central part of the state. The major urban centers are in the northern half of the state, and the area along Lake Michigan is one of the most intensely developed industrial and population centers in the country.

Background Issues

o It has been estimated that as much as 45% of Indiana's strippable reserves of coal may be under land that can be classified as prime farmland.¹⁵

o The state's major energy demand centers are in the northern and central parts of the state. Although Lake Michigan is the major source of water for new energy facilities, siting along the Lake is difficult, because most of the shoreline has already been pre-empted for industrial, commercial, residential, or recreational use. Siting near the major water sources in the southern part of the state necessitates long transmission distances with the attendant adverse impact of transmission right-of-ways.

o Several of Indiana's major crops, such as soybeans, wheat, and hay are highly sensitive to SO_2 .

Scenario-Induced Changes

o Coal mining is projected to disturb approximately 4,500 acres per year in the southwestern part of the state in 1985 and about 4,300 acres per year in 1990. A total of 65,000 acres could thus be disturbed during the scenario timeframe. Seventeen counties would be affected. Since agriculture and forests are the major land uses in this area, reclamation costs of strip-mined land are likely to be high. No conflicts with National Forest lands are expected.

o Major new power generating facilities may require another 3,000 acres of agricultural and/or forest land in the southwestern tip of the state. Additional land is likely to be required for transmission lines to carry power from this less populated area to the urban load centers. Construction of the transmission corridors may lead to disruption of agricultural activities or dissection of forested habitat.

Figure 5-30

- o SO₂ concentrations in the Gary area are projected to continue at levels high enough to affect crops and natural vegetation in the area.
- o At least 12 species of animals presently considered to be endangered in the U.S. were historically found in counties affected by the scenario. Critical habitat for one of these, the Indiana bat, is found in one of the counties where mining is projected.

Socioeconomic Impacts

- o Severe socioeconomic impacts are projected for two scenario-defined sites for energy development in Indiana. The number of available workers in these counties and those adjacent to them may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Figure 5-31

Description

Indiana is the smallest state west of the Appalachian Mountains. It is basically a manufacturing state, with its northern counties surrounding the heavily industrialized areas of Chicago. The other important contributor to the state's balanced economy is farming.

The 5.3 million residents of Indiana are distributed over 36,077 square miles with a density factor of 147 people per square mile. The per capita income

is \$5,656, principally within the manufacturing and fuel development (excluding processing) sectors.

The state government has not become involved in power plant siting issues and, consequently, has been highly criticized by many academic, technical, and citizen representatives. Substantial citizen opposition to the construction of power plants in the Indiana/Kentucky river valley has arisen.

Background Issues

- o Indiana has 31 high assimilative capacity counties, 43 moderate, 12 low and 6 extra low. These correspond to 16% of the high assimilative capacity counties within the region, 26% of the moderate, 12% of the low and 9% of the extra low, respectively.
- o The Indiana counties identified as projected sites for energy development have either low, moderate, or high assimilative capacities.
- o There are no state power-plant siting regulations. This has resulted in construction of plants in flood plains and a lack of coordination with respect to operation requirements.¹⁷

Scenario-Induced Changes

- o New mines in the southwestern counties are expected to create more than 700 direct basic jobs.
- o Two counties, Gibson and Pike, are expected to experience severe adverse impacts as a result of a peak in-migration of 10,500 people over an eight-year period. These stable, moderately-sized industrial and farming counties are surrounded by the Ohio and Wabash rivers, have no major highway transportation routes, have only one secondary trade center within 60 miles, and have low population density relative to the rest of the state. They could incur a combined population growth of more than 23% of their baseline populations.²⁴

Figure 5-32

Figure 5-33

o Of the construction population increase, 845 people may remain, so that 444 basic workers can operate the newly constructed facilities.

o Socioeconomic impacts are compounded by the fact that additional developments are projected to occur in the counties adjacent to the two principally impacted. These concurrent developments can result in the employment of the calculated available workforce outside the counties and, thereby, cause a greater in-migration to fulfill the demands of local developments.

o Severe sociocultural problems are expected in these counties since they are inhabited by a large number of middle age and elderly residents, with a low per capita income (\$5,200) and a relatively stable, unskilled work force.²⁴

o When the average regional public costs for the particular size and type counties are calculated, the new permanent residents (845) may incur additional public costs in excess of \$475,000 annually.

o No infrastructures are currently established that would mitigate these impacts. Many of the adjacent counties may experience similar impacts on a smaller scale, and without proper management, control and planning these could also be adverse impacts.

o Of the projected increases in generating capacity in Indiana by 1990, the scenario sites 79% of the coal, 100% of the oil steam and 78% of the nuclear increases in Gibson and Pike counties. About 64% of the total increase in generating capacity by 1990 is sited in these counties.

o About 14% of the estimated 1990 mine employment in Indiana is likely to be in these two counties.

Health and Safety Impacts

- o Public health impacts of sulfur released from electricity generation and industrial fossil fuel use are projected to decrease, although the number of impacts per unit of fuel use may be higher in Indiana than in western portions of Region 5 because of interstate transport of sulfates.
- o The energy related occupational health impacts of implementing the scenario in Indiana are expected to be minimal.

Background Issues

- o The highly industrialized, heavy manufacturing area of northwestern Indiana has been cited in Federal court for polluting air and Lake Michigan water to levels dangerous to human health.
- o Respiratory and cardiovascular disease accounted for 8.5% and 54.8%, respectively, of all deaths in 1973.²⁰ Victims with either disease are highly susceptible to atmospheric concentrations of sulfur oxides and particulates.

Scenario-Induced Changes

- o Occupational health impacts due to energy related activities are likely to remain constant during the scenario timeframe in Indiana. Coal extraction is projected to account for over 60% of the total energy-related occupational health impacts.

Figure 5-34

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN INDIANA
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

- o Occupational impacts from coal extraction are expected to be small because 90% of the coal mining in Indiana is strip rather than deep mining.
- o Public health impacts from SO₄ exposure in Indiana are projected to decrease by 35-40% during the scenario timeframe. However, due to interstate transport of sulfate and easterly dispersion patterns, impact per unit of energy use may be higher in Indiana than in the western states of Region 5.

Figure 5-35

RANGE OF POTENTIAL ACCIDENTAL DEATHS IN INDIANA COAL MINES
DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

RANGE OF POTENTIAL DEATHS AND CASES OF CHRONIC RESPIRATORY
DISEASE (CRD) IN INDIANA DUE TO COAL MINING OCCUPATIONAL
EXPOSURE UNDER THE MID-MID SCENARIO

ESTIMATED RANGE IN DEATHS IN INDIANA FROM SO₂ EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

MICHIGAN

The scenario projects an additional 6,835 MW of electrical generating capacity in Michigan by 1985 and 14,169 MW by 1990. No coal mining is projected to occur in the state.

Although Michigan has an abundant energy resource base to fuel its industries, it produces only 4% of its total energy needs. In 1975, Michigan produced 8% of its oil needs, 10% of its natural gas needs, and imported the majority of its coal supply.

The impacts discussed in the following sections are summarized in the Appendix.

Table 5-6

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - MICHIGAN
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	1943	1246	444	3169	0	33	6835
1975-1990	4933	2139	79	4837	108	2073	14169

¹base year: 1975.

²includes conventional hydro and pumped storage

³includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

o 1990 TSP violations are projected for the southeastern and northeastern sections and SO₂ NAAQS violations in a localized area in the western portion of Michigan.

o Fifty-seven percent of the projected 1990 industrial growth and one-fourth of the combined cycle increases sited by the scenario in these areas are subject to review.

o Coal, oil, and combined cycle utilities sited in the Upper Peninsula and in northern lower Michigan could be subject to visibility protection statutes.

Figure 5-36

MICHIGAN - POTENTIAL AIR QUALITY IMPACT AREAS

Description

Coal (from Ohio, Kentucky, Pennsylvania, and Wyoming) and oil are the primary energy sources for electrical generation in Michigan. Heavy industrial activity in southern portions of the state contribute to air quality problems in that area. The air is relatively clean in the northern parts of the state, where wilderness uses predominate.

There are two PSD Class I areas in Michigan: Semey National Wilderness, which includes about 25,000 acres in the northern part of lower Michigan, and Isle Royale Natonal Park, a 540,000 acre island in Lake Superior.

Background Issues

- o Two counties in the state are in violation of primary SO₂ standards and four counties are in violation of primary particulate standards.
- o Southeastern Michigan is only marginally in violation of TSP standards even though the area is high in industrial activity.

Scenario-Induced Changes

- o Large coal capacity increases projected for western Michigan could cause violations of Federal primary SO₂ standards. SO₂ levels would increase substantially between 1985 and 1990.
- o NAAQS TSP violations are projected for the southeastern and northeastern portions of the state due, in part, to proposed increases in fossil fuel combustion.
- o 57% of industrial growth is projected for nonattainment areas. Emission offsets and appropriate control technologies will be required.
- o One-quarter of the proposed combined cycle power facilities could be restricted with regard to fuel use and emission control technology since they are sited in areas with marginal to poor air quality.
- o Small capacity increases in coal, oil, and combined cycle plants in the northern part of the state may be subject to visibility protection regulations.

Water Quality/Availability Issues

- o An increase in phosphorus and total dissolved solids loadings to Lake Huron resulting from the increased utility activity in the Saginaw River (Lake Huron Basin) may lead to an increase in eutrophication in Saginaw Bay.

Description

Water quality in Michigan ranges from pristine to severely degraded. Rivers exhibiting the lowest water quality are generally in the southern half of the Lower Peninsula. Practically every stream in the state drains into one of the Great Lakes. Thus, water quality within the state has a direct effect on Great Lakes water quality.

Overall, water quality is slowly improving; however, many shoreline areas remain contaminated by fecal coliform, mercury, and biocides.

Figure 5-37

MICHIGAN RIVER BASINS

Background Issues²⁵⁻²⁷

- o Several Great Lakes areas are highly eutrophic, particularly Saginaw Bay, Thunder Bay, western Lake Erie, and western Lake St. Clair. Of even greater concern is the mesotrophic status of the southern deep water areas of Lake Michigan.
- o Michigan has experienced high levels of mercury and biocide contamination both in rivers and the Great Lakes. Public use warnings and fish consumption limitations are in effect in many areas.
- o Water quality of the Great Lakes is an international issue involving the national and local governments of the United States and Canada. Requirements that phosphorus loadings be substantially reduced are in effect, but have not yet been met.

Scenario-Induced Changes

- o A projected increase in phosphorus concentration in the Grand River (Southern Lake Michigan Basin) in 1985 due to significantly increased utility activity could accelerate the mitigation along the shoreline unless advanced phosphorus removal techniques are implemented.

Figure 5-38

o According to the analysis, phosphorus levels are also projected to increase due to industrial and utility activity in the Saginaw River basin. Violations of total dissolved solids criteria may also occur in 1985 to 1990.

Figure 5-39

Solid Waste Impacts

o 1990 industrial solid waste residuals are projected to increase by 500%. Indicators show fifteen counties that may have difficulty disposing of the wastes.

o Installed coal-fired utility capacity is projected to increase by 70% compared to 1975. Solid waste disposal problems should not constrain development; however, disposal at some plants may be more expensive due to transportation costs.

[illegible]

- o A shallow overburden underlaid by bedrock and a high groundwater table characterizes much of the Upper Peninsula, making it difficult to find suitable waste disposal sites.
- o A liner will have to be used for an ash disposal pond at a proposed utility site in the upper Peninsula.
- o There has been concern in the Detroit area about contaminating groundwater by disposing of ash in an abandoned stone quarry.

- o Industrial coal use, 7.9 million tons per year in 1975, is expected to increase by 90% in 1990. Solid waste generation for this same period is projected to increase by over 500% due to the application of FGD systems.
- o Land requirements for industrial disposal are projected at 71 acres per year by 1990.
- o Based on criteria relating to the availability of municipal landfills and the potential impact of solid waste on sewer systems, fifteen counties may experience difficulty disposing of industrial wastes. Disposal will be most difficult in areas constrained by both lack of landfill sites and inadequate sewer systems.
- o Land requirements for utility waste disposal are estimated at 4,000 acres for the lifetime of the plants.

Figure 5-41

o Existing utilities located in or near high population density areas may eventually have to transport wastes to off-site disposal sites at additional cost. Most new plants should be able to plan for on-site disposal.

Figure 5-42

Ecological and Land Use Impacts

- o Relatively small acreages are likely to be required throughout the state for the projected new generating facilities, with the largest impacts in the Detroit and Grand Rapids areas.
- o Projected 1990 SO₂ concentrations in the Grand Rapids area are high enough to adversely affect exposed crops and sensitive natural vegetation.

Figure 5-43

GREATEST POTENTIAL FOR ECOLOGICAL IMPACTS - MICHIGAN

Description

Recreation is an important land use in Michigan, which remains 52% forested. There are 7.3 million acres of public recreation land in the state, 40% of which are in National Forests, Parks, and Wildlife Refuges. Much of this land is in the northern part of the state and in the Upper Peninsula. Michigan is boarded by four of the Great Lakes, and this large amount of shoreline is another important recreational resource. Twenty-three percent of the state is in croplands, including more than ten times as many acres in orchards as any other state in the region. Berries are another special agricultural product in Michigan.

Background Issues

- o The state has passed a "Shorelands Management Act" in order to preserve the environmental amenities of its shorelines by limiting development and fostering public acquisition of significant areas.
- o The "Farmland and Open Space Preservation Act" protects the land of participating owners from forced sales due to property tax increases. This could affect the siting of new power plants, especially at the edges of metropolitan areas.

- o The state's natural and agrarian ecosystems are particularly sensitive to high SO₂ levels, especially the fruit and berry crops and the coniferous forests of the northern part of the state.

Scenario-Induced Changes

- o The projected energy development in Michigan is not likely to require large amounts of land except in the Detroit and Grand Rapids areas, where approximately 4000 acres (total) may be disturbed for new utilities. Participation in the farmland preservation program is not yet high, thus the conversion of croplands in these areas may not be limited significantly.
- o Projected SO₂ levels in the Grand Rapids area may be high enough to cause damage to natural vegetation (some in National Forest and other preserves) and fruit, berry and vegetable crops being grown in the area. Forty to forty-five percent of the area of the affected counties is covered by vegetation sensitive to the projected SO₂ levels.
- o The siting of new facilities may become a controversial issue at the local level because of the Shorelands Management Act, the concern for the preservation of open space and fragile wetlands areas.

Socioeconomic Impacts

- o No adverse socioeconomic impacts are expected in Michigan since all projected electric utility increases are sited in high assimilative capacity counties able to absorb the population growth and associated public service demands resulting from energy development.

Health and Safety Impacts

- o Occupational health impacts of energy related activities will be minimal.
- o Deaths from SO₄ exposure due to industrial and electricity generation fuel use will decrease by 34% to 38% as a result of Clean Air Act initiatives despite a 40% increase in fossil-fueled electricity generation.

Background Issues

- o Michigan has experienced several episodes of environmentally released toxins such as PCB, PBB, and DDT that have threatened human life through direct exposure and biomagnification. The impact has been severe enough to force public health authorities to confiscate contaminated livestock and food stuffs.²⁸
- o Water concentrations of contaminants such as heavy metals and phenols along portions of heavily industrialized areas of the Detroit River, Saginaw River, Lake Erie, and Lake St. Clair violate levels acceptable for human use.²⁹

Scenario-Induced Changes

- o A minimal amount of occupational health and safety impacts will occur in Michigan due to electricity generation, oil production and refining, and gas production.

Figure 5-44

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN MICHIGAN
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

- o Despite a 49% increase in coal-fired electricity generation during the scenario timeframe, public health impacts from sulfates are projected to decrease in Michigan by 34-38% because of implementation of sulfur emission controls.

Figure 5-45

ESTIMATED RANGE IN DEATHS IN MICHIGAN FROM SO₄ EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

MINNESOTA

The scenario projects an additional 2,964 MW of electrical generating capacity in Minnesota by 1985 and 4,190 MW by 1990. No coal mining is projected to occur in the state.

Table 5-7

PROJECTED INCREASES ¹ IN ELECTRICAL GENERATING CAPACITY (MW) - MINNESOTA MID-MID SCENARIO							
	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	2350	160	429	0	0	25	2964
1975-1990	3150	460	426	0	0	154	4190

¹ base year: 1975.

² includes conventional hydro and pumped storage

³ includes solar, combined cycle, and "other".

Minnesota has no conventional fossil energy resources and imports the majority of its supplies. Presently, electric power plants are converting from oil to coal, and industries from natural gas to fuel oil. Canada supplies 88% of the fuel oil imported into the state, but that country is currently reducing its oil exports, which has led Minnesota to evaluate other fuel options such as low Btu coal gasification, nuclear power, and peat gasification.

The impacts discussed in the following sections are summarized in the Appendix.

Air Quality/Visibility Impacts

o Minnesota contains 8 counties which, in part, have not achieved primary SO₂ standards and 9 counties where TSP NAAQS violations are occurring. The entire northeastern portion of Minnesota, totaling over 860,000 acres, is protected under PSD Class I air quality regulations. Projected developments are not expected to cause significant deterioration of air quality, but potential visibility impacts, resulting from scenario-projected coal-burning power plants sited near a visibility protected area in the northeastern part of the state, could restrict such development.

Figure 5-46

MINNESOTA - POTENTIAL AIR QUALITY IMPACT AREAS

Water Quality/Availability Issues^{27,30}

o Minnesota has generally good water quality: state environmental officials estimate that 78% of the state's rivers already meet 1983 water quality goals. No significant scenario-induced changes in water quality were identified for Minnesota.

o Several streams in the extreme southern part of the state are subject to extremely low flows seasonally; however, no increases in energy-related activities were sited in these basins.

Solid Waste Impacts

o 1990 solid waste residuals from industrial coal usage are projected to increase by 110%. Indicators show only three counties that may have problems disposing of these wastes.

o Solid waste disposal problems should not constrain utility development; however, additional costs may be incurred when the material has to be transported to an off-site disposal area.

Figure 5-47

INDEX

1. Significant increase in land requirements for waste disposal along with high population density
2. Significant fraction of municipal wastes due to coal
3. Significant increase in industrial waste due to FGD sludges
4. Significant increase in TDS of municipal sewage due to FGD sludges

Background Issues

- o Present industrial coal use of less than 2 million tons per year. One-fourth of this is concentrated in one county, the remainder is scattered throughout 16 counties.
- o The fractured limestone topography in the southeastern portion of the state makes it more difficult to find an environmentally acceptable disposal site.
- o There is a continuing effort toward ash utilization, either in filling projects or concrete production.

Scenario-Induced Changes

- o Industrial coal use is projected to increase by 80% in 1990 relative to 1975. Solid waste generation is projected to increase by about 10%.

Figure 5-48

o Land requirements for disposal are projected to be 6 acres per year in 1990.

o Three counties may experience problems disposing of industrial wastes, based on criteria relating to availability of landfills and potential solid waste impact on municipal sewer systems; however, solid waste disposal associated with industrial coal use is not expected to pose a significant problem in Minnesota.

Figure 5-49

- o Installed coal-fired utility capacity will more than double by 1990, reaching 6,000 MW. New plants should be able to plan for on-site disposal. Some existing plants may have to transport wastes off-site, but no significant problems are foreseen.

Ecological and Land Use Impacts

- o Though the potential for adverse ecological and land use impacts is high in Minnesota, because of large amounts of natural habitat and shoreline acreage in the northern part of the state and the intense agricultural activity in the southern half of the state, impacts are expected to be minimal since only small acreages are projected to be disturbed for new energy facilities. State environmental legislation* and a power siting law³¹ may limit the number of sites available for these facilities, and will influence the siting process at the local level.

Socioeconomic Issues

- o No adverse socioeconomic impacts are expected in Minnesota since all projected electric utility increases are sited in counties that are able to absorb the population growth and associated public service demands resulting from energy development.

Health and Safety Impacts

- o Public and occupational health impacts of the scenario will be minimal in Minnesota. No fossil fuel reserves are currently economically recoverable in Minnesota. Although electricity generation is projected to increase by 61% and oil refining by 40%, the relatively low risk of these occupations will keep impacts small.
- o Public health impacts from sulfate exposure due to fossil fuel use will also be low despite a 90% increase in utility fossil fuel use. Increased control of sulfur emissions, and low potential for exposure, will keep impacts minimal.

OHIO

The scenario projects an additional 4,788 MW of electrical generating capacity in Ohio by 1985, and 11,400 MW by 1990. Coal production in the state is projected to increase from 46.3 million tons per year in 1975 to 52 million tons per year in 1985 and then decrease to 48 million tons per year in 1990. More than half of this coal comes from surface mines.

*Relevant legislation includes the Critical Areas Act of 1973 (authorizes state to identify areas that would be damaged by uncontrolled development); The Shoreland Management Act of 1969, amended 1973 (directs coastal counties to develop zoning ordinances for shorelands); and the Green Acres Law of 1967, amended 1969 and 1973 (allows deferred taxation for agricultural land and private recreational, open space, and park land).

Ohio is one of the largest users and producers of coal in the nation. Ohio coal has a high sulfur content and low sulfur coal is presently being imported to blend with the Ohio coal. Little petroleum is used by Ohio industry, but there is a high degree of industrial dependence on natural gas.

The impacts discussed in the following sections are summarized in the Appendix.

Table 5-8

PROJECTED INCREASES ¹ IN ELECTRICAL GENERATING CAPACITY (MW) - OHIO MID-MID SCENARIO							
	Coal	Oil	Gas	Nuc.	Hydro ²	Other	Total
1975-1985	2061	136	-352	2893	40	10	4788
1975-1990	2951	971	-412	7090	40	760	11400

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

o Although ambient TSP levels are projected to decline by 1990, many areas within the state may continue to be in violation of standards. Additional coal generating capacity is projected in southeastern Ohio where current TSP violations occur.

o Over 33% of the scenario-projected utility oil growth, 56% of the proposed utility combined cycle, and 66% of the industrial growth are expected in nonattainment areas.

Figure 5-50

OHIO - POTENTIAL AIR QUALITY IMPACT AREAS

Description

Nearly all the eastern counties in Ohio have been designated as AQMAs, and the state has 23 counties in violation of primary SO₂ standards and 31 counties with violations of primary particulate standards. Southeastern Ohio, in particular, must decrease SO₂ emissions in order to comply with Clean Air Act requirements, and this has led to a major controversy in the state. A large part of Ohio's economy has been dependent on local coal mining, which is the principal employer in 25 of the 88 counties in the state. Requirements of the Clean Air Act have resulted in the steady decline in demand for high sulfur Ohio coal, and the EPA is presently considering comments on its proposed determination that significant economic disruption would result from utility compliance with environmental rules by switching to low-sulfur out-of-state coal. If the EPA decides that "significant local or regional economic disruption and unemployment" would result from the plan by Ohio utilities to burn out-of-state coal, the utilities could be compelled, under Section 125 of the Clean Air Act, to use locally or regionally available coal. This could involve the installation of pollution controls that would not be needed for low-sulfur coal.³²

Ohio has no visibility-protected areas.

Background Issues

o Particulate violations are most pronounced in counties along Lake Erie and the Ohio River, and TSP levels, in general, are significantly above Federal primary standards.

- o SO₂ levels are above primary standards in some parts of the state, but are expected to improve with enforcement of the SIP. The controversy over the importation of low-sulfur coal in order to attain these goals remains to be resolved.

Scenario-Induced Changes

- o The scenario projects additional coal generating capacity in areas in the Cincinnati Inter-state AQCR which is currently in violation of primary TSP standards.
- o Significant increases in TSP from power plants could offset air quality improvement from SIP enforcement in southwestern and eastern Ohio.
- o Over one-third of the scenario-projected oil growth occurs in non-attainment areas (Parkersburg-Marietta Inter-state AQCR).
- o Over 56% of the proposed combined cycle power plants may have restricted fuel use. Most of these increases are projected to occur in the Greater Metropolitan Cleveland and the Steubenville Winton-Wheeling Inter-state AQCRs.
- o Two-thirds of the industrial growth is proposed for areas with poor air quality.

Water Quality/Availability Issues

- o Major increases in utility activity projected to occur along the Lake Erie shoreline and Lake Erie tributaries may be constrained by state and Federal efforts to improve water quality in the lake.
- o Increases in surface mining activity in the Hocking River Basin may exacerbate mine-related pollution issues in that area. Projected decreases in surface mining in other Ohio river basins will probably not improve water quality because of the expected impact of reclamation activity and continuing drainage from abandoned mines.

Figure 5-51

OHIO RIVER BASINS

Description

Northern Ohio streams are tributary to Lake Erie and drain densely populated, heavily industrialized areas.³³ Central and southern Ohio are part of the Ohio River Basin. The area is characterized by large urban areas surrounded primarily by agricultural activity.

Extensive coal deposits occur in the Muskingum, Hocking and Raccoon basins. Drainage from abandoned strip mines and current mining activities have had major impacts on the quality of work in those basins and on the Ohio River mainstem.

Background Issues

- o Ohio water quality criteria are stricter in many respects than those of other Great Lakes states.
- o In general, the quality of Ohio rivers is very low, particularly near the industrialized cities in the north.
- o Many Ohio streams are subject to seasonal low flows when a large percentage of the total flow consists of effluents.
- o The Portage, Huron, and Grand Rivers in the Lake Erie Basin experience frequent water quality violations of limits on toxic substances, trace

metals, and phenols. Major increases in utility activity are projected in these basins.

- o The Grand River is subject to salt leaching from industrial disposal sites.

Scenario-Induced Changes

- o Violations of water quality criteria for sulfate and total dissolved solids may occur in the Grand River basin.

Figure 5-52

- o Although there is a projected net decrease in surface coal mining in Ohio, drainage from abandoned mines and reclamation of active mines will likely continue to degrade the water quality.

Solid Waste Impacts

- o Industrial coal use is projected to increase by 25%. Indicators show 27 counties that may experience difficulty disposing of these wastes.
- o Solid waste disposal problems should not constrain new utility development; however, several utilities may have to transport wastes to off-site disposal areas.

Figure 5-53

Background Issues

- o Present industrial coal use is 17 million tons per year, the highest of any state in the nation. The state, with several large urban areas, also generates large quantities of municipal solid waste.
- o Licensing a new disposal site is an extremely time-consuming process. Industries are advised to start looking at least 3 years before they actually need a new site.
- o Many utilities already have to haul ash to off-site disposal sites. Hauling distances tend to be further in some of the highly urbanized and industrialized areas, significantly increasing the cost of disposal.

Scenario-Induced Changes

- o Industrial coal use is projected to increase by 20%; however, the amount of waste generated is projected to increase by 370% due to the application of FGD systems.
- o Land requirements for industrial waste disposal are projected to be 160 acres per year.

Figure 5-54

o Based on criteria relating to the availability of landfills and the solid waste impact on municipal sewer systems, 27 counties may experience difficulty disposing of industrial wastes. Disposal will be most difficult in areas constrained by both lack of landfill sites and inadequate sewer systems.

Figure 5-55

- o Installed coal-fired utility capacity is projected to increase to 30,000 MW by 1990 (or by 13% compared to 1975). The lifetime land requirement for disposal of utility wastes is projected at 7,300 acres.

- o Although many existing utilities have waste disposal problems, new plants, with proper planning, should be able to provide for on-site disposal.

Ecological and Land Use Impacts

- o Large amounts of land are projected to be disturbed by surface and underground mining in the eastern part of the state in 1990. The potential for adverse ecosystem impacts is high since this area is largely forested.

- o Large utility increases sited for the shores of Lake Erie and the Ohio River could require the conversion of agricultural land and natural habitats.

Figure 5-56

GREATEST POTENTIAL FOR ECOLOGICAL IMPACTS - OHIO

Description

Ohio is the most urbanized state in Region 5, although farming remains an important land use. Forty-nine percent of the state is covered by croplands with the major crops being corn, soybeans, and wheat. Southeastern Ohio is hilly and largely forested and contains 69,000 acres of National Forest lands.

Background Issues

- o Surface mining in Ohio is a major land use concern; Ohio strip mining legislation conveys the authority to delete certain lands from coal mining.³⁴
- o Ohio's National Forest lands are located in the southern part of the coal mining area.

Scenario-Induced Changes

- o Coal mining projected by the scenario is potentially the most important energy-related ecological issue in Ohio. Surface mining is projected to disturb about 5,600 acres per year in 1985 and 5,100 acres per year in 1990. A total of 58,000 acres are thus projected to be surface mined in the eastern part of the state in the period 1975-1985, and 85,000 acres by 1990. An additional 3,800 acres of undermined land may be affected by subsidence by 1990 (2,400 acres by 1985). Forest and pasture land are the major land uses in the mining area; the greatest ecological impacts would occur if forested areas were mined since restoration of the original forest ecosystem is unlikely.

Figure 5-57

- o Although the state's National Forests are located in the coal mining area, little conflict may occur since only a small amount of mining activity is projected for the counties with Federal lands.

- o Approximately 2,500 acres of land in the Cleveland and Toledo areas and about 1,500 acres in the southern part of the state may be required for large (1000 MW or more) power plants projected by the scenario. The construction of these facilities and their attendant transmission lines would remove land from its present use (most likely cropland in the north and

natural habitat in the south) and may adversely affect shoreline ecosystems on Lake Erie.

o Although short-term SO₂ concentrations are high enough to damage crops in the northeastern part of the state in 1975, by 1985 these levels have decreased below the damage threshold except in the Mansfield area, where 40% of the land is covered by SO₂ sensitive vegetation.

Socioeconomic Issues

o Severe socioeconomic impacts are projected for one scenario-defined site for energy development in Ohio. The number of available workers in this county and those adjacent to it may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects in private sector goods.

Figure 5-58

Description

The Ohio population (10.8 million) resides principally in the northern half of the state and in the southwestern corner. This population is distributed over 41,000 square miles for a density of 263 people per square mile. This factor is heavily influenced by the more urbanized centers of Cleveland, Columbus, Akron and Cincinnati.

The state produces many heavy industrial goods including machinery, primary metals, fabricated steel products, and motor vehicles and equipment. The farming sector of the Ohio economy has been slowly declining although it still produces substantial income from dairy products and from corn, oats and hay crops. Overall, the durable goods sector is generally mature or aging and because of this, as well as uncertainties in

the primary metals industry (strongly dependent on the state of the economy), Ohio has an unemployment rate equivalent to the national level.¹

Background Issues

- o Ohio has 53 high assimilative capacity counties, 29 moderate, 5 low and 1 extra low. These correspond to 28% of the high assimilative capacity counties in the region, 17.3% of the moderate, 5% of the low and 2% of the extra low, respectively.
- o The Ohio counties identified as potential sites for future energy developments range from extra low to high assimilative capacity.

Scenario-Induced Changes

- o All scenario-projected energy developments except mining are sited in higher assimilative capacity counties which can absorb the calculated in-migrant population.
- o It is estimated that 38% of the projected total of 5,025 new miners will be employed in Monroe County in the southeastern section of the state, which currently does not contain a major industrial plant or transportation route. Monroe has only one community with a population greater than 1,000 people and has experienced an out-migration for the past decade. This is primarily attributed to the marginally productive farmland and the prospect of employment in adjacent counties.²⁴
- o 883 basic workers could be required in excess of the present and projected available workforce in this county. These workers and their families would increase the permanent population by 1,678 people or 11%.

Figure 5-59

- o When the average regional public costs for the particular size and type county are calculated, and the new residents (1678) may incur additional public costs in excess of \$900,000 annually. The public costs of expanding services in the affected county would be greatest for sewage disposal and water treatment, since these two services require the largest capital expenditures.

- o No infrastructures currently exist to mitigate the socioeconomic impacts. Since the adjacent counties may experience similar mining expansion impacts, proper management, control and planning are required to reduce the possibility for adverse impacts in these counties.

Health and Safety Impacts

- o A shift from surface to deep mining techniques is projected to result in a 7-18% increase in accidental impacts and a 35-40% increase in the incidence of chronic respiratory disease during the scenario timeframe. Coal extraction may account for more than 75% of energy related occupational health impacts in Ohio.

- o Although public health impacts from exposure to sulfates are projected to decrease significantly from 1975 levels because of implementation of Clean Air Act regulations, impacts per unit of fuel use will be higher than in other states due to interstate transport of sulfate.

Background Issues

- o Water in portions of several Ohio rivers (e.g., Mahoney, Cuyahoga) violate suggested EPA standards for domestic water supplies.²⁹

- o Many counties throughout Ohio have been designed as non-attainment areas for primary standards, and many others have been so designated for photochemical oxidants.³⁵

- o Acid drainage from abandoned coal mines in several counties of southeastern Ohio has contaminated groundwater.²⁹

- o Cardiovascular and respiratory diseases, both of which are aggravated by exposure to sulfur oxides and particulates, accounted for over sixty percent of total deaths in Ohio in 1973.²⁰

Scenario-Induced Changed

- o Accidental occupational deaths and injuries due to surface coal mining may decline slightly whereas deaths and injuries attributable to deep mining are projected to increase from 36% to 66% under the scenario.

- o As a result of a 43% increase in coal production using underground techniques, the number of deaths and cases of chronic respiratory disease attributable to coal extraction is expected to increase by approximately 37% to 44%.

Figure 5-60

RANGE OF POTENTIAL ACCIDENTAL DEATHS IN OHIO COAL MINES
DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

RANGE OF POTENTIAL DEATHS AND CASES OF CHRONIC RESPIRATORY
DISEASE (CRD) IN OHIO DUE TO COAL MINING OCCUPATIONAL
EXPOSURE UNDER THE MID-MID SCENARIO

o The relative contribution of coal extraction to overall energy-related occupational health impacts in Ohio will decrease because of significant projected increases in oil refining and electricity generation impacts. Coal extraction will still account for over 75% of total energy-related impacts. Extraction impacts will be centralized in the southeastern portion of the state.

Figure 5-61

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN OHIO
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

o Deaths from exposure to sulfate concentrations resulting from industrial and utility fossil fuel use are projected to decrease by approximately 45% due to increased control of sulfur emissions during the scenario timeframe. However, impacts per unit of fuel use will be higher in Ohio than in other states in Region 5 because of interstate transport of sulfates.

Figure 5-62

WISCONSIN

The scenario projects an additional 6,283 MW of electrical generating capacity in Wisconsin by 1985, and 7,651 MW by 1990. No coal mining is projected to occur in the state.

Table 5-9

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - WISCONSIN
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	2715	591	750	0	28	2199	6283
1975-1990	2603	879	662	1150	28	2329	7651

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Wisconsin imported 98% of its energy needs in 1977, principally in the form of fossil fuels. More than 85% of the imports came from Canada in 1976. Wisconsin also imports sizeable amounts of electricity from Illinois. The state's energy dependence is expected to decline with the implementation of conservation measures and more widespread use of emerging technologies. Wisconsin has initiated a plan to reduce energy growth to 1.2% annually by 1985. This is expected to be accomplished through rate

reform to encourage conservation, rather than flat block rates or the construction of new generating stations.

The impacts discussed in the following sections are summarized in the Appendix.

Air Quality/Visibility Impacts

o Overall air quality in 1990 is projected to improve over existing 1975 and projected 1985 levels assuming compliance of existing sources due to enforcement of SIP regulations and to improved control technologies.

o NAAQS SO₂ violations in 1990 may occur in the north-central AQCR and TSP violations in the southeastern AQCR of Wisconsin. These violations represent over 53% of projected utility coal growth, 18% of projected utility oil growth, and 100% of proposed combined cycle expansion.

Figure 5-63

WISCONSIN - POTENTIAL AIR QUALITY IMPACT AREAS

Description

Of the states in Region 5, Wisconsin burns the smallest quantity of fossil fuel. 1977 coal deliveries to steam plants were one-fifth of those to Ohio plants.¹² Oil and gas use is more prevalent as compared to other states in the region. Wisconsin's overall density of emission producing sources is significantly less than other midwestern states. Although Illinois has over 540 major installations capable of emitting 100 tons per year of criteria pollutants, Wisconsin has only 143 sources in the same category. Steel processes, a major source of particulate emissions, number over 72 in Illinois but only four in Wisconsin. Coal transported to Wisconsin comes primarily by train from the Montana/Wyoming region and the sulfur content are less than 1% and ash content is low. Expansion of fossil fuel use is not

likely to create air quality problems except in those counties where attainment problems already exist. Wisconsin has no PSD Class I areas.³⁵

Background Issues

- o Air quality problems exist in Wisconsin near industrial centers in the southeastern and central portions of the state.
- o Total suspended particulates have been a persistent problem in the southeast; however, total levels have decreased over the past decade in Milwaukee, the most industrialized area of the state.
- o High SO₂ levels are a problem in parts of the northcentral AQCR.
- o Visibility protected areas in the northern part of Wisconsin have the potential for influencing development in this area.

Scenario-Induced Changes

- o SO₂ violations may continue in the northcentral AQCR; however, levels will be lower in 1985 and 1990 than 1975 levels.
- o TSP violations will continue in the southeastern AQCR; however, substantial TSP improvements by 1990 will bring several localities into attainment of standards.
- o Over 53% of the proposed utility coal growth sited in this study will occur in non-attainment areas. Over one-third of Wisconsin's coal growth is projected in the southeast corner of the state where persistent particulate violations occur. Continued violations of short-term SO₂ and particulate air quality standards are expected in central Wisconsin where coal utility expansion is projected.
- o Only 18% of the proposed utility oil growth is likely to conflict with non-attainment provisions. The impact of utility oil development in Wisconsin could be mitigated by selective fuel purchasing policies.
- o 100% of Wisconsin's combined cycle capacity is proposed in non-attainment areas. Regulatory impediments will depend upon facility design and fuel selection. Use of coal as a primary fuel could have significant adverse impacts on particulate air quality levels.
- o About one-quarter of Wisconsin's industrial growth is projected in areas with poor air quality. Fuel selection and sufficient offsets could mitigate air quality issues.

Water Quality/Availability Issues

- o Projected increases in utility and industrial activity in counties adjacent to Lake Michigan may be constrained by water quality and availability issues.

Figure 5-64

WISCONSIN RIVER BASINS

Description

The Great Lakes are subject to water quality regulations at the international, Federal, and state levels. Ammonia, phosphorus, chlorides, and dissolved solids are of primary concern. Planning management for Lake Michigan requires an 80% reduction of phosphorus in effluents discharged to the lake.

Water demand from utilities may be high along the Lake Michigan shoreline, particularly in the southeast corner of the state if once-through cooling were not permitted.

Background Issues³⁶

- o Wisconsin has a history of concern for improving and maintaining the quality of the Lake Michigan shoreline.
- o Increasing concentrations of heavy metals such as Zinc, Cadmium, Nickel, and Mercury in the lake sediments has been observed and partly attributed to energy-related air emissions.
- o Discharges from heavy industrial development along the Fox River from Lake Winnebago to Green Bay have produced an accumulation of sludges with a high dissolved oxygen requirement. As a result, Green Bay is in advanced stages of eutrophication. Improved practices of effluent discharge are not expected to reduce the problem in the near future.

- o The Milwaukee River commonly discharges into Lake Michigan and violates standards, especially during heavy rainfalls. Eutrophication along the lake's shoreline in the vicinity of the river outfall is not uncommon.

Scenario-Induced Changes

- o Because the use of once-through cooling by future utilities will likely be restricted, the projected utility activity along the lake would use wet evaporative cooling, which requires substantially more water than does once-through cooling. Because large utility increases are projected, utilities may be required to develop alternative water supplies, use dry cooling, or locate away from the scenario-defined sites.

Solid Waste Impacts

- o Industrial solid waste generation is projected to increase by over 500%; the greatest proportion of this increase is due to the application of FGD systems. Indicators show eight counties that may have difficulty disposing of these wastes.

- o Coal-fired capacity is projected to increase by 68%. Solid waste problems are not expected to constrain development.

Figure 5-65

1. Significant increase in land requirements for waste disposal along with high population density
2. Significant fraction of municipal wastes due to coal
3. Significant increase in industrial waste due to FGD sludges
4. Significant increase in TDS of municipal sewage due to FGD sludges

Background Issues

- o State regulations prohibit disposal within any area where it can have a detrimental effect on surface or groundwater will result. This creates a situation where disposal near wetlands, on slopes, or above rock is prohibited; the best sites are then in the most productive farming areas of the state.
- o There is strong organized opposition to removing farmland from production. Recent legislation requires an agricultural impact statement for any action that impairs the productivity of five or more acres of land.
- o There are currently no FGD scrubbers in Wisconsin. Consequently, the Federal New Source Performance Standards will cause a substantial change in both pollution control technology and solid waste (sludge) production and disposal.

Scenario-Induced Changes

- o Industrial coal use is projected to increase by 82% and solid waste generation by over 500% by 1990.
- o Land requirements for disposal are projected to be 24 acres per year in 1990 compared to 3 acres per year in 1975.
- o Indicators show 8 counties that may have difficulty disposing of industrial wastes. Those areas constrained by both lack of landfill sites and inadequate sewer systems will have the most problems.
- o Some utilities will have to transport wastes to off-site disposal areas at additional cost; however, new plants should be able to plan for on-site disposal. Life-time utility land use requirements are projected at 1,500 acres.

Ecological and Land Use Impacts

- o Relatively small acreages, primarily of agricultural land, are projected to be disturbed throughout Wisconsin for new power facilities. Wisconsin has zoned its coastal areas along Lakes Michigan and Superior into conservancy, recreational-residential, and general purpose (including industrial use) areas, which limits the number of sites available for facilities projected for the Lake Michigan shoreline. A current moratorium on new nuclear power plants in the state makes it unlikely that a large nuclear facility projected for the western border of the state will be built.

Socioeconomic Issues

- o Severe socioeconomic impacts are projected for one scenario-defined site for energy development in Wisconsin. The number of available workers in this county and those adjacent to it may not be sufficient to fill all the newly created jobs. The affected area may experience shortages of local public services as well as price effects on private sector goods attributable to the immigration of additional workers.

Figure 5-66

Description

Wisconsin has a population of 4.6 million people distributed over almost 55,000 square miles. The average density for the state is 85 people per square mile but most of the urbanized areas are located in the southern and east-central sectors. The majority of the state's 1.5 million private and government workers are employed in this section of the state.

Figure 5-67

Agriculture is the cornerstone of the Wisconsin economy. In 1974 Wisconsin had 105,000 farms and a total acreage of 19,600,000. There are many interrelated industries in the state that complement the agricultural and dairy base. The trucking industry, for instance, assigns 40% of its hauling capacity to the transportation of farm products.

Tourism is a second major contributor to the state's economy. There are presently 30,000 businesses directly associated with serving tourists, representing 26% of the state's total retail service establishments.¹⁷

Background Issues

- o Within Wisconsin there are 25 high assimilative capacity counties, 21 moderate, 14 low and 11 extra low. This corresponds to 13% of the high assimilative capacity counties within the region, 13% of the moderate, 14% of the low, 17% of the extra low.
- o The Wisconsin counties identified as potential sites for future energy generating facilities have either an extra low or high assimilative capacity.

Scenario-Induced Changes

- o The construction of a projected nuclear plant on the western border of the state is the only scenario-defined energy development which is likely to create adverse socioeconomic impact since it is sited in a small rural county, Pepin. All of the counties in this area have extra low to moderate assimilative capacity.
- o The nuclear facility could require 1,980 basic construction workers at peak development. An estimated in-migration of 1669 workers and their families would temporarily increase the population by 3,171.

Figure 5-68

- o The in-migration of this number of basic workers could cause temporary shortfalls in the public revenues and inadequacies in the provision of public and private services. The absolute impact is dependent on the spatial distribution of the new in-migrants. Since Pepin is a very small county the probability of a larger area incurring impact is high.

- o The public costs for this 6-year increase in population is presently indeterminable. The costs are a function of the utilization rate and capacity of existing services. The public costs of expanding services in the affected county would be the greatest for sewage disposal and water treatment during the construction of the facility.

- o No infrastructures are currently established that would mitigate or prepare for the resultant impacts. Furthermore, it is uncertain, because of institutional and legislative constraints, whether this plant could be constructed.

- o 100% of the scenario-defined increase in nuclear generating capacity for the state (15% of the total new generating capacity projected for Wisconsin by 1990) is sited in Pepin county.

Health and Safety Impacts

- o Health impacts projected from the scenario will affect the general public more severely than they will occupational populations. Public health impacts will be most severe in the southeastern portion of the state but will be significantly smaller than 1975 impacts.

Background Issues

- o Ambient air concentrations of SO₂ and TSP that exceed proposed guidelines have been recorded in Dane, Columbia, Rock, Waukesha and Milwaukee counties.³⁵

- o In 1973, 8% of total deaths in Wisconsin were due to respiratory diseases, and 56% were due to cardiovascular disease; both diseases are aggravated by SO_x exposure.²⁰

- o 43% of the 1975 Wisconsin population lived in counties where 62% of the coal-fired electricity generation occurred.

- o No fossil fuel reserves are currently commercially recoverable in Wisconsin.

Scenario-Induced Changes

- o Projected energy-related occupational health impacts in Wisconsin will be minimal. Occupational impacts from operation and maintenance activity at electricity generation facilities and from fuel transportation may increase, but by 1990 these activities are projected to account for less than one death and fewer than 40 injuries per year in Wisconsin.

- o From 1975 to 1990, estimated deaths from SO₂ exposure due to fossil fuel use in Wisconsin are projected to decrease by 62% despite an increase

of 60% in fuel use. This decrease is primarily due to the observance of sulfur control regulations.

Figure 5-69

ESTIMATED RANGE IN DEATHS IN WISCONSIN FROM SO_4 EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

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FEDERAL REGION 6

OAK RIDGE NATIONAL LABORATORY

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Water Quality	Janet Hyndman
Air Quality	Dick Raridon
Visibility	Carl Petrich
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Socioeconomic	Bob Braid Charles Kerley Phil Scharre
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FEDERAL REGION 6

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REGIONAL OVERVIEW - REGION 6

Federal Region 6 (the South Central) is diverse in its culture, climate, and energy resources. Differences within the region affect energy use, the development of state and local policies, and the responses to proposed or existing national policies about energy and environment.

Heating degree days in Louisiana average one-third of the national average, while much of New Mexico's population lives in areas with one-third more heating degree days than the national average. The climate becomes progressively dryer from east to west, and rural population density decreases with the rainfall. Agriculture in the western part of the region relies heavily on irrigation and ranching; the central portion is part of the wheat belt; and the east is a mixture of large and small farms. New Mexico and western Texas and Oklahoma are culturally part of the West. The eastern portion of the region is culturally part of the South. The region has only four of the nation's 50 largest metropolitan areas, with three of these in Texas. Per capita personal income in the region is below the national average. In 1975, per capita income in Arkansas was 23% below the national average; Texas had the highest per capita income, which was still 5% below the national average. The region's housing consists of a higher percentage of mobile and single-family homes than does the nation as a whole.

The South Central Region has been the principal source of oil and natural gas for the nation, although extraction of these fuels has been declining since 1970. Only Arkansas pumped more oil in 1977 than it did in 1970, and this was only 1% of the regional total for 1977. Much of the region's income is from the extraction, processing, and exporting of these fuels to the rest of the country. It processes a substantial portion of the nation's imported oil. In addition, the region relies heavily on these fuels to meet its own energy needs; for example, Texas generates 90% of its electricity from burning natural gas. The region is understandably concerned with national energy policies that affect these fuels.

Substantial deposits of lignite are found in the region, and Texas had begun to develop these deposits to reduce its dependence on natural gas even before the oil embargo of 1973. New Mexico is the largest producer of uranium in the nation. It produces significant amounts of coal and is beginning to develop geothermal resources. The region has significant reserves in fuel wood (particularly in New Mexico), and agriculture in Louisiana yields substantial residues (bagasse) that could be burned directly or processed into fuels.

In addition to its concern over outside federal decisions that affect the region's energy industry, the region has several problems in meeting its own energy demand. Cooling water for power plants is in short supply in the High Plains and in New Mexico. New Mexico is concerned that its air and water resources not be preempted solely to produce electricity for export to other regions, such as California; Arkansas is concerned that energy development elsewhere upstream on the Arkansas River, when combined with federal environmental protection laws, may ultimately place limits on the state's economic growth.

The region is still poor by national standards, despite its recent economic growth, and its people do not wish to discourage future growth. The region also has a cultural tradition of self reliance—of trying to solve its own problems. It resents domination and interference by outsiders, whether they are businesses from another state or an agency from Washington. Although many people in the region are aware of potential environmental problems from energy development, the greater public concern is over economic impacts of oil price policies, orders to convert facilities to burn coal, and restrictions on air emissions.

REGIONAL SCENARIO

The energy supply and demand scenario for Federal Region 6 is summarized in Table 6-1. These projections were the basis for the county level utility, industrial, and mining siting patterns, developed by ORNL, BNL, and MITRE Corporation, which, in turn, provide the baseline for the impact statements. Whereas electrical generation accounts for over 75% of the industrial fuel use (thereby creating the larger proportion of environmental impacts), most of the analysis has focused on this sector. Figures 6-1 through 6-8 illustrate the regional distribution of electrical generation for coal, nuclear, oil, and gas between 1975 and 1990. Each graduated circle reflects the total electrical generation capacity for that county for the specified technology. All state projections are based upon the Mid-Range Projection series C Scenario and reflect the growth in electrical generation requirements to 1990.

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REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

A number of issues cannot be limited to state or even regional boundaries. They are the product of national or multiregional developments. Issues within this analysis that fall most naturally in this category are national socioeconomic impacts and long-range transport of pollutants. Additionally, impacts affecting major natural water systems may be a product of several of the regional entities assumed for this study. The issues, however, are of great importance because individual regions may bear disproportionately both the impacts and the cost of proposed remedies.

Table 6-1. Energy supply/demand balance for Region 6
(quadrillion Btu's per year)

Projection series ^a	1975	1985	1990
<u>Domestic production</u>			
Crude oil	12.54	9.92	8.18
NGL and butane	1.82	1.05	.82
Shale oil	0.00	0.00	.19
Natural gas	16.61	10.57	8.14
Coal	.39	1.23	1.93
Nuclear	0.05	0.46	0.85
Hydro and geothermal	0.08	0.10	0.22
Total domestic production	31.49	23.33	20.33
<u>Imports</u>			
Crude oil		4.22	6.06
Coal		.61	.66
Natural gas			2.49
Total imports		4.83	9.21
Total supply	31.49	28.16	29.54
<u>Domestic consumption</u>			
Oil	2.53	7.48	8.58
Natural gas	9.23	9.73	10.63
Coal	.34	1.84	2.59
Nuclear	.05	.46	.85
Hydro and geothermal	.08	.10	.22
Total domestic consumption	12.23	19.61	22.87
<u>Exports</u>			
Crude oil	2.89		
Petroleum products	20.96	24.68	23.45
Natural gas	6.87	.84	
Coal	.03		
Refinery loss	.09	.17	.12
Total consumption and export	43.07	45.30	46.44
<u>Domestic consumption by sector</u>			
Residential	1.49	2.07	2.25
Commercial	1.24	1.53	1.68
Industrial	7.24	12.62	15.43
Transportation	2.76	2.89	3.21
Total domestic consumption	12.73	19.11	22.57

^a Mid-Range Projection Series C

1975 COAL STEAM CAPACITY IN REGION VI

● 100 MWe

● 1,000 MWe

● 4,000 MWe

● 8,000 MWe

1990 COAL STEAM CAPACITY IN REGION VI

ORNL DWG 79-14426

1975 NUCLEAR CAPACITY IN REGION VI

Figure 6-3

Total nuclear steam electric
capacity by county for 1975.

1990 NUCLEAR CAPACITY IN REGION VI

OENL DWG 79-14428

1975 OIL STEAM CAPACITY IN REGION VI

1990 OIL STEAM CAPACITY IN REGION VI

Figure 6-6

Total oil steam electric
capacity by county for 1990.

1975 GAS STEAM CAPACITY IN REGION VI

1990 GAS STEAM CAPACITY IN REGION VI

Long-Range Transport, Visibility

Region 6 (New Mexico, Texas, Oklahoma, Arkansas, Louisiana) will not be significantly impacted by regions to the west (at least in terms of long-range transport of pollutants) mainly because of the general lack of any major metropolitan regions in the air flow leading to the area. Some problems with visibility will be possible, mainly from wind-blown dust. Any coal development in Arizona or New Mexico will affect the other eastern states, but not significantly.

National Socioeconomic Issues

Because of national demand for skilled construction and operation manpower, not only in energy but also in other industries, the South Central Region could experience possible shortages if the Series C Scenario is realistic. Energy development in Region 6 could be constrained in acquiring construction capital because of competing national demands. In addition, nuclear development will be affected by whether the nation resolves current reactor safety and waste disposal issues. This is closely tied to how the nation decides to handle licensing procedures.

Considerable conflict exists in the federal-state-local authority infrastructure. Disagreements among federal, state, and local agencies with regard to control of energy resources and who will use them have become a major issue for the nation as well as for Region 6. A conflict also exists between national commitments for energy development and the desire to preserve the environment. This is exemplified by the conflicting goals for the coal conversion section of the NEA and the Clean Air Act Amendments of 1977.

In terms of health and safety, several federal acts and compliance issues will affect the well-being of residents in the South Central Region. Enforcement of surface mining legislation will improve the water quality and diminish the possibility of health impacts in the region. Also, compliance with the clean air standards adopted by EPA will significantly reduce the exposure levels of sulfur dioxide (SO₂) and sulfates currently experienced by residents in Region 6, particularly in Texas. Finally, enforcement of safe mining practices will reduce the additional mine deaths that could result from the scenario's coal production levels.

Inland and Coastal Water Resources

Current EPA regulations regarding thermal discharge from power plants should be reexamined in view of the possible water shortage problems identified in the Series C Scenario. The current emphasis on wet cooling towers, in effect, may be trading the thermal problems of once-through cooling systems for a plethora of problems and conflicts associated with increased water consumption. Research and development of cooling options that consume less water, including evaluation of state and federal regulations that inhibit full utilization of residual heat, also should be examined. Alternative sources of cooling water, including groundwater, new and existing reservoir storage, and saline water, are especially needed to identify viable mitigation strategies. An appraisal of how state legislatures can best deal with water shortages is needed, particularly those

states following the riparian doctrine and containing problem basins defined in this analysis. Finally, data and projections of water use by competing (non-energy) sectors is greatly needed to assess water availability conflicts.

Regional Issues

The following is a summary of the environmental, social, and economic impacts of the scenario affecting the South Central Region. Issues identified are those impacting more than one state in the region.

Local Air Quality, Visibility

Violation of the National Ambient Air Quality Standards (NAAQS) for photochemical, total suspended particulates (TSP) and sulfur dioxide (SO₂) concentrations are currently occurring in several metropolitan areas of Region 6, most notably in the Dallas, Houston, and Albuquerque areas. Carbon monoxide problems are noted by EPA in the Albuquerque and Four Corners areas of New Mexico. These problems could become worse if the conversion of oil and gas boilers to burn coal occurs in the region.

Overall, air quality in Region 6 is not expected to improve appreciably during the period 1975-90 because emissions of noxious gases and particulates to the atmosphere are likely to increase. Table 6-2 gives a summary of SO₂ and TSP emissions by states for 1975 and 1990. Table 6-3 displays data on SO₂ and nitrogen oxide (NO_x) emissions for 1975, 1985, and 1990 for each of the Air Quality Control Regions (AQCRs) in Region VI (see Figure 6-9 for distribution of AQCRs). Although SO₂ may not be a severe problem, except in localized situations, it is readily converted in the atmosphere to sulfates which are thought to be a factor in health effects. Sulfur dioxide, sulfates, and NO_x all contribute to making precipitation more acidic. The pH of many lakes, particularly in the Northeast is now so low that fish populations are greatly reduced (Cronan and Schofield, 1979). Nitrogen oxide is also a factor in increased ozone levels.

Particulate emissions can cause problems due to the presence of undesirable trace elements, such as arsenic, cadmium, fluorine, and selenium, and trace organics such as benzopyrene (Vitez, 1976). Emissions of selenium are expected to increase with increased coal combustion, because it is volatile and cannot easily be controlled. Because coal also contains trace amounts (parts per million) of uranium, thorium, and their decay products, increased levels of radioactivity in the atmosphere may also result from increased coal combustion.

Local Air Quality Assessment

Where available, the following data were provided by ANL on a county-by-county basis: utility and industrial SO₂ and TSP emissions for 1975, 1985, and 1990; 1975 ambient air quality for SO₂ and TSP, and projections for 1985 and 1990; and an air quality impact assessment. The BNL emissions data were used for the 1985 and 1990 projections. The emissions assumptions were: State Implementation Plan (SIP) compliance by 1983 for existing sources, Energy Supply and Environmental Coordination Act conversions (ESECA) included; 90% SO₂ control for new utility sources; existing New Source Performance Standards (NSPS) controls for new industry sources;

Table 6-2. Summary of SO₂ and TSP emissions for Region VI (10³ tons/year)^{a/}

State	SO ₂			TSP		
	1975	1990	% change from 1975	1975	1990	% change from 1975
Arkansas	62	262	+ 423	164	210	+ 28
Louisiana	133	342	+ 257	178	253	+ 42
New Mexico	636	420	- 34	132	60	- 55
Oklahoma	68	231	+ 340	149	143	- 4
Texas	674	1632	+ 242	622	673	+ 8
Totals	1573	2887	+ 184	1245	1339	+ 8

^{a/} Data taken from SEAS, MED-MED Scenario

and 99% TSP control for new sources. Prevention of Significant Deterioration (PSD) Class I areas are shown in Figure 6-10.

The air quality (AQ) impact assessments are based on the following criteria: incremental AQ changes are compared with allowable PSD increments for Class I or Class II areas as appropriate; ambient AQ levels for 1985 and 1990 are compared with appropriate NAAQS; and percentage increase in emissions is calculated if no ambient data are available, and counties are flagged if the increase is greater than 25%.

Factors not included in the analysis are: contributions from long-range transport; subcounty siting factors in large counties, changes in emissions from sectors other than utility and industrial fuel combustion, area distribution, and metallurgical coal, local air quality regulations, contributions from rural fugitive dust, and cross-county impacts.

Table 6-4 summarizes the ambient air quality (AAQ) and incremental air quality (IAQ) results by listing the number of counties in each state for which nonattainment occurs or where there are PSD incremental violations.

For Region 6, there are data for 141 of the 502 counties, including three in Class I. In 1975, no counties were in nonattainment for SO₂, but 33 counties were in nonattainment for SO₂ in 1985 and 1990. One Class I county is in nonattainment for TSP for all three years. Since our present laws state that there will be no nonattainment areas in 1990, the counties listed here represent potential trouble spots which will have to be corrected by that date. In 1985, there will be 2 counties in PSD increment violation for SO₂ and nine counties for TSP. In 1990, the corresponding numbers are four and six. Figures 6-11 to 6-13 show the corresponding AQCRs involved. Figures 6-14 to 6-16 show the sulfur oxide (SO_x) emissions in the AQCRs of Region 6 for the three years.

AIR QUALITY CONTROL REGIONS IN REGION VI

Figure 6-9. Air quality control regions (AQCRs) in Region 6

Table 6-3

Annual SO₂ and NO_x emissions (kilctons) by air quality control regions

AQCR	SO ₂			TSP		
	1975	1985	1990	1975	1985	1990
12* ARIZONA - NEW MEXICO SOUTHERN BORDER	986	194	206	13	20	22
14* FOUR CORNERS	203	269	324	106	211	262
16 CENTRAL ARKANSAS	28	63	94	63	69	87
17 MET. FORT SMITH	5	37	56	22	36	46
18* MET. MEMPHIS	114	100	93	65	67	57
19 MONROE - EL DORADO	25	81	118	60	88	109
20 NE ARKANSAS	17	18	26	41	31	36
21 NW ARKANSAS	3	61	94	12	43	63
22 SHREVEPORT - TEXARKANA - TYLER	62	323	536	168	257	337
106 SOUTHERN LOUISIANA - SE TEXAS	231	556	788	515	591	689
152 ALBUQUERQUE - MID RIO GRANDE	4	15	23	39	56	71
153 EL PASO - LAS CRUCES - ALAMOGORDO	206	158	174	53	48	44
154 NORTHEASTERN PLAINS	0	0	1	4	4	4
155 PECOS - PERMIAN BASIN	16	18	17	31	27	29
156 SOUTHWESTERN MOUNTAINS - AUGUSTINE PLAINS	3	6	8	4	6	7
157 UPPER RIO GRANDE VALLEY	0	2	2	7	12	9
184 CENTRAL OKLAHOMA	8	25	31	75	78	44
185 NORTH CENTRAL OKLAHOMA	19	102	145	17	66	93
186 NE OKLAHOMA	22	88	128	87	107	135
187 NW OKLAHOMA	3	3	3	14	10	8
188 SE OKLAHOMA	10	20	24	46	51	41
189 SW OKLAHOMA	6	12	11	27	26	20
210 ABILENE - WICHITA FALLS	16	33	50	58	55	55
211 AMARILIO - LUBBOCK	23	117	174	74	103	123
212 AUSTIN - WACO	71	384	586	149	295	381
213 BROWNSVILLE - LAREDO	5	11	17	39	31	27
214 CORPUS CHRISTI - VICTORIA	59	126	177	94	111	117
215 MET. DALLAS - FORT WORTH	33	162	319	262	257	293
216 MET. HOUSTON - GALVESTON	272	504	699	411	437	442
217 MET. SAN ANTONIO	22	98	152	105	120	132
218 MIDLAND - ODessa - SAN ANGELO	11	19	27	42	35	36
Totals	2483	3605	5103	2713	3348	3852

*Includes a portion outside Region VI (data taken from SEAS).

CLASS I AREAS - REGION VI

Figure 6-10. Class I areas in Region 6

Table 6-4. Number of counties in each state with violations in ambient and incremental air quality for the period 1975-1990^a

Number of counties			Number of counties with violations of air quality standards by year and pollutant type										
State	Total	With data ^b	Number of PSD Class I counties	Ambient air quality 1975		Ambient air quality 1985		Ambient air quality 1990		Incremental air quality 1985		Incremental air quality 1990	
				SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP
Arkansas	75	15			12		12		11				
Louisiana	64	30			2	1	3	1	3	2	2	4	2
New Mexico	32	9	2		6 ^c		5 ^c		5 ^c				
Oklahoma	77	22	1		2		4		3		2		1
Texas	254	64			11		12		12		5		3
Totals	502	141	3	0	33	1	36	1	34	2	9	4	6

^a County data provided by Argonne National Laboratory.

^b A number of counties in each lack historical data for predicting changes in air quality. This number reflects the total number of counties with existing air quality data.

^c Includes one county in a PSD Class I area.

Table 6-5 summarizes the air quality impact assessment for 1985 and 1990. In addition to noting counties for nonattainment or increment violations, any county that will experience a greater than 25% increase in emissions but has no 1975 AAQ data is identified for further investigation. The numbers for nonattainment are similar to those in Table 6-2. Also included are counties where NAAQS or the PSD Class II increment is exceeded.

Long-Range Transport Assessments

Data on the long-range transport of SO_2 were obtained from BNL. Table 6-6 lists total fuel consumption, electrical generation, and SO_2 emissions for Region VI for each of the scenarios. There is a shift from oil to coal for utility use after 1975. The following data for both SO_2 and sulfate (SO_4) are provided for each state: area, population, concentration of pollutant (maximum, minimum, average, and population-weighted average), and exposure (product of population and population-weighted average concentration). This information forms the basic input to the health impact assessment.

Water Quality and Availability

Water shortages are projected throughout Region VI, primarily along the Texas-Gulf, Lower Arkansas-Red, and Colorado rivers. Of the 22 Water Resources Council Aggregated Subareas (ASAs) partially contained within the region (Figure 6-17) eleven are projected to have severe water shortages associated with significant levels of water consumption by energy. Five of these have medium impacts in the 1975 base year (Figure 6-18). Four ASAs are assessed to be highly impacted (as defined for the RIIA I analysis) by projected energy development, including the Lower Arkansas (ASA 1104), the Red-Sulphur (ASA 1107), Trinity-Galveston Bay (ASA 1202), and the Brazos (ASA 1203). Figure 6-19 illustrates the distribution of water-for-energy impacts assessed in Region 6.

Included among the medium impact basins are the Sabine-Neches (ASA 1201) and the Colorado of Texas (ASA 1204), both of which have potential for severe water shortage problems combined with high water-for-energy demands. These basins are not high impact basins because they contain planned or possible water resource projects which promise to alleviate any major constraints to energy development while being consistent with environmental protection. The remaining medium impact basins also have a high potential for severe water shortage, but comparatively low percentages of water-for-energy demands.

Areas identified as having water availability problems also tend to show water quality violations caused by utility effluents. ASAs with extremely limited surface flows were considered zero discharge areas for utility and industrial effluents in the water quality assessment. These ASAs are shown as having "flow restrictions" in Figures 6-20 and 6-22. Implementation of effluent controls and surface mine reclamation standards in mining areas may prevent water quality violations and cause some water quality improvement at the ASA level, but control of accidental releases and local problems are difficult to project.

AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES
SHOWING NON-ATTAINMENT FOR TSP

Figure 6-11

AQCRs with One or More Counties Showing Nonattainment
for TSP 1975, 1985, 1990

AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES EXCEEDING NAAQS OR PSD INCREMENTS IN 1985

NAAQS EXCEEDED
 PSD CLASS II EXCEEDED
 NAAQS & PSD CLASS II

Figure 6-12

AQCRs with One or More Counties Exceeding NAAQS or PSD
Increments in 1985

AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES EXCEEDING NAAQS OR PSD INCREMENTS IN 1990

NAAQS EXCEEDED

 PSD CLASS II EXCEEDED

 NAAQS & PSD CLASS II

Figure 6-13

AQCRs with One or More Counties Exceeding NAAQS or PSD
Increments in 1990

1975 SO_x EMISSIONS IN REGION VI (tons/mi²)

Figure 6-14. SO_x Emissions in 1975

1985 SO_x EMISSIONS IN REGION VI (tons/mi²)

Figure 6-15. SO_x Emissions in 1985

ORNL-DWG 79-11203

Figure 6-16. SO_x Emissions in 1990

Table 6-5. Air quality impact assessment
(Number of counties involved)^a

State	PSD Class I increment exceeded		Nonattainment continues for SO ₂		Nonattainment continues for TSP		National ambient air quality standard exceeded		PSD Class II increment exceeded		No 1975 air quality data, >25% increase in SO ₂ emissions		No 1975 air quality data, >25% increase in TSP emissions	
	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990	1985	1990
Arkansas					12	11					1	2	1	
Louisiana					2	2	2	2	1	3	16	19		
New Mexico					6	6								
Oklahoma					2	2	2	1			1	2		
Texas					10	10	1	1	3	1	12	18	3	1
Totals	0	0	0	0	32	31	5	4	4	4	30	41	4	1

^aCounty data provided by Argonne National Laboratory.

Table 6-6

Fuel consumption, electric generation, and SO₂ emission in Federal Region

Scenario	COAL			OIL			TOTAL		
	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr	SO ₂ ^a	Quads ^b /yr	Quads ^c /yr
<u>1975</u>									
Utilities	196	.083	.249	42	.737	2.237	238	.820	2.486
Industries	5		.005	216		2.752	221		2.757
<u>1985</u>									
Utilities (85%) ^d	806	.529	1.508	104	.035	.100	910	.564	1.608
Utilities (90%) ^d	804	.529	1.508	104	.035	.100	910	.564	1.608
Industries	93		.116	749		5.420	841		5.536
<u>1990</u>									
Utilities (85%) ^d	928	.732	2.087	124	.041	.118	1052	.773	2.205
Utilities (90%) ^d	903	.732	2.087	124	.041	.118	1027	.773	2.205
Industries	124		.152	1045		6.745	1169		6.897

^aEmission in 1000 tons/year^bElectric output (1 quad = 10¹⁵ Btu)^cTotal fuel use^dAssumed percent control of SO₂ emissions for plants built after 1982

AGGREGATED SUBAREAS IN REGION VI

Figure 6-17. Water Resources Council Aggregated Subareas (ASAs) in Region 6

1975 WATER-FOR-ENERGY QUANTITY IMPACTS REGION VI Mid-Range Projection Series C Scenario

LOW IMPACTS
 MEDIUM IMPACTS
 HIGH IMPACTS

SEVERE WATER SHORTAGE
IN MEETING DEMANDS BY
ALL SECTORS, WITH MOD-
ERATE WATER-FOR-ENERGY
DEMANDS.

Figure 6-18. Water-for-Energy Quantity Impacts in the 1975 Base Year

ORNL-DWG 79-12660

1990 WATER-FOR-ENERGY QUANTITY IMPACTS REGION VI Mid-Range Projection Series C Scenario

Figure 6-19. Water-for-Energy Quantity Impacts in 1990

The Texas Gulf area also has water quality violations in total dissolved solids, nitrates, and phosphorus from utility plant effluents. Increased coal use along the Gulf Coast, especially in Louisiana, may cause groundwater contamination from ash disposal facilities.

Land Use, Ecology, Solid Waste

Land Use

Data on power plant siting requirements indicate no significant conflict with existing land use practices. Texas, which will accommodate the majority of power plants for this region by 1990, will have approximately 12,000 acres directly impacted by power plant siting. On the other hand, parts of this region will be severely impacted by the extraction of energy resources. In particular, east Texas will have approximately 63,000 acres impacted by surface mining of lignite (Figure 6-23). The northwest corner of New Mexico (San Juan, McKinley and Valencia Counties) will also show signs of land use impacts with a total of 16 coal strip mines and 11 uranium mines scheduled to be in operation by 1990.

Ecology

At this time, there appear to be no major regional ecological impacts associated with energy utilization to the year 1990. Most impacts appear local and are the result of uranium and coal mining-related activities. For example, the critical habitat of an endangered species (Houston toad) may be impacted by coal mining activities in east Texas, whereas coal mining impacts in northwestern New Mexico may impact the black-footed ferret, peregrine falcon and bald eagle. However, a note of concern should be expressed at this point relative to the environmental impacts of air pollutants on both crops and natural vegetation. This document deals only with the counties where power plants are located and does not take into account the synergistic problems associated with downwind air pollution from multi-county sources. As indicated in the National Coal Utilization Assessment for the South (Davis 1978), the apparent effects of SO₂ on crops and forests are greater in counties not containing coal-fired power plants. Most noticeably there appears to be a potential problem between SO₂ and soybeans in the Mississippi River flood plain regions of Louisiana and Arkansas. Also there is a potential impact on commercial forests, primarily pine species, in Texas, Louisiana, and Arkansas (Figure 6-24). Note should be further made that the effects of sulfates (acide precipitation), NO_x and ozone are not documented for this region.

Solid Waste

Solid waste disposal does not constitute a significant scenario impact in Region 6. Of all energy-related activities, strip mining consumes the most land in disposing of a solid waste, in this case, overburden. Solid waste production from strip mining, along with land disturbance in Region 6, increases over the period because of substantial increases in coal production. For instance, Texas moves from 1469 acres per year in 1975 to 9525 acres per year in 1990. However, the impact of this level of activity is insignificant in relation to the size of Texas or even the counties in which the mining occurs.

1975 WATER QUALITY IMPACTS IN REGION VI

Figure 6-20. Water Quality Impacts in 1975

1985 WATER QUALITY IMPACTS IN REGION VI

BRAZOS, SABINE, TRINITY,
and NECHES RIVERS

Cooling towers for
electrical utilities
cause consumptive water
use and concentration
of dissolved minerals
aggravates existing
water quality problems.

COASTAL LOUISIANA

Heavy consumptive use
for cooling causes loc-
ally high TDS levels.

* Areas where evaporation exceeds
precipitation. Surface flows are
extremely limited. Zero discharge
was assumed for utility and indus-
trial boiler effluents.

Figure 6-21. Water Quality Impacts in 1985

1990 WATER QUALITY IMPACTS IN REGION VI

IMPACTS SEEN IN 1985
CONTINUE.

* Areas where evaporation exceeds precipitation. Surface flows are extremely limited. Zero discharge was assumed for utility and industrial boiler effluents.

Figure 6-22. Water Quality Impacts in 1990

IMPACTS ON LAND USE IN REGION VI COUNTIES Mid-Range Projection Series C Scenario

Figure 6-23. Impacts on Land Use

SO₂ IMPACTS ON VEGETATION-ECOLOGY IN REGION VI AQCR'S Mid-Range Projection Series C Scenario

Figure 6-24

Impacts of SO₂ Emissions on Vegetation-Ecology in 1975,
1985, 1990

Potential impacts from increased strip mining may be mitigated by the return to contour and reclamation requirements of the new strip mine law (PL 95-87, Federal Surface Mining and Control Act of 1977). The only potential problem with mining in Region 6 occurs in the northwestern corner of New Mexico, where reclamation will be hampered by the lack of rainfall.

Solid waste resulting from the production of energy in power plants and coal conversion facilities is not expected to constitute a major constraint on the deployment and operation of such facilities. BNL projections at the county level show increases in all states but at levels which constitute minimal land impact. BNL reviewed recent utility planning reports and found that utilities apparently can assemble sites with sufficient acreage for future waste disposal needs (BNL, 1978). The sites available to utilities have the basic attributes needed for onsite storage. Furthermore, most existing plant sites are apparently sufficiently large to accommodate increased solid waste storage in the event that scrubber systems are required by state regulatory agencies. In effect, it will be physically possible for utilities to find the land needed to dispose of large amounts of solid waste in the future.

The existence of sufficient land may not mean that the land is truly available to the utilities. If EPA classifies utility solid waste as hazardous under the Resource Conservation and Recovery Act, utilities will have to overcome public opposition to the presence of hazardous substances in local environments. Concern generated by incidents such as the Love Canal and the Kepone episodes have created a national issue where none existed a few years ago. The siting of commercial hazardous waste facilities for the general use of industry may be resisted strenuously by local groups and may become embroiled in local politics. The situation for a large utility, however, may be different. Utility disposal sites are normally part of the larger area occupied by the plant and under direct control and use by the utility. Ash ponds are a recognized accessory to power plants and do not suggest images of danger to the public.

While BNL did not supply information on solid waste generated by coal conversion facilities, the facilities are very similar to coal burning electric generating plants in solid waste production and can be grouped with power plants. For example, a solvent-refined coal process liquefaction plant of 50,000 bbl/day requires 20 acres/year for solid waste disposal (TRW, 1978). This is roughly equivalent to a large electrical generating plant. Ten such plants might be on line by 1990, contributing little additional solid waste impact.

To put the projected solid waste impacts in better perspective, an interesting comparison is one between utilities, which are expected to produce approximately 1 million tons of sludge by 1990 and other activities generating sludge waste, such as municipal sewage which will produce 55 million tons of sludge in 1980, or taconite mining, which generated 55 million tons of waste in 1971.

Solid waste production from the increased use of coal by industry is small compared to utility output, but it can create local impacts and environmental issues that would frustrate the mandated conversion to coal. Small

industries and industries with insufficient land and land unsuited to waste disposal traditionally ship their waste to commercial disposal facilities or release liquid wastes directly to a sewer system or a natural watercourse. If industries choose to ship the increased wastes generated by conversion to coal, they will bear relatively high transportation costs. Industry relocations may be hastened because of the conversion process, and local economic hardships may occur, particularly in areas that have lost industry in recent times. If industry uses liquid systems, they will have to negotiate with the receiving sewer system over increased loads of dissolved solids. If solid waste from industrial boilers and pollution control equipment is classified as hazardous waste, the added costs of handling hazardous waste will enhance structural and location impacts.

In summary, solid waste problems stemming from the energy fuel cycles will result in local economic adjustments and produce local political issues. However, solid waste and its associated problems do not pose a significant constraint on acquiring, transforming, and delivering energy.

Social, Economic, and Institutional

Social Impacts

Under the Series C Scenario, energy development is projected to occur in 67 of the 502 counties of Region 6 by 1990. This development is varied and includes 7 nuclear plants, 30 coal plants, 13 gas plants, 5 oil plants and coal mining activity in 23 counties. All the nuclear plants and 26 of the coal plants should be over 500-MWe capacity. The other plants are generally smaller, with only two gas plants over 500-MWe capacity. Thirteen of the counties (including ten in Texas) containing energy development are expected to experience significant socioeconomic impacts, which means that their population will increase at least 10% from temporary, in-migrant workers and dependents during the construction period as a result of the insufficient supply of skilled labor within commuting distance of the project. While there are many localized impacts in these, there are no significant statewide impacts during the construction phase of these developments. Consequently, no significant regional impacts are expected. Two states, Louisiana and Arkansas, are not expected to have any significant localized impacts during construction.

According to projections, most of the energy development and most of the significant impacts will occur in Texas. In the region as a whole, only a few localized socioeconomic impacts are expected during the operating phase of these energy developments, primarily as a result of projected increased public spending on services and facilities totaling approximately \$900,000 annually. The operation phase impacts on either statewide or regional levels should be insignificant, with eight counties experiencing projected population increases of approximately 3000 people. The absence of significant regional impacts does not reduce the potential severity of impacts on the local communities which are projected to be impacted by energy facilities by 1990.

Direct Economic Impact

Under the Series C Scenario, the direct economic impacts of the construction and operation of energy facilities in Region 6 cannot be established from data made available for such an assessment. The following tables contain pertinent data for the 14-state ORNL region (Region 6 minus New Mexico, plus DOE Region 4, Virginia and West Virginia) assigned under the Regional Studies Program and henceforth termed the South. Because Region VI is such a large component within this larger area in terms of energy production and use, considerable direct economic impact from construction and operation of energy facilities is assumed to occur.

The importance of the South's role in the national energy picture is clearly demonstrated in Table 6-7. From financial, employment, and materials standpoints, the construction and operation of energy facilities located in the South constitute almost half of all such activities occurring in the United States.

Table 6-7. Total annual costs of constructing and operating energy facilities in the South as a percentage of total U.S. costs

	1975	1976-1980	1981-1985	1986-1990
Construction				
Capital	47	46	46	48
Manpower	47	45	44	45
Resource (materials)	49	48	47	49
Operation				
Costs	51	50	58	46
Manpower	49	48	46	44
Resource (materials)	48	47	45	43

Another means of comparing the South's energy role with that of the rest of the country is on the basis of various energy types, as measured by estimated 1975 operating expenses. Such a comparison again indicates the 14-state region's predominance in either generating or supplying energy to the rest of the United States. The South's proportionate use of each fuel is depicted in Figure 6-25. These portions result in a combined total of 51% of the nation's output. It should be noted that this total includes costs of recovering, processing, and transporting energy to regions outside the South.

An additional basis for assessing the energy picture in the South is to identify the region's current and future energy use as measured by operating costs and employment requirements. Table 6-8 indicates that, under the Series C Scenario, coal, nuclear, and other fuel cycles will undergo expansion, while oil and gas will experience contraction relative to their previous degrees of utilization. In oil, the relative decrease measured in operating costs is moderate and, indeed, on an absolute basis, oil usage actually increases approximately 15% from 1975 to 1990. With gas, the relative decrease measured in operating costs is approximately 31% over 15 years, and the absolute decrease in gas utilization is approximately 12%.

THE SOUTH'S 1975 SHARE OF ENERGY PRODUCTION MEASURED BY OPERATING EXPENSES AND FUEL TYPE

Figure 6-25

The South's 1975 Share of Energy Production Measured
by Operating Expenses and Fuel Type

Two additional important issues for the South are raised by projections of the Series C Scenario. These issues are the availability of skilled construction and operations personnel and the availability of the large amount of capital required to construct projected energy facilities.

The scenario calls for a 27% increase in construction man-years and a 36% increase in operating man-years by 1985 to 1990 as compared to 1975 requirements.

With respect to financial considerations, the 1985-1990 projections call for increases in both construction capital and operating funds amounting to 30% over 1975 totals. These increases in themselves are significant. Assuming continuation of the serious escalations which have been occurring in manpower and financial requirements for energy facilities, it is apparent that potential shortages of skilled employees and national as well as utility-specific constraints on availability of capital could constitute serious barriers to implementation of the Series C Scenario in the South.

Table 6-8. South's energy mix (%) by time period as measured by operating costs (OC)/manpower requirements (MR)

Fuel cycle	1975 OC/MR	1976-1980 OC/MR	1981-1985 OC/MR	1986-1990 OC/MR
Coal	23/31	26/34	29/37	32/39
Oil	33/31	32/29	31/28	29/26
Gas	29/23	27/21	23/17	20/15
Nuclear	4/1	5/2	5/2	6/3
Other	10/14	11/15	12/16	14/18
Total	99/100	101/101	100/100	101/101

Indirect Economic Impacts

The indirect economic impacts on Region 6 of the construction of energy facilities throughout the United States in the Series C Scenario can be assessed to a limited degree from the data made available. The economic activity created by such construction will be heavily concentrated in a few sectors, as is evidenced in a 368-sector breakdown of the region's economy. The ten categories most affected (in absolute dollars of gross output) and the approximate gross output in millions of 1977 dollars for 1976-1980, 1981-1985, and 1986-1990 are indicated in Table 6-9.

The degree of concentration of the indirect impacts is clearly evidenced in the projections that between 45 and 46% of the Region 6 increase in gross output caused by nationwide energy facilities will occur in the ten most affected sectors in each of the three time periods. Five of these sectors (wholesale trade, retail trade, real estate, miscellaneous business services, and miscellaneous professional services) are not related directly to the

Table 6-9. Indirect impacts on Region 6 of the nationwide capital and manpower expenditures for construction of energy facilities^a

Ten leading industrial sectors		Increase in gross output in millions of 1977 dollars ^b		
Sector No.	Sector description	1976-1980	1981-1985	1986-1990
800	Crude petroleum and natural gas	270 (1.5)	305 (1.7)	329 (1.8)
3101	Petroleum refining and related	269 (1.5)	304 (1.7)	327 (1.8)
3701	Blast furnace, basic steel	110 (7.1)	126 (8.1)	131 (8.4)
4006	Fabricated plate	238 (41.9)	249 (43.9)	283 (49.9)
4503	Oil field machinery	250 (19.7)	246 (19.4)	232 (18.3)
6901	Wholesale trade	231 (1.9)	258 (2.1)	275 (2.3)
6902	Retail trade	220 (1.2)	252 (1.3)	275 (1.5)
7102	Real estate	220 (1.9)	249 (2.1)	276 (2.3)
7301	Miscellaneous business services	160 (3.3)	181 (3.8)	202 (4.2)
7303	Miscellaneous professional services	249 (8.3)	282 (9.4)	322 (10.8)
Total - top 10 sectors		2217	2452	2652
Total - 368 sectors		4816	5399	5866
Concentration in top 10 sectors		46.0%	45.4%	45.2%

^aGross output data provided by Lawrence Berkeley Laboratory.

^bNumbers in parentheses indicate increase in gross output as a percentage of that sector's gross output in 1972, measured in 1977 dollars.

energy industry, but the remaining five categories are either directly related to the industry (crude petroleum and natural gas, petroleum refining, and oil field machinery) or produce major components for energy facilities (basic steel and fabricated plate). Note that the three categories directly associated with the energy industry all involve oil and gas production, thus emphasizing the importance of those fuels in the region's energy base.

Finally, the four sectors of basic steel, fabricated plate, oil field machinery, and miscellaneous professional services will experience particularly significant increased annual demands. The fabricated plate industry warrants particular concern because the projections of the Series C Scenario would call for production increases over 1972 totals of at least 41.9%. Most of the output expansion in this industry would occur in Texas and Louisiana, which are the two largest fabricated plate producers in Region 6. Such a projected demand, if accurate, may be impossible for that industry to meet and could jeopardize attainment of the Series C Scenario.

Institutional Issues

Some institutional concerns affected most or all of the states in the federal region. Many were identified at a recent meeting of the Regional Energy Advisory Board, Southern Governor's Conference. Therefore, rather than repeating them in each state summary, they are listed here, and the more state-specific issues are listed in the state summaries. A few of the general issues appear also in the state summaries when state officials considered the problem especially acute.

- o Federal-state-local infrastructure—The relationship among the federal, state, and local governing bodies and agencies and the efficiency with which they work together is vital to resolving energy questions. The roles of regulatory agencies and energy offices are being redefined with new legislation. Federal legislation now demands more citizen participation and local input on industrial siting decisions as well as local initiative in many applications for federal funds. Many states do not have effective mechanisms for informing and helping local officials on such decisions. For example, the use of Prevention of Significant Deterioration increments can affect economic development in an area for many years, but local communities do not have sufficient air quality information to make informed choices (SINB, 1976 and SSEB, October 1978).

- o Federal Control—Many regulatory areas that were previously state concerns are now controlled by the federal government. There is a question within the states as to when the limit of federal power will be reached (Boercker and Davis, 1978a).

- o Conflict in priorities and regulations between the national commitment to produce energy and the desire to preserve the quality of the environment—The coal conversion sections of the National Energy Act and the Clean Air Act Amendments of 1977 (SINB, 1976; SSEB, October 1976; Boercker and Davis, 1978a) are in direct conflict. There is also the possibility that new surface mining regulations may bring about decreases in coal production (Boercker and Davis, 1978a).

- o Attitude of the states toward both economic and population growth vs. no growth—This attitude and the existence of pressure groups influences the acceptability and expansion of energy production facilities in the state (ORNL Staff discussion).
- o Need for information by industries on the choice of technology and technical and economic problems encountered in converting from gas or oil to coal (Boercker and Davis, 1978a).
- o Inadequate funding for state energy conservation programs (SSEB, 1978).
- o Nuclear licensing reform—Concern exists about the time delays in nuclear plant licensing. The Southern Governors' Conference and the National Governors' Association have said that the "states, cooperating in a regional framework are better qualified than the federal government to perform environmental review, forecast need for power and site energy facilities." (Boercker and Davis, 1978a and SSEB, October 1978).
- o Comprehensive federal regulatory overview needed for all energy facility siting—The suggestion was made that an agency other than DOE (e.g., EPA or the Department of Transportation) take the lead for developing comprehensive siting plans. This would also include problems of nuclear waste management, which will require new types of federal-state cooperation (Boercker and Davis, 1978a and SSEB, October 1978).
- o Transportation of coal—The adequacy and safety of the railroads, coal haul roads and bridges, barge facilities, and possible environmental and water impacts of slurry lines is of concern. Although this problem is more acute in coal-producing states, it is also a concern for states considering development of coal and those now turning to coal for electric power generation (SSEB, October 1978 and Boercker and Davis, 1978a).
- o Regulation and deregulation of crude oil and natural gas—This includes problems of stimulating development and funding of enhanced oil recovery techniques and the impact on state economies of federal control of intrastate gas (although the producing states will be most affected, other states rely on intrastate gas for supplementary supplies). (SINB, 1976; SSEB, October 1976; McBride et al., 1977.)
- o Standards for solar equipment inspection and installation (Boercker and Davis, 1978a).
- o Radiological hazards from coal—Although not considered to be a health hazard at this time, recent data have shown that the airborne radiation from some coal-fired plants exceeds the allowable limit for radiation from nuclear plants. The solid waste disposal potentially poses greater problems and is of concern to the states and the coal industry (SSEB, October 1978; Boercker and Davis, 1978b).
- o The development of the outer continental shelf—The aesthetic, community, and environmental impacts on the coastal states in the region are of concern to coastal states (McBride et al., 1977; SSEB, October 1978).

Table 6-10. Estimated mortality resulting from population exposure to fossil fuel combustion products^a

	Population (millions of people)			Population-weighted concentration ($\mu\text{g}/\text{m}^3$)			Range of estimated total deaths per year (60% confidence limits) ^b		
	1975	1985	1990	1975 ^c	1985 ^d	1990 ^d	1975 ^c	1985 ^d	1990 ^d
Arkansas	2.1	2.2	2.3	1.8	2.5	3.0	20-310	28-440	35-560
Louisiana	3.8	3.9	4.0	0.95	2.5	3.4	18-290	49-780	67-1100
New Mexico	1.2	1.1	1.2	0.22	0.39	0.45	1-20	2-34	3-41
Oklahoma	2.7	2.9	3.0	0.79	1.3	1.5	11-170	18-290	23-360
Texas	12.0	13.0	14.0	0.23	0.70	0.86	14-230	46-730	60-960

^aMortality projections developed from Brookhaven National Laboratory damage functions.

^bConfidence limits based on health damage function only.

^c1975 SO_4 , utility and industrial.

^d1985 and 1990 SO_4 , utility (85% control) and industrial.

Health and Safety

Table 6-10 summarizes estimated health effects of air pollution from the Series C Scenario for all states in Region 6 as projected by BNL. Only a range of possible risk or death is indicated, and caution is noted in interpreting the numbers to be absolute. The range of uncertainty is great.

Employees of fossil fuel extraction and processing industries in Texas will suffer the greatest total numbers of energy technology related deaths and injuries in the region. Power generation from coal- and gas-fired facilities is also among the highest in the region. The most health-damaging industries appear to be oil and natural gas production. The worker and general populations of Arkansas are at significant risk due to fossil fuel combustion, natural gas production, and oil electric generation.

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STATE ISSUES

The state assessments provide specific details of the possible impacts of the Mid-Range Projection C Scenario in contrast to the regional impacts discussed in the previous section. Each state section begins with a summary of the major findings. Discussions of the institutional/political issues are presented first, followed by discussions of the socioeconomic, water quality and availability, and the land, air, and health impacts. Any significant findings are presented at the beginning of each issue topic. Changes that could occur as a result of the scenario are discussed in relation to present conditions within the state. Graphics are used whenever desirable to enhance the reader's understanding.

Opinions from state officials have been used to help identify potential institutional and political issues. A complete sample of officials was not obtained due to the financial and time constraints of the project. The opinions used may not express the general opinion of all officials, nor the position of the state administration.

ARKANSAS

Arkansas is expected to receive moderate impacts from fuel use switching (principally to coal) resulting from the Series C Scenario. The most significantly impacted areas are air and water quality. By 1990, drainage basins will be significantly impacted in terms of water availability and water quality. Health impacts from increased coal use are also expected to be significant by 1990.

Institutional/Political Issues

Major Findings

o Institutional/political issues are not expected to restrain development of energy facilities within the state of Arkansas.

Existing Conditions

Arkansas has begun to turn to coal for its future electric generating needs with some assistance from gas-steam and hydroelectric power. In 1975 the state used 0.7 quads of energy (0.7×10^{18} joules). Only about 8% of this energy was in the form of electricity delivered to end users. Two-thirds of the electric generation was from gas and hydro. Arkansas enacted a "two-stop" power plant siting law in 1973 granting the Public Service Commission and the State Department of Pollution Control and Ecology authority to issue permits. Information sources within the state administration believe Arkansas will continue to use more coal and alternate sources of energy and limit the growth of nuclear power. Major studies are underway on lignite production and use within the state. The opinion of some state officials is that Arkansas should proceed with caution in the use of lignite, to ensure that it will be used in the best interest of the state. According to one state official, the increase in coal use will not overstress the transportation system.

Arkansas officials are concerned with both the state's economic growth and its status as a recreational center in relation to the effects of the coal conversion provisions of the Natural Gas Act. Some lessening of the air quality restrictions may be necessary if industries are to comply with the coal conversion provisions.

Scenario-Induced Changes

The scenario projects more than doubling Arkansas' generating capacity from 4,800 MW in 1975 to 12,400 MW in 1990 (Figs. 6-26 to 6-30). Two-thirds of the increase is expected to be from coal steam plants which will place an additional burden on the present road, river, and rail transportation systems. The utilities project more use of coal than the scenario, but projections for other technologies are comparable (Fig. 6-30). If oil shale is developed in Arkansas, it may impact a national wild river area. There are also concerns about the environmental and economic problems associated with developing Arkansas lignite.

Socioeconomic Issues

Major Findings

- o Arkansas is not expected to experience significant localized impacts from the construction of energy facilities. The counties receiving energy development will require moderate amounts of worker in-migration, if any at all.

Background

Energy development is expected to occur in seven Arkansas counties under the Series C Scenario. Five of these counties are rural and the other two are relatively urban. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of inmoving workers. A county is classified as significantly impacted if it is expected to have at least one year of at least 10% growth in population.

Scenario-Induced Changes

None of the seven Arkansas counties receiving energy development are expected to experience significant impacts from power plant construction.

Many of the counties with large developments should experience increases in the cost of providing public services and facilities, however none of these counties are expected to experience impacts during the operation period of the projects.

Water Quality and Availability Issues

Major Findings

- o In the Red-Sulphur River (ASA 1107) and Lower Arkansas River (ASA 1104) basins, utility plant effluent will add significantly to continuing background violations of the total dissolved solids (TDS) criterion.

COAL STEAM CAPACITY IN REGION VI

EXISTING 1975 CAPACITY
PROJECTED 1985 AND 1990 CAPACITY

Figure 6-26

Change in coal steam electric capacity by state.

NUCLEAR CAPACITY IN REGION VI EXISTING 1975 CAPACITY PROJECTED 1985 AND 1990 CAPACITY

Figure 6-27

Change in nuclear steam electric capacity by state.

OIL STEAM CAPACITY IN REGION VI EXISTING 1975 CAPACITY PROJECTED 1985 AND 1990 CAPACITY

Figure 6-28

Change in oil steam electric capacity by state.

GAS STEAM CAPACITY IN REGION VI EXISTING 1975 CAPACITY PROJECTED 1985 AND 1990 CAPACITY

Figure 6-29

Change in gas steam electric capacity by state.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN ARKANSAS

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	126	3,328	6,128	4,728	6,128
Oil Steam	315	315	315	315	315
Oil Peaking	194	1,461	194	1,611	194
Gas Steam	2,166	1,963	1,963	1,963	1,963
Gas Peaking	73	73	73	73	73
Nuclear	836	1,748	1,748	1,748	1,748
Hydro	1,092	1,092	1,092	1,092	1,092
Pump. Stor.	28	300	28	747	28
Solar	0	0	0	100	0
TOTAL	4,830	10,280	11,541	12,377	11,541

*ORNL's Data from utility data file.

Figure 6-30. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Arkansas.

o Severe water shortages associated with large water-for-energy demands are projected in the lower Arkansas (ASA 1104) and in the Red-Sulphur (ASA 1107) basins. These are downstream ASAs where water shortages are generally less severe; however, irrigation upstream diverts a great amount of flow. Total water consumption within these ASAs is moderate compared with more heavily irrigated areas farther to the west, but water demands by energy are substantially greater.

Existing Conditions

Major drainage regions for the U.S. have been delineated by the Water Resources Council. These basins are called Aggregated Subareas (ASAs) and are shown for Region 6 in Fig. 6-17. The rivers in Arkansas all flow from the west toward the Mississippi River (ASA 801) which forms the eastern border of the state. From north to south, the major river basins in Arkansas are the White River and its tributaries (ASA 1101), the Arkansas River (ASA 1104), the Sabine-Ouachita River system (included in ASA 802), and the Red-Sulphur River (ASA 1107).

Existing dissolved solids levels are highest (350-500 milligrams per liter) in the Arkansas and Sabine Rivers and in the mainstems of the Mississippi and White Rivers (120-350 milligram per liter). They are lower (less than 120 milligrams per liter) in most tributary areas. Suspended sediment levels are also highest (100-200 milligrams/liter) in the Mississippi and Arkansas Rivers. They are somewhat lower (50-100 milligrams/liter) in the White and Sabine-Ouachita systems, especially in tributary areas (Briggs and Ficke, 1977 and Geraghty et al., 1973).

Existing water supply problems are found within the Lower Arkansas (ASA 1104) and Red-Sulphur (ASA 1107) basins areas. In many areas both surface and groundwater supplies are insufficient to satisfy existing demands. Many domestic water companies and municipalities have water supply problems, and serious shortfalls may inhibit growth.

Arkansas has experienced progress in abating point-source pollution problems, including municipal and industrial discharges. There is a continuing problem with brine pollution from point and non-point sources in the south Arkansas oil fields, acid mine drainage in bauxite mining areas, and agricultural runoff. Progress is expected, however, in controlling brine and mine drainage discharges. Pollutants in agricultural runoff, including pesticides, nutrients, and sediments will be a continuing problem in the Mississippi delta area (U.S. Environmental Protection Agency, 1977).

Scenario-Induced Changes

Lower Arkansas River (ASA 1104). Major energy-related impacts in the lower Arkansas basin are expected to come from the generation of electricity. Dissolved solids levels, already higher than the current domestic water supply criterion (250 milligrams/liter), are expected to increase by 60 milligrams/liter in 1985 and 126 milligrams/liter in 1990. These concentrations are produced by new wet cooling towers. Though levels of iron and manganese in mine effluents will be reduced 90% and 60% respectively, background levels are expected to continue.

Increased water consumption in the Lower Arkansas by energy development will exacerbate existing water supply problems. Consumption by all sectors may exceed 90% of the estimated critical surface supply by 1990. Agricultural activity in the region is expected to decrease as more water rights are transferred to the energy, industrial, and domestic sectors. Groundwater will continue to be a major source of water, but this resource is being systematically depleted. Low streamflow in the fall may have adverse effects on aquatic habitats as well.

Mississippi-St. Francis River Basin (ASA 802). Energy related facilities in ASA 801 are not expected to cause significant water quality or availability changes by 1990. However, agricultural pollution will continue to be the major problem in the basin.

Ouachita-Sabine-Lower Mississippi River Basin (ASA 802). The levels of development specified by the Series C Scenario are not expected to cause significant water resource impacts in ASA 802. Pollution by brine from the southern Arkansas oil fields will continue to be a problem in some drainage areas, though improved point-source effluent control is expected (U.S. EPA, 1977).

Red-Sulphur River Basins (ASA 1107). New electrical utilities planned for the Red-Sulphur rivers are expected to increase the concentrations of TDS in this system by 135 milligrams per liter by 1990. While existing TDS background concentrations (at 200-500 milligrams per liter) already violate domestic water supply criteria, the predicted increase of 230 milligrams per liter caused by electrical generation would be significant.

Water consumption by energy facilities in 1990 is projected to be five times the amount used in 1975, totaling 104 million gallons per day under peak base load operation. Total water consumption by all sectors in 1990 exceeds 96% of the estimated critical surface supply and reduction of flows by consumptive use will further concentrate pollutants beyond the levels indicated.

Air Quality/Visibility Issues

Major Findings

o Acid rainfall may be a significant problem by 1990 according to state information sources if the areas' industry and utilities are forced to convert to coal as called for by the scenario. The scenario analysis, however, does not address these concerns although other studies have (Davis, et al., 1978).

Existing Air Quality Conditions

Several AQCRs (generally around Little Rock) presently have counties with high TSP concentration levels, but this may be caused by wind-blown dust, because current measured increases in TSP emissions are low. Other pollutant levels are relatively low for the state compared to other states in Region 6. No counties are currently experiencing SO₂ problems.

Scenario-Induced Changes

Twelve counties in AQCRs 16, 17, 18, 19, 20, and 22 are forecasted to continue nonattainment for TSP for 1985 and 1990. Although no areas are predicted to have significant increases in SO_2 and $\text{SO}_4^{=}$ some concern exists for the possibility of acid rain becoming a problem due to increased coal burning (EPA, 1977).

The Caney Creek Wilderness and the Upper Buffalo Wilderness (Fig. 6-10) are the only areas in Arkansas concerned with plume blight or regional haze. No significant impacts are expected by 1990.

Land/Ecological Issues

No serious impacts are predicted for the state of Arkansas.

Health/Safety Issues

Major Findings

- o Public health effects of exposure to fossil fuel combustion products is estimated to be of greater magnitude in Arkansas than in any other state in the region.
- o The scenario did not include anticipated expansion in west Arkansas lignite production, which could cause mining deaths and injuries to increase.

Existing Conditions

In 1975, occupational injuries, deaths and disease incidents were estimated for coal, oil, and natural gas extraction, oil refining, coal electric generation. Figure 6-31 shows the estimated pattern of risk from mining of coal by country for 1975. The single most hazardous technology was natural gas production, with an estimated 0.3 annual deaths and 26.0 annual injuries. No occupational hazard equaled the size of that produced by general public exposure to fossil fuel combustion products (20 to 310 annual deaths using a 60% confidence interval).

Scenario-Induced Changes

Occupational health hazards projected for energy technology worker within Arkansas are low- to mid-range for the region. However, the coal extraction scenario projections for this state do not reflect the expected increase in surface mining of lignite in the early 1980s (Rich, 1978) (Fig. 6-31). In contrast, Arkansas's general population is expected to be exposed to the region's greatest health risk from fossil fuel combustion (20 to 440 deaths annually between 1975 and 1990). This risk is considered low to moderate by Starr's ranking (Starr, 1976).

LOUISIANA

The health and safety of Louisiana's general population and energy-related work force will be significantly affected by the increase in coal use

ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG ARKANSAS COAL MINERS
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

NEGLIGIBLE MORTALITY
 0.0 TO 99.9
 100.0 TO 499.9
 500.0 TO 999.9
 1000.0 AND GREATER

Figure 6-31. Estimated mortality due to occupational accidents among Arkansas coal miners.

projected by the scenario. Although the scenario failed to capture anticipated development of Louisiana's lignite resources, state officials predict significant expansion in this industry, which is expected to increase occupational mortality and morbidity.

Air and water quality, and public health and safety problems are among the most significant concerns for Louisiana among the forecasted effects of the Series C Scenario. Some problems with acid rainfall have been noted in other studies (Davis, et al., 1978), and these problems may become more serious with the increased coal burning in the scenario.

Institutional/Political Issues

o Institutional/political issues are not expected to restrain energy development in general, but nuclear development may be impeded by construction costs, rate problems, and delays.

Existing Conditions

Louisiana's electricity generation is mainly from gas steam plants. In 1975 the state used 2.5 quads of energy (2.7×10^{18} joules). About 5% of this energy was in the form of electricity delivered to end users. The state is heavily dependent on natural gas which accounted for 82% of the total energy consumed in 1975.

Major concerns for the state's economy are: the effects of deregulation of natural gas, federal control over the large amounts of intrastate gas used in Louisiana, and the forced conversion of utilities from gas to coal. For example, 19 towns in the state own their own gas-fired electric generation plants and use the revenues to finance local government. Because these plants are not able to handle coal, several have sold out to large utilities.

Industries which located originally in Louisiana because of the availability of natural gas find that availability now threatened. In responding to this perceived threat Louisiana has joined Oklahoma in court action, "State of Oklahoma et al. vs Federal Energy Regulatory Commission," challenging the authority of the federal government to regulate intrastate gas. With the increased availability of natural gas, industries are not converting to coal as expected. Louisiana is expected to continue to use oil and gas as long as it is economically feasible, especially because of the cost of waste disposal problems which may be encountered from coal-fired installations. In addition, Louisiana has followed EPA's lead in designating coal sludge wastes as "special wastes," further inhibiting coal conversion. The state waste management program is now out for comment.

Because of the increased level of oil and gas drilling activity in the highly productive (marine life, waterfowl) coastal zone, one Louisiana official stated that the designation given the area by the Federal Bureau of Land Management is not adequate. He believes Louisiana should receive more funding for monitoring because the drilling activities are more concentrated in Louisiana than in other states' coastal areas.

Development of lignite is expected in the northern parishes, and the first commercial plant using lignite is scheduled to start in 1982. Over 400 test

hole permits have been granted by the state to companies searching for profitable veins of lignite in northern Louisiana.

Scenario-Induced Changes

The scenario projects that the state's generating capacity to almost double from 1975 (11,000 MW) to 1990 (22,00 MW), with the increase being accounted for mainly by coal steam (3,800 MW) and nuclear (3,000 MW) (Figs. 6-26 to 6-29). ORNL data on the utilities' plans for capacity match fairly well (except for oil peaking), but assume that the coal and nuclear facilities will come on line by 1985 rather than by 1990 , as the scenario predicts (Fig. 6-32). A Louisiana official reports that 950 MW of nuclear power, projected for 1984, have been postponed indefinitely. Louisiana does not have a power plant siting law; however, power plant sites are subject to standards of approval from several state agencies. A large portion of Louisiana has been designated as a "wetland" or "flood-plain" and officials state that this may constrain the siting of new electric generating facilities and the disposal of solid wastes from coal plants.

Officials see some problems in siting nuclear plants, but the main difficulties for nuclear lie in the areas of regulatory climate, rate problems, and the economics of construction. The Gulf States Utilities' Riverbend II facility has been postponed indefinitely as the result of the outlook for power, delay, and cost. There are several bills relating to nuclear control which have been submitted to the state legislature this year. Many of these were in response to the recent accident at Three Mile Island. Louisiana has passed a law prohibiting transport of high level nuclear wastes into the state. The intent is to keep nuclear wastes produced out-of-state from being stored in Louisiana.

With the increased emphasis on coal, the transportation of coal by rail to plants in Louisiana may cause vehicular traffic congestion in Alexandria and Shreveport. New generating facilities in the northern part of the state are expected to use lignite, in mine-mouth plants. Although landowners may be unwilling to lease the productive farmland for actual lignite development.

The scenario projects development of 500 MW of electricity from geothermal sources by 1990. State officials say the although the impacts of this type of development are hard to assess, the questions of ownership, liability, brine disposal, and subsidence need resolution.

Socioeconomic Issues

Major Findings

o Louisiana is not expected to experience significant local socioeconomic impacts from the construction of energy facilities. The parishes receiving energy development will require moderate amounts of worker in-migration, if any at all.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN LOUISIANA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)					
	1975		1985		1990	
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*	UTILITY*
Coal	0	1,610	3,230	3,760	3,760	3,760
Oil Steam	2,579	1,585	1,370	1,585	1,420	1,420
Oil Peaking	10	2,734	16	2,734	16	16
Gas Steam	8,307	10,057	10,208	9,953	10,133	10,133
Gas Peaking	121	121	121	121	121	121
Nuclear	0	1,165	3,045	3,045	3,045	3,045
Combined Cy.	100	180	100	180	100	100
Solar	0	0	0	100	0	0
Geothermal	0	0	0	500	0	0
Refuse	0	0	80	0	80	80
TOTAL	11,123	17,452	18,170	21,978	18,675	18,675

*ORNL's Data from utility data file.

Figure 6-32. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Louisiana.

Background

Energy development is expected to occur in ten Louisiana parishes under the scenario. Approximately half of these parishes are rural with low population densities while the others are more urbanized. Rural parishes will have a lower assimilative capacity for impacts from many in-movers. A parish is considered significantly impacted if it is expected to have at least one year of at least 10% growth in population. This increase is caused by an insufficient supply of basic labor within commuting distance of the plant.

Scenario-Induced Changes

None of the ten Louisiana parishes receiving energy development are expected to experience significant impacts from power plant construction. Several of the counties with large developments should experience increases in the cost of providing public services and facilities but no parishes are expected to experience impacts during the operating period of their respective projects.

Water Quality and Availability Issues

Major Findings.

- o Utility plant effluents will contribute to continuing violations of total dissolved solids levels in southern and western Louisiana. Utility coal use, which begins between 1975 and 1985 and increases through 1990 could cause groundwater contamination problems related to waste disposal, as Louisiana is entirely underlain by unconsolidated aquifers.
- o Water-for-energy development does not pose a problem in most of the state. However, along the extreme western border of Louisiana possible water shortage problems are projected in the lower Red-Sulphur (ASA 1107) and the Sabine-Neches (ASA 1201) Basins. Development of new coal-fired generating facilities using cooling towers may require modification of present water management practices.

Existing Conditions

Northwestern Louisiana drains into the Mississippi River through the Red (within ASA 1107) and Ouachita (within ASA 802) Rivers (Fig. 6-30). Southeastern Louisiana is the delta of the Mississippi River (ASA 803). The southwestern corner of the state is drained by several small coastal rivers, including the Pearl River (within ASA 309) and the Sabine River (ASA 1201), which forms most of Louisiana's western border.

Louisiana's major river basins show large difference in average concentrations of the major water quality constituents. Suspended sediment levels are very high (greater than 500 milligrams per liter) in the Red River basin, low (less than 50 milligrams per liter) in the Ouachita basin, and moderately high (100-200 milligram per liter) in the rest of the state. Dissolved solids are highest in the coastal rivers (500-1000 milligrams per liter) and in the main stems of the major rivers including the Sabine, Ouachita, Mississippi and Red Rivers (120-500 milligrams per liter). They

are lowest (less than 120 milligrams per liter) in tributaries in the central parts of the state (Briggs and Ficke, 1977; Geraghty et al., 1973).

The lower Mississippi River receives the drainage and the pollution from much of the central portion of the United States. Within the Louisiana drainages, important sources of pollution are agricultural runoff, contributing sediment, pesticides, bacteria, and point and non-point oil field brine pollution (EPA, 1977).

In western Louisiana, the Red-Sulphur River (ASA 1107) has severe existing water supply problems, with insufficient surface and groundwater to satisfy the needs of many domestic water users. Water use within the basin is moderate, however, irrigation in upstream areas diverts a great amount of flow.

Scenario-Induced Changes

Lower Red River (in ASA 1107). Increased water consumption by energy facilities, combined with a total percentage consumption by all sectors of over 96% of the estimated critical surface supply, indicate a possibly severe water shortage situation in the Lower Red River portion of ASA 1107 in Louisiana.

Existing high (200-500 milligrams per liter) levels of TDS in ASA 1107 may be significantly increased by three predicted levels of electricity generation along the Red River. Water quality model projections indicate a final TDS concentration of 238 milligrams per liter from all energy-related sources, and 227 milligrams per liter which will come from electrical utilities.

Ouachita River (in ASA 802). Pollution from oil field brines are likely to be a continuing problem in the Ouachita River, though point-source control will probably improve. No new water quality impacts are expected.

Mississippi River Delta (ASA 803). In the Delta area of southern Louisiana, the contribution of electrical generating facilities to dissolved solids is expected to increase from 36 milligrams per liter in 1975 to 55 milligrams per liter in 1985 and 70 milligrams per liter in 1990. The total concentrations attributable to energy may reach 97 milligrams per liter in 1990, an increase in 43 milligrams per liter over the period of the analysis. Background concentrations of 200-500 milligrams per liter would be increased 20% by energy activities.

Air Quality/Visibility Issues

Major Findings

- o Some degradation in air quality (particularly for TSP) may be expected for selected parishes in Louisiana and population exposure to SO₂ and SO₄ could increase by 1990 due to increased coal burning by industry.

Existing Conditions

Several parishes currently have slightly elevated ambient levels of SO₂ and TSP, although TSP emissions are low overall. There are no parishes exceeding NAAQS for carbon monoxide or nitrogen dioxide but standards are presently exceeded for photochemical concentrations in the New Orleans metropolitan area, the Shreveport AQCR and the Beaumont-Port Arthur, Texas AQCR.

Scenario-Induced Changes

Two counties in AQCR 106 are forecast to continue nonattainment for TSP in 1985 and 1990. In two separate counties in AQCR 106, NAAQS will be exceeded in 1985 and 1990. Concentrations of both SO₂ and SO₄ are well below standards at present, but industrial contributions are expected to increase significantly by 1990.

The Breton Wilderness area, located on islands in the delta region, (Fig. 6-10) is projected to be moderately impacted in terms of plume blight through 1985 and 1990 from gas steam units in one of two adjacent parishes. Oil peaking units are projected to produce a low plume blight impact through 1990. No significant regional haze problems are projected.

Land/Ecological Issues.

Existing Conditions

Louisiana spans two major ecological provinces: the southeastern mixed forest province in the northwestern third of the state, and the outer coastal plain province in the remainder. The outer coastal plain contains the southern flood plain forest running parallel to the Mississippi River, and the beech, sweetgum, magnolia, oak, and pine forest is found in the southwestern one-third of the state. The latter forest is considered sensitive to SO₂ while the floodplain forest is resistant. The southeastern mixed forest is predominately oak, hickory and pine and is considered to be of intermediate sensitivity.

Louisiana now has over 650,000 acres of diversified agriculture, with 880,000 acres of rice (ranking second only to Arkansas) and of over 1.9 million acres of soybean (Copenhaver, et al., 1978). Louisiana has approximately 1.2 million acres in national forests or wildlife refuges, with over a million of those being in the Kisatchie National Forest in the west central part of the state.

Scenario-Induced Changes

Louisiana has one parish in AQCR 19 (in northeast Louisiana) impacted by SO₂ in 1985, and two parishes located near New Orleans and the Beaumont-Lake Charles AQCR affected in 1990. These parishes contain vegetables, berries, and grains which may be seriously affected. Also considerable acreage (87,000 acres) of commercial forest is present.

It should be noted that in previous studies (Davis et. al., 1978) the overlaying of predicted SO₂ levels showed considerable potential impact on

soybeans and commercial forest (pine) within the state. The American alligator is the only known endangered species present, but it is not expected to be impacted.

Health/Safety Issues

Existing Conditions

Most of Louisiana's electrical generation as well as industrial fuel use is presently provided by gas and oil. No electric generation was supplied by coal or nuclear in 1975. Occupational accidents were highest in oil refining (290 annually) and natural gas production (1500 annually).

Scenario-Induced Changes

The occupational hazards from oil electric generation and natural gas production are the highest in the region (0.02 to 0.03 annual accidental deaths and 1.9 to 3.1 accidental injuries from oil electric generation; 13 to 16 accidental deaths and 1300 to 1500 accidental injuries from gas production) and second only to Texas in hazards from oil production and refining.

Public health risk from fossil fuel combustion is approximately half of Arkansas's in 1975 (18 to 290 projected annual deaths), equal to it in 1985 (49 to 780 projected annual deaths), and slightly exceeding it by 1990 (67 to 1100 projected annual deaths). Because of increased coal use, Louisiana's population is expected to be exposed to the largest concentration of fossil fuel combustion products in the region by 1990. The scenario, however, did not include the increase in occupation mortality and morbidity for anticipated development of lignite resources.

NEW MEXICO

Water availability problems are currently serious within some drainage basins and will worsen by 1990 without development of alternate sources such as groundwater or additional impoundments. The proposed nuclear waste isolation pilot plant is considered a serious controversy for the state.

Institutional/Political Issues

Existing Conditions

New Mexico's electricity generation is mainly from coal-fired plants with some assist from gas steam facilities. In 1975 the state used approximately 0.7 quads (0.6×10^{18} joules) of energy, of which about 4% was delivered in the form of electricity to end users. Natural gas and coal accounted for 66% and 31% respectively of the total energy consumed in 1975.

According to the scenario, the largest increase in power generation in New Mexico will occur before 1985 and as a result of additional coal-fired steam plants in the northwestern part of the state. A 50% increase is projected from this source, from 2500 MW in 1975 to 3800 MW in 1985. The remainder of the 1975-1985 increase of 52% is from oil and gas sources, both

steam and turbine. The total increase from 1985-1990 is only 5%. One hundred megawatts is forecast to come from solar sources in 1990.

New Mexico is a significant producer of coal, uranium, oil and gas, and the state consumes more fuel wood than any other Rocky Mountain state. Solar, wind, and geothermal resources may provide future energy needs. From 1960 to 1970, the greatest population increases were in uranium and copper mining regions. There was a 12% increase in population from 1970 to 1975; 7.8% was due to in-migration. The state is mostly rural with 68.9% of the population residing outside the major metropolitan areas. Employment is greatly tied to the land, in tourism, mining, food products, lumber, printing, stone glass and clay, jewelry and electronics.

Scenario-Induced Changes

If the planned electric generation projects are completed as scheduled by the utilities, the 1985 capacity will be 7% less than the requirements of the scenario, but the 1990 capacity will be higher (Figs. 6-26 to 6-30 and Fig. 6-33).

Institutional issues particularly the environmental impact statement (EIS) process, negotiations for transmission line rights-of-way across Indian and federal lands, and Bureau of Land Management (BLM) delays in coal leasing could result in an additional shortfall from the 1985 scenario by delaying beyond 1985 the addition of the first 230 MWe unit of the Plains coal-fired steam plant. This represents 19% of the scenario. The 1985 shortfall should be recovered by 1990 because planned capacity exceeds the scenario forecasts by 1700 MW.

The scenario forecast only an additional 180 MW from coal steam sources in the 1985 to 1990 periods, although 2170 MW are planned. However, all projects depend on the approval of leases from BLM, other federal agencies, and the Navajo nation.

Legal, economic, and technological constraints will preclude adding capacity with oil or natural gas as fuel. However, according to the utilities, existing plants will be retained for backup and peaking requirements. Although the scenario requires no additional generation from hydroelectric sources, 600 MWe from pumped storage is likely by 1990 and an additional 25 MWe is possible by 1985, depending on the outcome of an ongoing environmental study.

By 1990, 100 MWe of solar central power generation is technically feasible for New Mexico. However, serious financing problems stand in the way. Their solution cannot be predicted at this time. Although technical uncertainties could delay power production from a geothermal project beyond 1982, 50 MWe will probably be in place before 1985.

The projects currently planned will exceed the 1990 scenario. Although all of these projects are likely to be built, many will not be completed on schedule because of institutional constraints. Certainly by 1995 to 2000, however, all of the projects currently planned will be built.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN NEW MEXICO

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975 SERIES C	1985 SERIES C	1985 UTILITY*	1990 SERIES C	1990 UTILITY*
Coal	2,497	3,750	4,435	3,930	5,435
Oil Steam	433	68	335	38	335
Oil Peaking	20	762	32	862	32
Gas Steam	887	1,196	904	1,185	891
Gas Peaking	12	78	101	78	101
Hydro	24	24	24	24	24
Solar	0	0	0	100	0
Pump. Stor.	0	0	0	0	600
Geothermal	0	0	50	0	50
TOTAL	3,873	5,878	5,981	6,217	7,468

*ORNL's Data from utility data file.

Figure 6-33. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in New Mexico.

Currently, it is not clear that New Mexico will need additional electric generating capacity beyond what is already planned. By the end of century, uranium mining is likely to decline, releasing generating capacity for other industrial and municipal purposes. If additional capacity is needed, issues of Indian sovereignty and the management of federal lands are likely to continue to be constraints.

The proposed waste isolation pilot plant (WIPP) near Carlsbad, New Mexico, is being actively considered after the Senate Armed Service Committee endorsed the funding for the project on May 14, 1979. The Committee also included language drafted by New Mexico Senators Pete Domenici and Harrison Schmitt, intended to protect the state's right to accept or reject the project. How the state's approval or disapproval would be voiced is yet to be determined. Possible ways that have been mentioned include a general voters' referendum, a vote by the legislature, or a decision by the governor. On February 9, 1978, the New Mexico house voted down 36-33 a proposal that would have given the voters the right to decide if nuclear wastes could be deposited in the state. However, the issue can be expected to come before the legislature again.

Because of the controversy surrounding the use of nuclear power, uranium mining, and the WIPP, the New Mexico citizens have seen vast amounts of newspaper and television coverage since 1975. A dominant statewide viewpoint has not emerged in the controversy. However, this lack of consensus may result from citizen confusion over the technical subject and the many conflicting conclusions of both private and government reports. Two small public opinion surveys have been completed. In October 1978, the residents of Carlsbad who responded to a newspaper opinion survey favored the WIPP project by a majority of over 3 to 1. In April 1978, Dr. Paul Fine, a public opinion researcher, conducted a two-week survey in New Mexico and found perhaps as many as 80% of those interviewed expressed "negative feelings" toward nuclear waste disposal in the state, although most had not formed a firm opinion on the issue. It is obvious that neither of the surveys can be considered scientific nor representative of the total population.

Because of this confusion, in April 1978, the New Mexico State Health and Environmental Department requested and received DOE funding to establish an independent advisory group to assist the state in its review of WIPP. The results of this group are not known.

Socioeconomic Issues

Major Findings.

- o Only one county in New Mexico is forecast to experience significant population increases (>10%) for one year between 1975 and 1990.

Background

Four counties are expected to experience impacts from new energy industries. A county is classified as significantly impacted if it is expected to have at least one year of at least 10% growth in population. This increase

is caused by an insufficient supply of basic labor within commuting distance of the plant.

Scenario-Induced Changes

Only one of the four New Mexico counties identified in the Series C Scenario will experience significant socio-economic impacts from the development activity. The combined potential activity could provide employment for over 1100 new miners. This growth is expected in the Four Corners area of New Mexico (Fig. 6-34). Population density was 9.5 persons per square mile (PSM) in 1970 and is projected to increase to a density of 15.1 by 1990.

This development may create modest impacts over an eight-year period, although the last four years could observe an annual population change between 28 and 30% beyond the baseline population each year. This represents an absolute growth of 25% between 1978 and 1985 and 50% between 1978 and 1990. The slow buildup in population, however, will permit a phasing in of the necessary local government infrastructure. Annual per capita costs of local government services range from a high of approximately \$162 in 1985 to \$135 in 1990, when more users will share the cost of the services.

Water Quality and Availability Issues

Major Findings

- o The primary type of energy development projected is coal and uranium extraction which is concentrated in the northwest portion of New Mexico. Very high levels of ammonia (NH_3) pollutant will result from the projected amount of surface coal mining within the Lower Colorado Basin (ASA 1501-Little Colorado).

- o Groundwater mining from uranium mines could affect the quality and quantity of water available to existing users in portions of western New Mexico (ASA 1501-Little Colorado). Also in western New Mexico, concern has been expressed by EPA and new Mexico state officials over heavy metal residuals from uranium mining and milling operations (ASA 1302-Middle Rio Grande).

Existing Conditions

New Mexico stream quality ranges from nearly pristine in isolated mountainous areas to saline and turbid in many lower reaches. Most existing problems can be credited to natural impacts or to degradation resulting from extensive use and are of a nonpoint-source nature. The state views the limited flow in most streams, which inhibits the assimilation and dilution of pollutants, as a major water quality problem. However, sedimentation is claimed to be below that of the pre-Spanish era of originally ephemeral natural flow in many regions. Eutrophication of large reservoirs and high fecal coliform counts in reaches below certain municipalities are also considered major problems.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED NEW MEXICO COUNTIES (Dashed Line = BEA Boundary)

Figure 6-34. Projected population growth rates for impacted New Mexico counties.

The EPA approval of salinity standards (1976) for the Colorado River system, in effect, has predicted a policy of zero discharge for utility plants under the Federal National Pollutant Discharge Elimination System (NPDES) permit program. The Series C Scenario water quality model assumes zero discharge for utility plants and industrial boilers in all ASAs in New Mexico.

All of New Mexico's surface water is considered fully appropriated, and most surface supplies for energy will probably come from agricultural transfers. Thus, impact on existing water quality should be minimal. In addition, waste water is a potential source of supply for power plants. New generating units in northwestern New Mexico are considering using uranium mine waste water. In such a case, energy development could benefit local water quality.

Aside from any new oil or gas development in the Permian Basin, the southeast, and the Nuclear Waste Isolation Pilot Project at Carlsbad, energy development is concentrated in the northwest - coal and uranium extraction and several conversion facilities. The water-related impacts of the conversion facilities are relatively benign. Designs of proposed gasification plants (which may never be built) reflect use of dry cooling and waste water treatment technology; the Public Service Company of New Mexico's San Juan 3 will employ the nation's only wet/dry cooling system at a commercial scale electric plant, and a proposed 2000-MWe generating station may use water pumped from underground uranium mines which might otherwise be evaporated. The big questions are related to the effects of mining coal and uranium ore from water-bearing formations. Also, because the Series C Scenario does not have an antiquities study, note that the Bisto-Star Lake coal field is a treasure chest of fossils and dinosaur bones.

Scenario-Induced Changes

Lower Colorado River Basin (ASAs 1501 and 1503). Energy impact on surface water quality in New Mexico as projected by the Series C Scenario centers in the northwest along the Arizona border in the Little Colorado Basin (ASA 1501). A very high level of ammonia (NH_3) pollution is projected to result from the large amount of surface coal mining in the county. Ammonia in concentrations above 1 mg/liter, and as a consumer of dissolved oxygen, is a toxicant to fish and other aquatic life. The scenario projects a residual of 5.0 mg/liter. Even so, this is possibly understated because the scenario underestimates the amount of surface coal mining likely to occur in the county (barring Indian leasing problems) by one-fourth - as compared with U.S. Bureau of Mines industry projections - and ignores all uranium mining. Groundwater mining from uranium mines, at the rate of 150,000 acre-ft/year, could affect the quality and obviously the quantity of water available to existing users, notably that available to the small town bordering the Navajo Reservation.

Any development of conversion facilities in the lower Colorado River basin beyond the proposed levels will probably require some combination of relatively expensive conservation technologies, purchase of water rights from existing users, or negotiation with the Navajo Indians for water currently allocated for their 225,000-acre ft/year.

Rio Grande River Basin (ASAs 1302 and 1304). EPA and New Mexico officials have expressed concern over heavy metal residuals from uranium mining and milling operations in the Middle Rio Grande (ASA 1302) portion of northwestern New Mexico. The Series C Scenario projects background concentration violations only. Not only does the scenario overlook the uranium mining but it underestimates by at least a factor of three the amount of surface coal mining which the U.S. Bureau of Mines expects to occur in San Juan County.

Clearly, the potential for groundwater and surface water pollution, sediment discharge, and destruction of stream channels in northwest New Mexico is greater than that indicated by the water quality model projections.

Air Quality/Visibility Issues

Major Findings

- o Several counties in New Mexico are forecast to continue experiencing nonattainment for SO₂ and TSP.

Existing Conditions

While ambient air quality in most of this sparsely populated state is excellent, there are currently several areas of nonattainment for SO₂ and/or TSP. Violations of ambient air standards are primarily caused by emissions from industrial processes, coal-fired power generating units, and metropolitan area sources. In the counties of Dona Ana, Valencia, San Miguel, and San Juan, occasional elevated TSP measurements are attributed to windblown dust.

Scenario-Induced Changes

Compliance with state regulations should reduce emissions to meet state and national standards in all but Grant and Bernalillo counties by 1985. Based on commodity market conditions, the copper smelter in Grant County is likely to avoid installing necessary control technology by obtaining a variance under Section 119 of the Clean Air Act. Furthermore, TSP levels projected for Bernalillo County do not meet state or federal ambient air standards and will result in continuing nonattainment for this county.

No significant deterioration in visual air quality due to regional haze is projected for the Class I areas located in New Mexico. A greater-than-moderate impairment from plume blight could affect Mesa Verde National Park and San Pedro Parks Wilderness Area because of 1433 MWe of increased coal steam capacity in San Juan County. Information on coal-fired power plants now under construction or permitted indicates that the capacity that will be sited by 1985 in the Rocky Mountain Region is substantially greater than that projected for the scenario. This projected capacity may cause significant impairment due to regional haze.

Land/Ecological Issues

Major Findings

- o Significant impacts to the land and ecological system existing in the Four Corners region of New Mexico can be expected from proposed energy development.

Existing Conditions

New Mexico is dissected by seven ecological regions: the grama-buffalo-grass, the grama-tobosa, tarbush-creasote bush, Mexican Highlands shrub steppe, upper Gila Mountains forest, Ponderosa pine-Douglas fir forest, and the grama-gulleto-steppe-juniper-pinyon woodland mosaic ecoregions (Bailey, 1978). As the ecological regions and natural vegetation varies so does the climate, especially annual precipitation. Precipitation averages 6 to 7 inches/year in the west to near 20 inches in the east with up to 40 inches/year in the high elevations of the Ponderosa pine-Douglas fir forest region. This scarcity of precipitation aggravates the problem of surface mine reclamation in the northwestern section of the state.

Most of the state is owned by the federal government, primarily as National Forests, Indian reservations and military installations. For example, in three northwestern counties, expected to be greatly impacted by energy related activities the federal government owns 84% of the land (7.32 million acres).

A number of threatened and endangered species are known to occur within the region projected to be impacted by energy development. These include the black-footed ferret, peregrine falcon and bald eagle, both species being reported as nesting in the vicinity. In addition, the Colorado squawfish, an endangered species inhabits the San Juan River downstream from planned coal gas and liquifaction and combustion facilities. Other endangered species include the silverspot butterfly and the Mesa Verde cactus.

In Colfax County, coal mining has been in process since the railroads first crossed Raton Pass. No reclamation of old mines and mine tailings was attempted until very recently. The water and land in the vicinity of Raton have been badly damaged over the decades.

Scenario-Induced Changes

There are many problems associated with the data provided by the scenario. This is especially true when the data is compared with the in-depth EPA sponsored study of the Navajo/Farmington area in San Juan County (EPA, 1977). Aside from the fact that NO_x emissions will significantly rise above the state emission standards, there exist a number of major discrepancies. For example, the scenario states that population is expected to rise to a total of 83,000 where the EPA study states over 100,000. In addition, the solid waste analysis for the scenario suggests that Colfax County (in the Four Corners area) will drop from a population density of 3.44 PSM to

2.21 PSM between 1975 and 1990. This contradicts data in the socioeconomic analysis and seems improbable in a context of a quadrupled coal production from underground mines and a winter tourist industry that is increasing in intensity.

Two other counties in the northwest corner of New Mexico are being heavily impacted by new energy industries. San Juan County is scheduled to absorb fourteen new energy projects before 1990: five strip mines, two power plants, two coal conversion projects, three refineries, and a new dam for both irrigation and hydroelectricity, as well as a railroad and a coal slurry pipeline.

A similar situation exists in McKinley County, where the development of 12 new coal strip mines, seven new uranium mines, and a new power plant has begun. The state and local governments and 51,000 people own less than 100,000 acres; 338 acres are already committed to uranium tailings, 77.2 acres are committed to ponded uranium wastes, and several thousand acres already are strip-mined and being reclaimed. In those terms, 1000 (or more) acres/year of coal mine waste disposal creates a heavy impact.

In Valencia County (west of Albuquerque) only 1.7 million acres of the 3.6 million acres total are federally controlled lands. Of the 1.9 million acres available to state, local, and private control, only 468 acres are already committed to uranium tailings and 154.5 acres to ponded uranium wastes, and only one uranium mill and four uranium mines are planned. The population growth rate for Valencia, however, is likely to accelerate in the future, and waste disposal planners cannot use Albuquerque's facilities because those are already inadequate for the new growth already in place. Consequently waste disposal will be a problem.

Health/Safety Issues

Major Findings

- o Total occupational health in New Mexico's coal and uranium mining and natural gas production industries will be adversely affected by expansion projected in the scenario.

Existing Conditions

Accidental deaths and injuries in coal mining (surface and underground), uranium minings, and natural gas production are significant. Of these, natural gas production results in the largest number of serious injuries (2.7 annual deaths and 260 annual injuries). Figure 6-35 shows the estimated pattern of risk from all coal mining by county in 1975.

Total accidents in surface and underground coal mining are comparable due to the dominant status of strip mine production in this state (0.42 to 1.4 annual strip mine deaths and 0.14 to 0.54 underground deaths, 23 to 34 annual strip mining injuries and 16 to 61 annual underground injuries).

**ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG NEW MEXICO COAL MINERS**
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

NEGLIGIBLE MORTALITY
 0.0 TO 99.9
 100.0 TO 499.9
 500.0 TO 999.9
 1000.0 AND GREATER

Figure 6-35. Estimated mortality due to occupational accidents among New Mexico coal miners.

Scenario-Induced Changes

Except for coal extraction, natural gas production, and uranium mining, occupational hazards in energy-related industries in New Mexico are low to mid-range for the region.

Because strip mining is the dominant method of coal extraction in New Mexico, total death and injuries resulting from this practice are comparable to those resulting from implementation of the more dangerous deep mine method in the state. Texas and New Mexico share first ranking in the region for coal extraction hazards (0 to 9.1 annual deaths between 1975 and 1990 and 0 to 573 annual deaths in the same period for New Mexico). Figure 6-35 shows the estimated risk from all coal mining in 1985 and 1990. Workers in uranium mines of New Mexico are expected to accrue the greatest number of deaths and injuries from occupational accidents, disease, and radiation-induced cancers in that industry for the region (7 to 11 annual deaths, 177 to 277 annual injuries).

OKLAHOMA

Selected counties in Oklahoma should be carefully monitored for potential adverse socioeconomic impacts if energy development occurs as reflected in the scenario. Otherwise, Oklahoma can expect only moderate impact in terms of the changes reflected in the scenario.

Existing Conditions

Oklahoma's electricity generation has been almost completely from gas-fired plants. In 1975 the state used 1.4 quads (1.2×10^{18} joules) of energy. Of these, 7% was in the form of electricity delivered to end users. Oklahoma is a major oil and gas producing state and in 1975, natural gas accounted for 85% of the total energy consumed. Coal accounted for less than 0.1%.

Oklahoma relies heavily on intrastate natural gas supplies and is concerned about the effects of federal control. Oklahoma and other states in Region 6 have taken court action, "State of Oklahoma, et al. vs Federal Energy Regulatory Commission," challenging the authority of the federal government to regulate intrastate gas.

Some officials see no problems in the eventual changeover of utilities to coal because as obsolete plants are phased out, new coal-fired plants will be built to replace them. Conversion of newer plants, however, will require complete retrofitting and, where these plants are located in urban areas, the necessary land may not be available for coal handling. There is concern that because of air quality problems, Oklahoma may be required to ship its coal to Kansas and Missouri and import coal from Wyoming.) At the moment, industries are hesitant to convert from gas to coal because of confusing signals from Washington.

The deregulation of natural gas has brought about more production but drilling has not increased at the rate expected. This was attributed to the uncertainty at the national level - first, the government says not to use natural gas, then to use natural gas instead of oil. Increasing oil production

is thought to be constrained by price controls. An official stated that artificial prices on all crude oil should be removed in order to generate capital needed for increased exploration and drilling.

Water regulation is a problem in Oklahoma. The EPA regulations for discharge are, in some respects, not applicable to Oklahoma which has dry streams for part of the year. The state has adapted the EPA regulations, and in some cases, the state effluent limits are more stringent than the federal regulations. The regional federal office writes permits that violate the Oklahoma standards and industries must comply with both.

Scenario-Induced Changes

The Series C Scenario requires Oklahoma's generating capacity to almost treble from 5,600 MW in 1975 to 16,000 MW in 1990 (Fig. 6-36). This agrees generally with the utility projections. Most of the increase is estimated to come from coal and nuclear (Figs. 6-26 to 5-29). The utilities project more coal use than the scenario does, and they predict that both coal-fired and nuclear plants will come on-line earlier than the scenario predicts.

Oklahoma does not have a power plant siting law nor does it require special permits other than those needed for any type of large development. Because large amounts of land and water required for power plants and transmission lines remove resources from agricultural use and other uses such as wildlife management, conflicts in development options are likely to develop. Currently a conflict exists about transferring water from eastern Oklahoma to the western part of the state. Eastern Oklahoma claims it is already short of water and cannot afford to share. In addition, financing is a major concern since the state does not have bonding authority for water projects of that type.

Residents of the state have shown little opposition to nuclear plants. One official said that most Oklahomans are for nuclear energy and if necessary, the question could be put to a state-wide referendum. The activities of anti-nuclear groups and the length of the nuclear licensing process may be a problem in bringing the planned nuclear capacity on line; however, the impact of the nuclear accident at the Three-Mile Island plant is unknown. Officials do not anticipate restrictions on nuclear transport; nuclear storage is still a question.

Socioeconomic Issues

o Significant socioeconomic impacts from the construction of energy facilities are expected for two counties in Oklahoma. These impacts should be the result of an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

Background

Energy development is expected to occur in eight Oklahoma counties under population. Rural counties will have a lower assimilative capacity for

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN OKLAHOMA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal		2,960	5,910	4,390	5,910
Oil Peaking	93	1,877	214	2,277	210
Gas Steam	4,126	6,015	5,968	5,974	5,968
Gas Peaking	164	164	164	156	164
Nuclear			2,300	2,300	2,300
Hydro	734	734	734	734	734
Comb. Cycle	475	775	775	775	775
Solar				100	
TOTAL	5,592	12,525	16,065	16,706	16,061

*ORNL's Data from utility data file.

Figure 6-36. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Oklahoma.

impacts from substantial amounts of in-movers. A county is classified as significantly impacted if it is expected to have at least one year of at least 10% growth in population. This increase is caused by insufficient supply of basic labor within commuting distance of the plant.

Scenario-Induced Changes

Significant impacts from coal and nuclear power plant construction are expected for two counties in the Tulsa BEA region (Fig. 6-37). For the two impacted counties, the projected non-coincident peak work force requirements are, 1796 and 3766. These counties are projected to experience a total of 1759 and 5475 in-migrants, including dependents, during the peak construction year.

At the construction peak, the two significantly impacted counties could experience an increase of \$0.855 and \$2.6 million in the cost of providing public services and facilities.

One county in the Tulsa BEA region is projected to experience project-related population growth of only 80 people during the operating period. Increases in the annual cost of public facilities and services of approximately \$45,000 are expected.

Water Quality and Availability Issues.

Major Findings

- o Utility effluents will increase background violation of total dissolved solids in the upper and lower Arkansas River basins. Zero discharge of utility and industrial effluents was assumed for the Cimarron River basin, though slight increases in some mining effluents are expected.
- o Energy development projected in the Lower Arkansas (ASA 1104) and the Red-Sulphur (ASA 1107) basins may pose water availability problems in extreme eastern Oklahoma. Water demands of upstream irrigation and downstream energy development may be cause for seeking alternative water sources or management practices.

Existing Conditions

All of Oklahoma drains toward the Mississippi River. From north to south, the major river basins are: the Upper Arkansas-Cimarron (ASA 1103), the Lower Arkansas (ASA 1104), the Canadian (ASA 1105), and the Upper Red-Washita (ASA 1106) and the Lower Red-Sulphur (ASA 1107).

Concentrations of major water quality constituents are generally highest in the western parts of the state. Dissolved solids are highest (greater than 2500 milligrams per liter) in the Cimarron and western Red Rivers, and slightly lower (500 to 1000) in the Washita, Upper Arkansas, and Upper Canadian, and Arkansas drainages. Hardness follows approximately the same pattern, ranging from very hard in the western side to only moderately hard in the eastern parts of the state. Suspended sediment levels are

PROJECTED POPULATION GROWTH RATES FOR IMPACTED OKLAHOMA COUNTIES (Dashed Line = BEA Boundary)

No Counties
 One County
 Two Counties
 Three Counties

Figure 6-37. Projected population growth rates for impacted Oklahoma counties.

highest (greater than 500 milligrams per liter) in the central parts of the biggest state in the Canadian, Cimarron, Washita, and Red River basins (Briggs and Ficke, 1977).

Except for parts of the eastern portion of the state, Oklahoma's waters have high background dissolved solids levels. Some of the dissolved minerals come from natural deposits, including gypsum formations in the Red River drainage and salt deposits in the Arkansas River drainage. Non-point agricultural pollution also contributes to background levels of minerals and nutrients, with the minerals appearing to be the more significant problem components, except in the southeastern part of the state (U.S. EPA, 1977).

Water quality problems are apparent throughout the state, but only in the Lower Arkansas (ASA 1104) and the Red-Sulphur (ASA 1107) are there significant water-for-energy demands. Both surface and groundwater supplies are heavily utilized, and in some areas the supply of surface water in the summer and fall is insufficient to meet the demands for irrigation water even in a normal year.

For example, the Upper Arkansas-Cimmaron (ASA 1103) has the highest percentage of consumption in the nation by all sectors of the critical surface supply. Total projected water demands are over 200% of the estimated critical month surface water supply. Energy sector water demands, are generally negligible, however, totaling less than 0.2% of total consumption within the area even under maximum base load generation.

Scenario-Induced Changes

Upper Arkansas Cimarron Basin (ASA 1103). Background levels of dissolved solids in the basin are high, and the electrical generation capacity predicted by the scenario will make them higher. The national water quality model predicts a doubling of TDS concentrations from energy facilities from 227 milligrams per liter in 1975 to 482 milligrams per liter in 1990. It also has a 22 milligrams per liter increase in contributions from electric utilities to continuing violations of sulfate standards. Background violations of phosphorus, arsenic, boron, iron, and lead are expected to continue, with only very small or no changes in the amounts attributable to energy effluents.

Lower Arkansas River Basin (ASA 1104). Severe water shortages during critical flow periods are indicated in the lower Arkansas basin, with the energy's contribution to total basin consumption roughly tripling between 1975 and 1990. About 92% of the estimated critical surface supply is consumed by all users in 1990, which represents a 10% increase over 1975.

The lower Arkansas River shows background concentrations of total dissolved solids, cadmium, iron, lead, and manganese, all in violation of water quality standards. In 1975 the estimated concentrations of TDS from energy facilities were 78 milligrams per liter. The national water quality model shows it increasing to 145 milligrams per liter in 1985 and 205 milligrams per liter in 1990. Almost all of the increases comes from the generation of electricity. Energy facilities are expected to have little or no effect on other water quality constituents.

Red River Basin (ASAs 1106 and 1107). While background levels of dissolved solids are high and will be increased a small percentage by energy activities, primarily generation of electricity, few new facilities are expected in the Oklahoma portion of the Red River Basin.

Upper Red-Cimarron Basin (ASAs 1106) and Lower Red-Sulphur Basin (ASA 1107). Both rivers have severe water shortage problems. Water demands, primarily for irrigation, exceed supplies during dry years in the Upper Red-Cimarron. Agricultural activity over the region is expected to increase as marginal lands are taken out of irrigation and more water rights are transferred to industrial and domestic uses.

Water-for-energy demands are negligible in the Upper Red-Cimarron (ASA 1106) area, accounting for less than 0.3% of total water use even at peak generation. Energy water consumption is significant in the Lower Red-Sulfur (ASA 1104) although little new development is scheduled.

Canadian River Basin (ASA 1105). Water-for-energy demands are negligible in the Canadian River Basin, however, water shortages are projected during critical flow periods for all uses. The national water quality model assumes zero discharge for utilities and industries in this basin because the low streamflows could not be depended upon for dilution of pollutants. This must be considered a severe limitation. There is also coal mining in the basin and coal effluents are expected to increase TDS and sulfate levels slightly, adding to continuing background violations. Concentrations of suspended sediments and iron from mining are predicted to decrease.

Air Quality/Visibility Issues

Existing Conditions

Annual average SO₂ concentrations do not exceed 8 micrograms per cubic meter. Eight counties have annual average TSP concentrations in the range of 50 to 110 micrograms per cubic meter, while background values are in the range of 20 to 45 micrograms per cubic meter.

Scenario-Induced Changes

Several counties have high levels of TSP, probably due to wind-blown dust because TSP emissions are quite low. Two counties (located in AQCRs 184 and 186) are currently cited by EPA for nonattainment for TSP, and these counties are forecast to continue nonattainment for 1985 and 1990. Two counties (located within AQCRs 22 and 185) are forecast to exceed NAAQS for 1985 and one county continues for 1990.

No significant visibility impacts are expected for Oklahoma.

Land/Ecological Issues

No serious impacts are predicted for terrestrial environments. Surface mining of coal is expected to approach 11,000 acres by 1990 without creating significant problems.

Health/Safety Issues

Major Findings

- o Projected expansion in underground coal production will significantly increase the accidental death/injury and occupational disease incidence from the zero value existing in 1975.
- o Oil production and refining, and natural gas production will continue to produce the largest number of total accidental injuries for any energy industry in the state.

Existing Conditions

Oklahoma's historical energy industries are oil and natural gas. The size of the reserves and the number of workers involved ensure a significant number of accidents in each industry, although mortality is low. Annual accidental injuries in natural gas production, oil production and oil refining are estimated to be 360, 200, and 86, respectively.

There is no underground coal extraction, or coal or oil electric generation in Oklahoma in 1975.

Scenario-Induced Changes

Occupational health hazards from coal extraction (1985 to 1990) and natural gas production (1975 to 1990) are the only areas that do not fall into a low or mid-range category for the region. Coal mine accidents are expected to claim between 0 and 1.4 lives/year by 1985 and between 0 and 3 lives/year by 1990. Figure 6-38 maps the estimated pattern of risk by county. Injuries are projected to total between 0 and 220 in that same period. Occupational accidents in the natural gas industry are expected to kill between 2 and 4 and injure 200 to 360 persons annually. These levels are low compared to other states within the region. No oil electric generation is forecast in the state.

TEXAS

Texas is projected to be significantly impacted by the energy developments required by the scenario. Potential negative impacts may occur to air quality, water quality and availability, groundwater and terrestrial ecology. As many as 10 counties may experience significant socioeconomic impacts from the construction of new energy facilities or expanding mining activity.

Institutional/Political Issues

Major Impacts

- o Institutional/political issues are not expected to restrain energy development in the state although the mandated conversion to burn coal is expected to meet significant opposition.

**ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG OKLAHOMA COAL MINERS**
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

REDUCIBLE MORTALITY
 0.0 TO 99.9
 100.0 TO 499.9
 500.0 TO 999.9
 1000.0 AND GREATER

Figure 6-38. Estimated mortality due to occupational accidents among Oklahoma coal miners.

Existing Conditions

Texas's electricity generation was mainly from gas steam plants in 1975, with a small assist from coal. In 1975 the state used 7.11 quads (7.5×10^{18} joules) of energy and about 6% of this energy was in the form of delivered electricity. The state is a large producer of gas and oil, with natural gas accounting for 79% of the total energy consumed. Coal accounted for only 2% of the total energy consumed in Texas in 1975.

Water use and availability has been a concern for many years in Texas. The state appropriates surface water on a first come-first serve basis to anyone who can show a productive use as the water is available. Should the use be discontinued, the water reverts to the state for appropriation to another user. In general arrangements have been made for water appropriations for planned power plants. Groundwater is an alternate source and is regarded as a property right that can be pumped as desired except in certain districts where subsidence or depletion of aquifers is a concern. In some areas plans have been made to construct additional cooling reservoirs although financing has not been arranged. Although these cooling reservoirs will consume less water than evaporative cooling towers, there is still considerable consumption because of the high evaporation rate. In drought situations, the Wagstaff Act (Texas 1934) sets priorities for water use with domestic consumption first, followed by industries (including power generation), agriculture and then hydroelectric facilities.

Texas industries are heavily dependent on natural gas. With deregulation of natural gas and federal control of intrastate gas, there will be questions of authority between the Texas Railroad Commission, which regulates the oil and gas industry, and the federal government. Texas has joined with Oklahoma and other states of Federal Region 6 in court action, ("State of Oklahoma et al. vs. Federal Energy Regulatory Commission"), challenging the authority of the federal government to regulate intrastate gas. The coal conversion sections of the National Energy Act are causing economic and environmental problems, especially for industries located in the 50 mile wide coastal area, where high ambient ozone levels exist. The situation may prevent additional industrial growth and it is cited by state personnel as an example of the lack of consideration given to regional characteristics by the NEA and the Clear Air Act.

Rail transportation is adequate to supply western coal to Texas for industrial and utility use. However, as only one carrier (the Burlington-Northern Railroad) brings coal into Texas at present, officials believe the lack of competition results in higher rates for shipments. Transportation now accounts for almost three-quarters of the price of delivered coal to central Texas.

Texas does not have an energy facility siting law, although the Public Utilities Commission must issue a "Certificate of Public Convenience and Necessity." The state of Texas would like to assume jurisdiction in administering the Clean Air Act, surface mining, and NPDES permits currently under federal control. Two state agencies (the Texas Railroad Commission and the Water Resources Division) control waste water, brine, effluents, etc. and their jurisdictions have not been resolved in relation to the federal programs.

Lignite development is progressing and is predicted to be the preferred fuel over imported coal in the near future. On study notes, "An analysis of current plans for the use of coal and lignite by utilities in Texas indicates that through 1987, approximately 60% of the solid fossil fuel demand will be met by lignite" (Radian Corp., February 1979). New electric generating plants will be located near the mine mouths. The National Energy Act now gives local officials more control in determining industrial siting through use of EPA's Prevention of Significant Deterioration increments. There is concern that local officials will be making PSD decisions that will inhibit economic development in lignite regions for many years without adequate information on which to base decisions. The state does not have the necessary institutional mechanism for providing localities enough information on which to make these decisions.

Scenario-Induce Changes

The scenario projects that Texas would increase its coal-fired electric generating capacity from 2,300 MW in 1975 to over 21,000 MW in 1990 (Figs. 6-27 to 6-29 and Fig. 6-39). The scenario and utility projections from ORNL data are similar. Information from the Texas Energy Advisory Council (TEAC) shows 27,200 MWe from coal- and lignite-fired plants in 1990, however. The utilities assume a large portion will be from lignite plants located near the mine mouth.

The Texas Department of Water Resources and the TEAC officials foresee few problems with siting new coal-fired power plants since many alternate sites are available. Problems associated with air and water quality and quantity, however, need resolution before development proceeds. Choices may have to be made between economic growth and use of agricultural land because water is projected to be in short supply in some areas. Some state officials do not think nuclear plans will be more difficult to site than other facilities mainly because citizens are generally in favor of nuclear power. The impact of the accident at Three Mile Island is unknown. There is some debate on restricting storage of spent nuclear fuel from out-of-state facilities but no legislation has been passed. Also some concern exists about the adequacy of present Texas agencies to oversee the many aspects of a nuclear waste disposal site.

Socioeconomic Issues

Major Impacts

o Significant socioeconomic impacts from the construction of energy facilities are expected for ten counties in Texas. These impacts should be the result of an insufficient supply of available labor required to meet peak construction demand within commuting distance of the plant. These counties should experience a strain on public and private services and facilities from the influx of large numbers of construction workers.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN TEXAS

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975	1985		1990	
	SERIES C	SERIES C	UTILITY*	SERIES C	UTILITY*
Coal	2,300	16,716	22,174	20,766	22,924
Oil Steam	1,641	868	1,733	868	1,733
Oil Peaking	72	7,486	572	8,686	572
Gas Steam	33,914	35,313	34,774	35,243	34,044
Gas Peaking	1,073	1,444	1,420	1,444	1,420
Nuclear	0	3,650	6,000	6,660	6,930
Hydro	329	457	457	457	457
Comb. Cycle	474	474	474	474	474
Solar	0	90	0	380	0
TOTAL	39,803	66,498	67,604	74,978	68,554

*ORNL's Data from utility data file.

Figure 6-39. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Texas.

Existing Conditions

Energy development is expected to occur in 38 Texas counties under the Series C Scenario. All of these counties do not have similar socioeconomic characteristics, although the majority are rural. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-movers. A county is classified as significantly impacted if it is expected to have at least one year of 10% or more growth in population. This increase is caused by an insufficient supply of basic labor within commuting distance of the plant.

Scenario-Induced Changes

Of the 38 counties expected to receive energy development, 10 are expected to experience significant impacts. Of these ten counties, two are located in the Houston BEA region and two in the Corpus Christi BEA region (Fig. 6-40). The following BEA regions each contain one significantly impacted county: Texarkana, Tyler, Beaumont-Port Arthur-Orange, San Antonio, Dallas, and Lubbock.

For the above counties respectively, the projected noncoincident peak work force requirements are: 1800, 3900, 1200, 250, 2300, 1550, 3100, 1100, 2050, and 950. These counties are also expected to experience the following numbers of total in-migrants, including dependents, during the peak construction year: 1582, 5400, 0, 450, 5000, 2400, 5000, 1700, 5300, and 1600.

The other 28 counties are not expected to experience significant impacts as a result of minimum energy-related population increases of over 10%, if any at all. Many of these counties will receive mining activity.

The ten significantly impacted counties should experience, at peak years of construction, annual increases in the cost of public services and facilities ranging from \$1.0, to \$11.7 million. Several of the other counties should also experience increases in these costs.

Water Quality and Availability Issues

Major Findings

o In east Texas, the national water quality model indicated utility discharges will aggravate existing water quality problems and contribute to violations of criteria for total dissolved solids, nitrate, phosphorus, iron, and sulfate in the Red-Sulphur (ASA 1107), Sabine-Neches (ASA 1201), Trinity (ASA 1202), and Brazos (ASA 1203) River Basins.

o Critical period water supply shortages accompanied by major energy development are projected along the entire Texas-Gulf coast, including problems in the Sabine-Neches (ASA 1201), the Trinity-Galveston Bay (ASA 1202), the Brazos (ASA 1203) the Colorado of Texas (ASA 1204) and the Nueces Coastal (ASA 1205), with minor involved solids, nitrate, phosphorus, iron, and sulfate in the Red-Sulphur (ASA 1107), Sabine-Neches (ASA 1201), Trinity (ASA 1202), and Brazos (ASA 1203) River Basins.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED TEXAS COUNTIES (Dashed Line = BEA Boundary)

Figure 6-40. Projected population growth rates for impacted Texas counties.

o In west Texas, where water availability problems are more severe, the national water quality model assumes zero discharge practice for utilities and industrial boilers in the Canadian (ASA 1105), Colorado of Texas (ASA 1204), Nueces (ASA 1205), Rio Grande and Pecos (ASAs 1303 and 1305) rivers.

Existing Conditions

In Texas, the river basins generally run from the northwest to the southeast. The entire state ultimately drains into the Gulf of Mexico. Northern Texas is drained by the Canadian (ASA 1105) and Red Rivers (ASAs 1106 and 1107), which flow eastward through Oklahoma before turning south to the Gulf. The other major river systems, from east to west are: the Sabine-Neches (ASA 1201), the Trinity (ASA 1202), the Brazos (ASA 1205), and the Rio Grande and Pecos (ASAs 1302, 1303, and 1305).

Dissolved solids levels are very high (greater than 2500 milligrams per liter) in the western parts of the Colorado (ASA 1204), and the Brazos (ASA 1203) basins, and in the southern Gulf Coast area. Only slightly lower (1000 to 2500 milligrams per liter) TDS levels are found in the Pecos and Middle Rio Grande (ASAs 1302 and 1303) basins. Dissolved solids in other areas in the western half of the state range from 500 to 1000 milligrams per liter. They are generally 120 to 350 milligrams per liter in the eastern half of the state, with slightly higher levels along the coast itself. In the western half of the state, waters are very hard (250 to 2850 milligrams per liter CaCO_3). They are somewhat softer (181 to 250 milligrams per liter CaCO_3) in the eastern portions of most drainages, and much softer (0 to 60 milligrams per liter CaCO_3) in the extreme northeastern part of the state (Briggs and Ficke, 1977); Geraghty et al., 1973).

The waters of the western portions of many of the major river basins, including the Cimarron (within ASA 1103), the Brazos (ASA 1303), the Red (ASAs 1106 and 1107), the Colorado (ASA 1204), and the Pecos and Rio Grande (ASAs 1302, 1303, and 1305) have high mineral levels from natural sources aggravated, in some cases, by irrigation return flows. Because of high temperatures and low flows, most rivers have little assimilative capacity and municipal and industrial wastes cause local water quality degradation. This is especially common in the coastal areas, where non-point source agricultural runoff also contributes to the effluent load, frequently causing low dissolved oxygen levels. Oil field pollution is an additional, widespread problem occurring in the Red-Sulphur (ASAs 1106 and 1107), Neches (ASA 1201), Trinity (ASA 1202), and Colorado (ASA 1204) River basins and in other smaller coastal drainages (Texas Water Quality Board, 1977).

Scenario-Induced Changes

Rio Grande River Basin (ASAs 1302, 1303, and 1305) and Nueces-Texas Coastal Basins (ASA 1205). The Rio Grande and Pecos Rivers, and Nueces-Texas Coastal basins all have very limited surface water supplies with a history of serious deficiencies in water needed for irrigation and other purposes (Texas Dept. of Water Resources, 1979). During a critical drought period, all requirements in South Texas cannot be met. Water-for-energy demands show only slight change over the period 1975-1990, except in the

Nueces-Coastal area which increased somewhat. Because of the extreme low flows and highly mineralized waters in these basins, the national water quality analysis indicated zero discharges would be necessary for utility and industrial effluents.

Colorado River of Texas (ASA 1204) and Canadian River (ASA 1105). Because of extremely low flows in the Colorado River of Texas and the Canadian River, the national water quality model also indicates zero discharge for utility and industrial effluents in these basins. Both basins have projected severe water shortages during critical flow periods, however, water demands by energy are negligible in the Canadian River Basin (ASA 1105).

A significant increase in water-for-energy is projected for the Colorado River of Texas (ASA 1204) between 1975 and 1985. Tradeoffs between energy and agriculture, and development of potential surface water projects are the most probable means of supplying energy's water needs in the Lower Colorado basin. Serious constraints, both in terms of frequently severe low flows and water quality (salinity) will adversely affect energy development in the Upper Colorado Basin of Texas.

Brazos River Basin (ASA 1203). A significant growth in energy development is projected for the Brazos Basin between 1975-1990. Monthly average water-for-energy demands increase from 15 million gallons per day in 1975 to 75 million gallons per day in 1990, with peak load demands increasing from 33 million gallons per day to 145 million gallons per day. These projected increases represent a total peak level consumption of nearly 97% of the critical surface supply at the mouth of the Brazos by 1990. Considering both the projected distribution of energy facility sites, and the distortion inherent in aggregate lower water analysis, severe water shortages are most likely along the middle Brazos. Large increases in background violations for dissolved solids, sulfate, and phosphorus from energy facilities are anticipated, mostly from electric utilities, to accompany the concentration of existing salt and nitrate by increased consumptive use.

Sabine-Neches River Basins (ASA 1201). Water consumption by energy as a percentage of consumption by all sectors in the Sabine-Neches is the highest in FEA Region 6 by 1990. Although the potential for severe water shortage exists during critical flow periods, sufficient water resources are available if the planned water development schedule is met (Texas Water Dept. Board, 1977).

Increased generation of electricity could, however, cause violations of water quality standards for total dissolved solids by 1985. Current TDS concentrations in the ASA are just below the domestic water supply limit. Development of lignite reserves is projected, but little change in water quality is evident at the aggregate subarea level.

Trinity-River-Galveston Bay Basins (ASA 1202). The severe water supply problem in the Trinity River Basin is worsened by the projected amount of energy development which could consume up to 235 million gallons per day during maximum baseload operation of all facilities. Without further water resources development, total consumption by all users would total about

one and one-half times the estimated critical surface supply at the mouth of the river.

Increased energy development will further exacerbate water quality problems around the Dallas-Ft. Worth area (Texas Dept. of Water Resources, 1977) and could cause violations of water quality standards for total dissolved solids by 1985.

Salt water intrusion resulting from increased consumption during low-flow periods has the potential for contaminating freshwater supply at existing intake facilities (Texas Dept. of Water Resources, 1979).

Groundwater problems. The groundwater in the Texas Plains area (ASAs 1203 and 1204) comes from the Ogallala Aquifer, the level of which is dropping because of extensive groundwater mining. Groundwater availability problems also exist in the Carrizo Aquifer (ASA 1205). Many municipalities and irrigators have water supply problems of increasing severity. Also, part of the available water in underground storage is in the form of freshwater bounded by saline water, which may not be practical to exploit. Water-for-energy is a major contributor to current problems in the Sabine-Neches (ASA 1201) and Colorado of Texas (ASA 1204) basins.

Air Quality/Visibility Issues

o TSP concentrations will present problems to the expansion of and the conversion to coal use in Texas.

Existing Conditions

Only one county exceeded an annual average SO_2 concentration of 9 milligrams per liter, with a value of 23 micrograms per cubic meter. Thirteen counties have annual average TSP concentrations in the range of 75-125 micrograms per cubic meter, while some background values range up to 50 micrograms per cubic meter.

Scenario-Induced Changes

Several counties currently have high levels of SO_2 and TSP. Eight counties (located in AQCRs 153, 213, 214, 215, 216, and 217) are cited by EPA for nonattainment for TSP, although it is likely that wind-blown dust contributes significantly to these levels. Ten counties (scattered across the state) are forecast to continue nonattainment for TSP in 1985 and 1990. The PSD Class II increment will be exceeded in three counties (located in AQCRs 22, 106, and 216) in 1985 and in one county (located in AQCR 22) in 1990.

A high plume blight impact is expected through 1990 in the Guadalupe Mountains National Park from oil peaking units in one of five adjacent counties. There is no projected significant impacts due to changes in regional haze through 1990.

Land/Ecological Issues

Existing Conditions

Texas is one of the most diverse states within the South with areas ranging from Chihuahuan Desert in the southeast to the Big Thicket area in the east and the southern cordgrass prairie along the Gulf Coast. The major impacts are expected to occur in the eastern half of the state in the oak, bluestem parkland, the southeastern mixed forest and the beech, sweetgum, magnolia, pine, oak forest ecoregions. The Angelina, Davy Crockett, Sabine, and Sam Houston national forests with combined area of over 1.7 million acres are located in this region, as well as the Big Thicket National Preserve (85,000 acres).

Hay is the major agricultural crop in the eastern region with large areas of maintained pastures for beef production. The majority of the land is under commercial forest.

Scenario-Induced Changes

Surface mining of lignite coal between 1975 and 1990 will total 63,000 acres. All of the identified coal reserves of the Texas Gulf Region are lignite. Currently, all of these reserves are north of the Colorado River, where up to 180 feet of overburden is removed. This production is captive, and includes coal for nearby steam-electric plants and activated carbon. Because it is relatively uneconomical to transport bulky lignite over long distances, use of the coal for conversion or combustion near its source can be expected. One endangered species, the Houston toad, has its critical habitat located in the area undergoing surface mining.

Titus County, with hay and vegetable crops and 100,000 acres of commercial forest, will be impacted by SO₂ in 1975 to 1990. Rusk County, with sweet potatoes, hay, vegetables, and 304,000 acres of commercial forest will also be affected during the same period. However, much of the region's commercial forests, primarily pine species, may suffer impact from synergistic effects of multi-county sources of air pollution. There is growing concern in Texas that the large projected increase in solid waste from lignite fired power plants will cause groundwater contamination. This fear arises because lignite plants will probably be mine mouth and the lignite belt is coincident with one of the state's major aquifers, the Carrigo-Wilcox. Careful site selection and disposal techniques are needed to avoid threats of contamination as both groundwater use and waste disposal increase. The cost of waste disposal will be increased by efforts to protect the environment, but it does not appear that solid waste disposal problems will limit the magnitude of lignite development (Radian, February 1979).

Health/Safety Issues

Major Findings

- o Texas leads the region for total occupational health hazards in all energy technologies except oil electric generation, and uranium mining and milling.

ORNL-DWG 79-12650

ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG TEXAS COAL MINERS
Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

□ NEGLIGIBLE MORTALITY ▨ 0.0 TO 99.9 ▩ 100.0 TO 499.9 ■ 500.0 TO 999.9 ■ 1000.0 AND GREATER

Figure 6-41. Estimated mortality due to occupational accidents among Texas counties.

Existing Conditions

Numerous energy technologies coexist in Texas, although the principal ones continue to be oil production and refining and natural gas production, both in terms of production and total occupational hazard.

In 1975, natural gas production was expected to result in 18 deaths and 1700 injuries while oil production and refining were projected to produce a total of 9 deaths and 652 injuries. Occupational hazards from other energy technologies are not considered significant. There is no nuclear electric generation or underground coal mining in the state.

Scenario-Induced Change

Production of all forms of energy will greatly increase. The most significant alteration will be in the areas of surface-mining of lignite oil production and refining and coal electric generation. Figure 6-41 shows the estimated pattern of risk from all coal mining by county in 1985 and 1990. The resulting combustion use of fossil fuel will elevate public health exposures to combustion products.

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FEDERAL REGION 7

ARGONNE NATIONAL LABORATORY

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Program Manager	Stephen W. Ballou
Air Quality	Michael Senew David Streets
Water Quality	Michael P. Torpy Phillip Coop
Solid Waste	Susan Barisas Shen-Yann Chiu
Ecology/Land Use	Katrina Robeck Marian Gabriel Patricia Irving
Socioeconomics	David South Thomas Baldwin Danilo Santini
Health and Safety	John Gasper
Computer Assistance	Charles Comer Mary Snider

FEDERAL REGION 7

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REGIONAL OVERVIEW - REGION 7

The population of Region 7 was 11.5 million people in 1977. The average population density in the region is 41.3 people per square mile. The states of Iowa and Missouri are somewhat more populated with densities of 50.5 and 67.8 while Nebraska and Kansas are sparsely settled and have density factors of 19.4 and 27.5.

The population in this region is principally involved in farming or farm-related industries with a range of between 20,000 and 37,000 employed in each state. The other primary employers include wholesale and retail trade and agri-business is becoming increasingly dominant. The exception to these employment characteristics is the state of Missouri which has increased its manufacturing and industrial production activities since the 1960s. The industries within these states generated a median income of \$8,794 with a mean per capita income in 1976 of \$6,295 which corresponds to 97.7% of the average for the United States. The average per capita income did not vary greatly throughout the region.

The predominant land use in Region 7 is cropland. The region is the major producer of wheat and corn in the nation: approximately 15 million acres are planted in wheat, and 24 million in corn. Soybeans are an important crop in the eastern states. The original vegetation in most of this area consisted of prairie grasses, but these grasslands were easily converted to agricultural use, although the extreme western parts of Kansas and Nebraska are more arid, and the grasslands here are used for open range. Forested areas are largely confined to the Ozarks in southeastern Missouri, and to areas along streams and rivers.

Water is relatively scarce in Region 7, except in areas directly bordering major rivers, and water availability is likely to be the major issue affecting inland siting of new energy facilities. Competing water demands from the agricultural sector for irrigation needs compound the problem. Irrigation shortages already exist along the Platte River in Nebraska, and there is concern among the farmers and state officials that upstream developments associated with coal and power production could deplete flows even further. Localized water supply shortages have also occurred in the Des Moines and Cedar Rivers in Iowa. Groundwater is extensively used in some parts of the region to supplement the surface water supply, and areas of Kansas and Nebraska groundwater mining has been a cause of great concern. A recent study by the Kansas Geological Survey indicated that if current trends continue, groundwater resources in the West Central water planning district will be exhausted in six years. This problem has already prevented construction of one coal-fired power plant that would have relied solely on groundwater for make-up and cooling.

The low and variable streamflows of the region also affect water quality. It is difficult, for instance, for many streams to assimilate adequately

Much of the material in this section is excerpted from the Regional Energy-Environment Data Book (Draft) for the Midwest Regional (Argonne National Laboratory, October, 1978.)

treated municipal wastes from even relatively small population centers during low flow periods. The quality of both surface and groundwater is also affected by the natural leaching of salts and minerals from the soils and rock of the region, which has led to high concentrations of total dissolved solids (TDS) in the Missouri and Arkansas drainage basins (primarily Kansas and Nebraska). The problem is aggravated by municipal and industrial effluents that are high in TDS. Energy facilities can increase already high TDS concentrations by reducing the dilution capacity of streams through their consumptive water use and by discharging effluents high in TDS. Regional water quality planning is further complicated by extensive nonpoint sources of nutrients and metals. Waste load allocation plans in Region 7 must be designed to respond to extensive nonpoint source pollution during high flows and to effluent dominated streams during low flows.

Air quality in the region is good with localized problems in urban areas such as Omaha, St. Louis, and Kansas City. In each of these areas attainment of particulate national ambient air quality standards is questionable if combustion activity increases dramatically. There are difficulties in the St. Louis area in attaining both national particulate standards and sulfur dioxide standards.

The counties in this region can be categorized by socioeconomic assimilative capacity. This classification methodology refers to the adequacy of public services, facilities and infrastructure to absorb population growth induced by energy or other local developments. The factors which are most influential in determining the assimilative capacity are population density, proximity to an urban center and basic economic activity. The counties in Region 7 are primarily of extra low and low assimilative capacities. This is characteristic of small, sparsely distributed populations that are located at some distance from major trade centers. This classification is reinforced by the small average annual net change in population (0.5%) in this region between 1960-1976 and the fact that only 64% of the population could be classified as urban.

THE REGIONAL SCENARIO

The energy supply and demand scenario for Federal Region 7 is summarized in Table 7-1. These projections were the basis for the county-level utility (shown in Figures 7-1, 7-2 and 7-3), industrial, and mine siting patterns developed by ORNL, BNL and MITRE, which, in turn, provide the baseline for the impact assessments.

REGIONAL ASSESSMENT

NATIONAL OR MULTIREGIONAL ISSUES WITH REGIONAL IMPACTS

A number of issues cannot be limited to state or even regional boundaries. They are effectively the product of national or multiregional socioeconomic developments. Issues included in this category are national socioeconomic impacts, long range transport of pollutants and interregional natural water systems. National issues are of great importance because individual regions may bear disproportionately both the impacts and the cost of proposed remedies. Impacts from these broad range issues are disaggregated to the regional level in Table 7.2.

Table 7-1 Projected Electrical Generating Capacity, Coal Extraction,
and Industrial Fuel Use - REGION 7

	1975	1985	1990
<u>ELECTRICAL GENERATING CAPACITY (10^3 MW)</u>			
Coal	12.5	22.5	24.2
Oil	4.2	6.4	10.7
Gas	5.6	4.8	4.8
Nuclear	1.7	4.0	6.4
Combined Cycle	0.1	0.1	0.1
Hydro	1.0	2.2	2.3
Solar	0	0	0
Geothermal	0	0	0
Other	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	25.1	40.0	48.5
<u>COAL EXTRACTION (10^6 tons)</u>			
Deep Mines	3.6	3.8	3.7
Surface Mines	<u>63.8</u>	<u>51.3</u>	<u>48.7</u>
TOTAL	67.4	55.1	52.4
<u>INDUSTRIAL FUEL USE (10^{12} Btu)</u>			
Coal	3.2	32.4	36.2
Oil	157.6	124.8	200.9
Gas	<u>0.1</u>	<u>0.1</u>	<u>0.1</u>
TOTAL	160.9	157.3	237.2

1975 Electrical Generating
Capacity – Region 7
PIES Mid-Mid Scenario

Figure 7-1

1985 Electrical Generating
Capacity - Region 7
PIES Mid-Mid Scenario

Figure 7-2

1990 Electrical Generating
Capacity – Region 7
PIES Mid-Mid Scenario

Figure 7-3

Table 7-2

Disaggregation of National Impacts to Regional Level: FEDERAL REGION 7

Air Quality				
	Visibility	Long Range Transport	National Socioeconomics	Water Resources
Coal:				
- Electric	L	L ¹	L	L
Oil	L	L	L	L
Gas	L	L	L	L
Nuclear	L	L	L	L
Solar:	L	L	L	L

High - Large degree of certainty that conflict will arise at several facilities with no or little opportunity for cost effective mitigation.

Medium - Specified concern could occur at few facilities, but potential cost effective mitigation strategies available.

Low - Conflicts unlikely to occur.

¹Long range transport of pollutants may become an issue in local areas where ambient levels for criteria pollutants are near standards. While the overall contribution from long range transport may be small, it may, nevertheless, be sufficient to "push" ambient levels over national standards.

Figure 7-4

Long Range Transport, Visibility

As in the case of other midwestern regions, long range SO_2 transport may contribute to deteriorated air quality in non-attainment and marginal attainment areas. By itself, long range SO_2 transport is not expected to present severe impediments to energy development in Region 7.

National Socioeconomic

National socioeconomic impacts described here are those projected to occur in the Midwest as a whole (Federal Regions 5 and 7). The national analysis was not conducted on a Federal region basis.

Capital costs associated with the construction of the energy facilities are expected to increase by an annual average of 0.8% through 1990. The principal capital expenditure increases are calculated to be in the construction of low-Btu coal-fired power plants, oil refineries, gas distribution facilities, light water nuclear reactors and electrical distribution facilities. The largest capital expenditures are associated with nuclear reactor construction where annual investment is expected to be \$2.8 billion (1977 dollars) or 20% of the total annual cost for all energy facilities.

Manpower requirements during the construction of energy facilities are expected to exceed 1.2 million person-years between 1976-90 and to be concentrated in the same sectors as the large capital investments. Annual labor demand is projected to increase during the construction phase and be

primarily composed of demand from the gas distribution facility, light water reactor and electrical distribution facility sectors. These three sectors will require 50% of the total construction manpower needs through 1990.

The operating costs of the energy facilities will increase at an annual rate of 2.0% reaching a peak of \$4.3 million in 1990. The sectors that have the greatest operating expense include underground coal mining, coal transportation, oil refineries, oil tank trucks, gas distribution and electrical distribution facilities. These sectors correspond to 63% of the total annual operating costs attributable to the energy facilities.

Manpower requirements increase in the operating phase from 1.2 to 1.8 million person-years. The greatest manpower demands are concentrated in the sectors where the most significant operation costs are identified. These sectors correspond to 75% of the annual manpower requirements during the years 1976-1990.

Since the midwest is heavily industrialized, the manpower and resource requirements will not negatively affect the existing industries but instead may have significant indirect impacts. The increased demand for equipment, goods and services throughout the states from both the development inside and outside the region may slow the subsidence of businesses from this region. Any problematic effects of the subsequent impacts can be mitigated through interstate cooperation and effective regional planning.

Inland and Coastal Water Resources

Interregional water use conflicts have led to court decrees and interstate compacts regarding the use of water from the South Platte and North Platte Rivers. The South Platte Compact signed in 1923 by Nebraska and Colorado provides for minimum flow from Colorado to Nebraska, and a 1945 Supreme Court decree apportioned water from the North Platte River, limiting diversions by Colorado and Wyoming users and allocating natural flow. These agreements may become issues in neighboring regions, but are unlikely to affect siting in Region 7.

REGIONAL ISSUES

The issues described below are summarized in Table 7-3.

Local Air Quality, Visibility

All of the states in Region 7 are likely to experience regulatory impediments on coal growth during implementation of the Mid-Mid scenario. Iowa has two-thirds of its proposed coal growth located in non-attainment areas in the southeastern and southwestern portion of the state. Kansas has a single area in the northwestern portion of the state around the Pottawatomie Indian Reservation where most of the state's proposed coal growth is sited to occur. Offsets or improved control technology in this area are not expected to significantly mitigate air quality problems. Other high impact areas for coal development in Region 7 are the St. Louis area and portions of southeastern Nebraska.

Utility oil development may be restricted in industrialized areas including St. Louis, Lincoln, Omaha, and Kansas City. Fuel purchasing policies will aid in mitigating air quality problems in these areas, but non-attainment/offset issues must be satisfied.

Industrial development in Region 7, as projected by the Mid-Mid scenario, will be greatly influenced by regulatory constraints in non-attainment areas. All of Missouri's new major industrial sources are projected for non-attainment areas.

Seventy-three percent of Iowa's, and eighty-four percent of Nebraska's proposed industrial sources are located in areas with poor or marginal quality. Most of these sites will require satisfaction of non-attainment provisions and offsets.

Water Quality/Availability

The utility activities analyzed for water-related impacts were the coal, gas, oil, combined cycle (assuming coal type), and nuclear technologies. Of these categories, nearly 30 percent of the projected increase in generating capacity to 1990 was identified as having a potential impact on water quality or availability (assuming that effluent treatment beyond statutory point source requirements is implemented and/or that the 7 day-10 year low flow is maintained). This represents 10% of the total utility activity projected by 1990 for Region 7.

Projected increases having large water demands may be restricted in areas where seasonal low flows and agricultural water consumption create water use conflicts. In these areas, energy activities must compete with agricultural uses for water. Impact mitigation may require construction of reservoirs for water storage and for flow augmentation to maintain adequate dilution ratios.

Solid Waste

Disposal of all kinds of solid waste has become an important issue in all parts of the country. Historically, solid waste disposal has not been a constraint to new development; however, inexpensive dumping at nearby locations is no longer possible in many areas.

All regions face the challenge of disposing of ash, sludge and other wastes in an environmentally acceptable manner. Although Region 7 does not generate as large a quantity of ash and sludge as some other regions, local problems still exist.

Industrial disposal requires a large number of small sites, compared to utilities which require fewer, but larger sites. Some industries have their own disposal sites and others use municipal facilities. Although the amount of solid waste is much less than in Region 5 and the amount of open space near urban areas is much greater, institutional constraints can still make siting a disposal facility difficult.

Table 7-3

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the Regional Level - REGION 7¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:		Regional water quality/availability impacts were not identified with cer- tainty for the regions. However, because of upstream consumption and pollutant loading from all future economic activities, the impact on down- stream basins could become an issue, based on best basin management practices.								
-Coal	H						L	L		
-Oil	M						L	L		
-Gas	L						L			
-Nuclear	L						L	L		
-Combined Cycle	L									
-Solar										
-Hydro										
General:										
-Utility	M			M	L	L	L	L		
-Industry	H			M		L		L		
-Mining	L			M	M		L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ Criteria are not provided for socioeconomic issues because their extreme localized nature cannot be reflected in the aggregated analysis.

Industrial ash and sludge disposal problems are part of the general solid waste disposal problem, especially in the urban areas. For the nation as a whole, the quantity of municipal solid waste is expected to increase 30% from 1977 to 1990; however, the 150 largest metropolitan areas will account for two-thirds of the increase.

Although the quality of ash and sludge from a utility is greater, disposal is often easier than it is for an industry. Utilities have more land on-site available for disposal. Some existing utilities will have to transport wastes off-site, but the distance should not be prohibitive. New plants should be able to plan for on-site disposal for the lifetime of the plant.

Region 7 is not a highly urbanized or industrialized area. Industrial coal use in 1975 was less than 3 million tons and land requirements for disposal amounted to only 5 acres. Even with the 185% increase projected by the scenario, industrial coal use is low resulting in the production of relatively small amounts of ash and flue gas desulfurization (FGD) wastes.

Installed coal-fired utility capacity, 11,597 MW in 1975, is projected to increase to 17,257 MW by 1990. Application of FGD systems will increase the amount of solid waste generated.

The Resource Conservation and Recovery Act (RCRA) will regulate solid waste disposal. Although the strictest controls will exist for hazardous wastes, the Act will have a profound effect on all waste disposal. Currently, ash and sludge have a "special waste" status. The Act provides for an inventory and upgrading of existing landfills. At many waste disposal facilities, upgrading will not be practical and their closure would result in, at least, a temporary shortage of landfills in the region.

There are still uncertainties about the RCRA program and the ability of both state and Federal governments to implement it. The Environmental Protection Agency's solid waste program has been small with no regulatory responsibilities and many states have limited solid waste management programs. When the 1970 Clean Air Act and the 1972 Water Pollution Control Act were enacted, there already existed extensive pollution control programs operated on a state and regional basis by both EPA and well-staffed state agencies.² The implementation of this ambitious new regulatory program will be an important issue in the region.

Ecology/Land Use

Relatively small acreages (rarely over 500 acres in any one area) may be disturbed by projected energy development in Region 7, mostly in counties near the urban centers. The preemption of croplands for new power facilities is likely, but the total production of the area is not likely to be grossly diminished by these activities.

The coal resources in the region are not projected to be greatly exploited except in Missouri. Agriculture is the major land use in areas with projected mining activities, and the croplands are primarily devoted to wheat, corn, soybeans, sorghums, and hay crops. Office of Surface Mining regulations require that prime agricultural lands be returned to their

original crop productivity.³ The cost of reclamation in Region 7 may be high if such lands are mined.

Continuing high sulfur dioxide levels near urban areas are of concern in the region, since many of the major crops are sensitive to SO₂-induced damage which can cause decreases in productivity and yield. The sensitivity of the natural prairie-grassland vegetation to SO₂ is not yet known.

Figure 7-5

COAL MINING AREAS & POTENTIAL SO₂-INDUCED VEGETATION DAMAGE

Socioeconomic Impacts

Region 7 is projected to receive more than 25,000 MW of new energy generating facilities. Since these four states contain primarily low and extra-low assimilative capacity counties (see section on Regional Overview), there is a high potential for adverse socioeconomic impacts from the construction of new, large-scale energy facilities. However, the present siting pattern restricts the severe impacts to 3 counties in Nebraska, 3 in Kansas, and 1 county in Missouri. The identification of these socioeconomic impact subregions is based on the operation dates and the size and type of facilities to be sited within these particularly susceptible areas.

Besides the 7 counties assessed to receive severe socioeconomic impact, there are 18 other countries in this region that are expected to experience new growth as a result of energy activities. However, the growth in these areas is not expected to exceed 10% of the baseline population. These subregions will incur some negative impacts from the development, but these could be easily mitigated with proper planning.

Figure 7-6

REGION 7 ADVERSE SOCIOECONOMIC IMPACT AREAS

Since the existing workforces and rural infrastructures within the seven affected counties are not sufficient to satisfy the demands of the energy development(s), an in-migrant labor force in excess of 12,000 basic workers could be required. These workers would cause a temporary population increase of more than 26,000 people during the period 1975-1990. However, only approximately 2,500 are projected to remain during the long-term operation phase of the developments. Because of the divergent social and economic characteristics of the indigenous and in-migrant populations, the sociocultural problems encountered are expected to be severe ^{4, 5}.

Health and Safety

Regional 7 is not as intensively developed in terms of energy related activity as other more densely populated regions. As a result, the impact of health risks associated with the energy cycle, from extraction to end use, on occupational and public populations in the region is less significant than in other highly industrialized regions. The highest risk energy-related occupation is deep coal mining. Of the small to moderate amounts of coal mined in Iowa, Kansas, and Missouri, 90% is extracted by surface mining techniques. The number of accidental deaths and injuries and deaths and cases of chronic respiratory disease from coal mining are projected to be minimal in Regional 7 because of relatively low levels of extraction and the use of lower risk surface mining techniques. Despite these minimal impacts, coal extraction will be the primary source of energy related occupational health impacts in Region 7 during the scenario timeframe. Other energy cycle activities, such as oil production and refining, natural gas production, and electricity generation (fossil and nuclear fueled), are of insufficient magnitude to result in substantial occupational health impacts.

Figure 7-7

RANGE OF POTENTIAL ACCIDENTAL DEATHS IN REGION 7 COAL MINES DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

Figure 7-8

RANGE OF POTENTIAL DEATHS AND CASES OF CHRONIC RESPIRATORY DISEASE (CRD) IN REGION 7 DUE TO COAL MINING OCCUPATIONAL EXPOSURE UNDER THE MID-MID SCENARIO

In Region 7, public health impacts of sulfates released from fossil fuel use under the Mid-Mid scenario are projected to decline by 14% to 20%. The decline is primarily due to Clean Air Act requirements for sulfur emission control and a doubling in the amount of nuclear electricity generation in that region. Impacts that do occur are likely to be greatest at the eastern edge of the region in Missouri because of both interstate transfer of sulfates and the projected amount of fossil fuel use in Missouri.

IOWA

The scenario projects an additional 2,250 MW of electrical generating capacity in Iowa by 1985 and 4,770 MW by 1990. There is a relatively small amount of coal extraction in the state: production is projected to decrease from 620,000 tons per year in 1975 to 580,000 tons per year in 1985 and 560,000 tons per year in 1990. More than half of this coal will be mined underground.

Air Quality/Visibility Impacts

o 1990 TSP levels are expected to be lower than 1975 levels assuming attainment of existing sources due to the enforcement of SIPs and improved control technologies.

Figure 7-9

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN REGION 7
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

Figure 7-10

ESTIMATED RANGE IN DEATHS IN REGION 7 FROM SO₄ EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

- o Continuing TSP and SO₂ NAAQS violations are projected for several areas in Iowa where scenario-determined industrial and utility increases are proposed.
- o Over 65% of the projected utility coal growth, nearly 25% of the utility oil growth, and almost 75% of the industrial growth projected for Iowa is sited in nonattainment areas.

Table 7-4

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - IOWA
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	1680	679	-109	0	0	0	2250
1975-1990	1680	1949	- 59	1200	0	0	4770

¹ base year: 1975.

² includes conventional hydro and pumped storage.

³ includes solar, combined cycle, and "other".

Figure 7-11

Description

Over 50% of the state's electrical power came from coal burning plants in 1975; most of the coal burned in Iowa comes from Montana and Wyoming with smaller amounts from the Midwest. Iowa contains no PSD Class I protected areas.

Background Issues

- o Iowa has 8 counties in non-attainment for SO₂ and 6 for TSP. These areas are not concentrated in any part of the state.
- o Particulate violations are spread throughout the state with high TSP readings in the vicinity of Des Moines, Davenport, Waterloo and Dubuque. Coal burning places a significant burden on the particulate loading in these areas.
- o Since violations are not extreme, careful siting of new sources could prevent significant additional impacts and the continuation of noncompliance.

- o The high sulfur content of Iowa coal may lead to problems in meeting NSPS without emissions controls; new plants in the state are likely to depend on western coal and scrubbers.

Scenario-Induced Changes

- o TSP levels are projected to increase in various locations throughout Iowa between 1975 and 1985, but substantial reductions are expected between 1985 and 1990 assuming successful enforcement of the SIP and to improved control efficiencies.
- o Continued TSP violations are projected for portions of the North Central, Northeast, Southcentral, Southeast, and Omaha-Council Bluffs Inter-state AQCRs. SO₂ violations are projected for the Burlington-Keokuk Inter-state AQCR. Sixty-five percent of the projected 1990 coal-fired utility generating capacity increases are sited in TSP nonattainment areas. Most of these coal-fired increases are projected in the Metropolitan Omaha-Council Bluffs Inter-state AQCR; oil fired increases are projected in the Northeast and Southcentral Inter-state AQCR's.
- o Nearly 3/4 of the industrial growth is projected for non-attainment areas; offsets and stringent emission controls will likely be required.

Water Quality/Availability Issues

- o An increase in nuclear utility activity in the upper Skunk River Basin may require reservoir storage to supplement the natural flow during low flow periods.
- o No water quality problems related to the scenario are expected.

Figure 7-12

Description

Generally, Iowa water quality is affected most severely by non-point source runoff from agricultural activities. Seasonal low flows and high sediment loads during high flow periods characterize most of the state's streams. Increases in energy related activity will be relatively small. The additional loadings from energy activity will not be constraints on development because of already high loads contributed by non-point sources.

Background Issues

- o In addition to non-point source pollution, Iowa streams frequently exhibit violations of water quality criteria as a result of apparently natural weathering. Violations of barium, lead, zinc, and copper criteria apparently result from natural background.
- o Increasing temperatures in the Iowa River are of concern due to several industrial cooling water discharges to the river.

Scenario-Induced Changes

- o No significant scenario-induced changes were identified in the analysis, although a need for flow augmentation was cited for the Skunk River basin.

Solid Waste Impacts

- o Iowa should not have any serious problems disposing of the relatively small amounts of industrial waste.
- o Solid waste disposal problems should not constrain utility development; however, disposal costs will increase.

Background Issues

- o Industrial coal use was only 520,000 tons in 1975 (compared to 17 million tons for Ohio), and land requirements for disposal were less than one acre.
- o Suitable landfill sites are difficult to find in some of the loess hill areas of the western part of the state.

Scenario-Induced Changes

- o Industrial coal use is projected to triple by 1990; however, solid waste generation is estimated at less than 200,000 tons per year and land use required for disposal is estimated at less than 200,000 tons per year and land use required for disposal is estimated at less than 4 acres per year.

Figure 7-13

- o Indicators do not show any areas where disposal is likely to be a serious problem.

- o Installed coal-fired utility capacity is projected to increase by 75%, but no waste disposal problems are foreseen. Total lifetime area requirements for solid waste disposal are projected at 1,300 acres.

Ecological and Land Use Impacts

- o Sulfur dioxide concentrations in the Mason City and Clinton areas of Iowa are projected to increase steadily through 1990; 1975 levels are already high enough to cause damage to exposed soybean, hay and grain crops in these areas. Crop damage could become a major issue in Iowa, where over 75% of the land area is in cropland. Generating capacity increases are relatively small, and surface mining is projected to disturb 1000 acres in the state from 1975 to 1990.

Socioeconomic Impacts

o No adverse socioeconomic impacts are expected in Iowa since the scenario-defined energy developments are sited in counties able to absorb the population growth and public service demands likely to result from these developments.

Health and Safety Impacts

o Electricity generation - a low risk activity - will be the primary source of energy related occupational health impacts in Iowa. Only small amounts of fuel extraction or refining are projected to occur in Iowa. Despite a 66% increase in electricity generation, occupational health impacts of energy related activities in Iowa will be negligible.

o Sulfur emissions from fossil fuel use will not have a significant impact on exposed populations in Iowa because of dispersed location of sources and implementation of sulfur controls.

KANSAS

The scenario projects an additional 3,609 MW of electrical generating capacity in Kansas by 1985, and 5,224 MW by 1990. A relatively small amount of coal is mined in Kansas: production is projected to increase from 480,000 tons per year in 1975 to 520,000 tons per year in 1985 and 1990. All of this coal is surface-mined.

Table 7-5

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - KANSAS
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	2858	132	-531	1150	0	0	3609
1975-1990	4038	604	-568	1150	0	0	5224

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

- o 85% of the proposed 1990 utility coal growth occurs in one county in the northeastern portion of the state. This area is projected to be in violation of short-term SO₂ National Ambient Air Quality standards in 1985 and 1990.
- o Nearly 40% of the scenario-sited utility oil increases are in areas projected to exceed SO₂ standards in 1985; these areas are expected to be in compliance by 1990.

Figure 7-14

Description

Though coal use is increasing in Kansas, almost two-thirds of the state's electrical power was generated in gas-fired plants in 1975. Representatives from state offices feel that the state's important future energy sources are Kansas and Wyoming coals.

Sulfur dioxide emissions do not present significant air quality problems in Kansas. Primary particulate violations occur in two counties.

Background Issues

- o Air quality in Kansas is most serious in the Kansas City/Topeka area where particulate violations occur. Most of the state's industrial activity centers in this northeastern portion of the state.
- o Particulate levels in the state are naturally high; high winds and a lack of rainfall contribute to high levels fugitive dust in the air.

Scenario-Induced Changes

- o Sulfur dioxide levels could rise significantly in northeast Kansas if a large scenario-induced projected coal-fired plant is built. Primary standards for SO_2 may be violated by 1985. This plant accounts for over 85% of the new coal utility capacity projected for the state.
- o Over 60% of the state's projected total utility increases (coal and oil) are sited in non-attainment areas.
- o Almost 40% of the projected oil capacity increases are sited in SO non-attainment areas in the northeastern part of the state. This area is expected to be in compliance by 1990.
- o About 55% of the projected industrial growth is sited for areas with poor air quality.

Water Quality/Availability Issues

- o Flow augmentation may be required because of projected increases in utility activity in the Smoky Hill River basin in central Kansas. Seasonal low flows provide insufficient dilution capacity for energy effluents.

Figure 7-15

Description

Kansas water quality is determined by flow regime.⁹ Scenario defined energy increases occur in eastern Kansas where the impact of flow is less severe.

Background Issues

- o Impact of natural minerals and non-point source runoff is greater than that from point sources in most of Kansas.
- o Kansas has been historically successful in limiting point source discharges. More than 50% of Kansas municipal discharges were meeting 1983 requirements in 1976.

Scenario-Induced Changes

- o Flow augmentation may be required in the Smoky Hill Basin to meet energy needs.

Solid Waste Impacts

- o Industrial coal use is projected to double, but no significant solid waste problems are foreseen. Indicators show only 3 counties that may experience problems.
- o Solid waste disposal problems should not constrain utility development.

Figure 7-16

INDEX

1. Significant increase in land requirements for waste disposal along with high population density
2. Significant fraction of municipal wastes due to coal
3. Significant increase in industrial waste due to FGD sludges
4. Significant increase in TDS of municipal sewage due to FGD sludges

Background Issues

- o Ash disposal has not been an issue in the past because a majority of the facilities have used natural gas rather than coal.
- o Most facilities using natural gas are, or will be, converting to coal.
- o Older disposal sites in the metropolitan areas of Lawrence and Topeka are nearly filled; however, it appears that suitable alternative ash disposal sites are available within one mile of the utility plants.
- o In general, the small quantities of solid waste and the relatively large amount of open space in Kansas, even near metropolitan areas, make disposal of solid waste less of a problem than in more industrialized states.

Scenario-Induced Changes

- o Industrial coal use is projected to double by 1990 and resulting solid waste generation is projected to triple because of the application of FGD systems.
- o Land use requirements for industrial disposal are estimated at only 11 acres per year in 1990.
- o On the basis of criteria relating to land availability and adequacy of sewer systems, 3 counties may experience difficulty in disposing of industrial waste; however, determination of the extent of the solid waste disposal problem requires a county-specific or case study analysis.
- o Land requirements for utility solid waste disposal are projected to be 130 acres per year in 1990 with a total life-time area requirement of nearly 4,000 acres. Nearly 90% of this area is located in two counties; however, this should not present a problem because land has already been committed to this purpose.

Figure 7-17

Figure 7-18

Socioeconomic Impacts

o Severe socioeconomic impacts are projected for one scenario-defined site for energy development in Missouri. The number of available workers in this county and those adjacent to it may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Description

The population of Missouri is 4.7 million with a density of 69 people per square mile. The primary employment sector is trade, followed by manufacturing and the mineral processing industries. The manufacturing industries (largely aircraft and chemical processing) generate the greatest income; they are located primarily in the St. Louis area and thereby utilize the intersecting transportation networks of rail, highway and water.

Background Issues

o Missouri has 14 high assimilative capacity counties, 23 moderate, 35 low, and 43 extra low. This correlates to 31.1% of the high assimilative capacity counties within the region, 34.8% of the moderate, 30.7% of the low, and 23% of the extra low.

Ecological and Land Use Impacts

- o Increasing or continuing SO₂ emissions may affect the wheat crop in 3 areas in Kansas. Relatively small acreages are projected to be disturbed throughout the eastern half of the state for utilities and surface mining. The preservation of endangered species habitats may be a site specific issue for projected energy development.

Figure 7-19

POTENTIAL SITING CONSTRAINTS DUE TO LAND USE OR ECOLOGICAL ISSUES - KANSAS

Description

Sixty-one percent of Kansas land is covered with crops, and most of this land is planted in wheat. Kansas is the major producer of wheat in the region (two-thirds of the regional acreage of wheat) and in the nation. Sorghums, corn, and soybeans are locally important crops. The western part of the state is arid, with a natural grassland cover primarily used for open range.

Background Issues

- o Wheat, the major crop in Kansas, is extremely sensitive to SO₂.
- o The whooping crane (endangered) is known to occur in the state, and some parts of the state contain critical habitat for this species.

Scenario-Induced Changes

- o Emissions of SO₂ from the projected siting of a large amount of coal-fired capacity in the northeastern part of the state may result in local SO₂ concentrations high enough to cause damage to wheat crops grown in that area. Levels of SO₂ in the Kansas City area and on the Colorado border will remain high enough through 1990 to affect wheat crops in those areas.
- o Surface mining is projected to disturb about 2000 acres in the southeast corner of the state by 1990. Soybeans are the major crop in that area, although 20% of the land remains in natural grassland cover. Reclamation costs may be high if croplands are disturbed.
- o The whooping crane is known to be present in 2 counties in the central part of the state where new facilities are projected, and the Neosho madtom, a fish on the endangered species list, is known to occur in the surface mining area.

Socioeconomic Impacts

- o Severe socioeconomic impacts are projected for three scenario-defined sites for energy development in Kansas. The number of available workers in these counties and those adjacent to them may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Figure 7-20

Description

The total current employment in Kansas is 1.1 million from a population base of 2.3 million, concentrated in small metropolitan areas throughout the state's 82,000 square miles. The state density of 28 people per square mile represents an average of the more populated northeastern counties and the farm occupied central and western counties.

Kansas has a diversified economy; 38 of the 51 production sectors have businesses within the state. The agricultural sector contributes raw materials to the manufacturing sector and supports the growth of agribusiness industries.

The energy and material extraction industries have become important employment and economic resources for the state. With the exception of two, each of Kansas' 105 counties has an active mineral extraction industry. This industry includes the mineral commodities used by the construction industry such as sand, gravel, clay, shale, stone and cement.

Background issues

- o Local socioeconomic impacts are defined by the demographic, economic, and social changes expected with siting, construction and operation of energy generating facilities. The interdependencies among labor supply, local public capital, and the availability of accessible sources of goods and services define the most important spheres of socioeconomic impact.

- o Characteristic socioeconomic trends attributable to energy developments include:

- Construction of energy facilities creates an almost instantaneous demand for employees.

- If the local labor force is insufficient to fill these demands, new workers and their families create rapid increases in local populations.

- The timing of energy facility construction and operation and the availability of local labor determine the levels of population increase that may be realized in a given county.

- The direct demands of the industry and the increased incomes paid to workers expands wholesale, retail, commercial, industrial, and service employment and, concomitantly, population.

- The larger the demographic differences between the new and existing populations, the more severe are sociocultural problems relating to social organization and particular service needs.

- Revenue imbalance arises because of the immediate need for expenditures on services (e.g., schools, sewers, police, fire, utilities, and hospitals) and the delayed collection of revenues during plant construction.

— Shortfalls in public revenues and subsequent inadequacies in the provision of public services may have the undesirable consequence of stimulating population turnover, thereby worsening socioeconomic impacts.

— The provision of public services and facilities determine the quality of life that will be experienced by both the new and existing populations in the county.

— If the quality of life decreases enough because of these problems, the productive labor force may leave, resulting in lower productivity in the energy industry, less provision of services, and further social dissolution.

o Increases in population of 10% or more during any given period are considered severe. Although the literature will ascribe a 7-15% range of increase, the 10% figure used in this analysis is based on Gilmore's study which indicates that such a change is sufficient to result in social problems such as increased crime, divorce, out-migration, and labor turnover.

o The capacity for counties to assimilate new employment and population growth is a function of base population size and density, manufacturing employment, and distance to the nearest trade center.

o As a rough guide, counties with different assimilative capacity can absorb, without adverse population in-migration, the following types of energy activities:

— extra-low assimilative capacity: no commercial scale energy facility or mine.

— low assimilative capacity: small mining operations.

— moderate assimilative capacity: single plants or mines of moderate size.

— high assimilative capacity: single large-scale facilities or multiple facilities of smaller sizes.

o The Kansas counties identified for future energy developments have either a low or extra low assimilative capacity.

o Kansas contains 10 high assimilative capacity counties, 15 moderate, 17 low and 63 extra low. These correspond to 22% of the high assimilative capacity counties in the region, 23% of the moderate, 15% of the low and 34% of the extra low assimilative capacity counties.

Scenario-Induced Changes

o Three counties in the northeast and central parts of the state are likely to experience adverse socioeconomic impacts as a result of projected energy development. Lincoln, Linn and Pottawatomie Counties are projected to absorb 5,200 new temporary workers, of which 540 are expected to be retained for employment in the operations phase. This permanent work force corresponds to 1,020 new individuals or 445 households.

Figure 7-21

o Linn and Pottawatomie Counties could incur 23% and 32% increases in their baseline population as a result of the new facilities. The ability to absorb the new population and the public and private service demands may be greater than projected since the counties are adjacent to large standard metropolitan statistical areas.

- o Lincoln County is expected to be most severely affected since it could experience a 140% increase in population during the construction phase of the proposed nuclear development. However, since manpower requirements during the operations phase are drastically smaller, the long-term population increase should only be approximately 1%.
- o When the average regional public costs for the particular size and type counties are calculated, the new permanent residents (540) may incur additional public costs in excess of \$575,000 annually.
- o There is presently no state infrastructure for the mitigation of these impacts.
- o According to the scenario, the three identified counties will be the construction sites for 87% of the coal and 100% of the nuclear generating capacity increases projected for Kansas by 1990. Thus, 79% of the total projected energy growth may cause adverse socioeconomic impacts.

Health and Safety Impacts

- o The low levels of coal extraction, oil production and refining, and decreasing amounts of natural gas production are not likely to create a significant number of occupational health impacts in Kansas. The low risk nature of electricity generation will keep all energy related occupational health impacts negligible in Kansas.
- o As a result of sulfur controls, public health impacts from sulfates resulting from fossil fuel use will be minimal in Kansas despite a 70% increase in fossil fueled electricity generation.

MISSOURI

The scenario projects an additional 6,216 MW of electrical generating capacity in Missouri by 1985 and 8,474 MW by 1990. Coal production (all from surface mines) is projected to decrease from 5.7 million tons/year in 1975 to 4.4 million tons/year in 1985 and 4.2 million tons/year in 1990.

Table 7-6

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING CAPACITY (MW) - MISSOURI MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	3723	1277	-154	1150	220	0	6216
1975-1990	4023	3230	-176	1150	247	0	8474

¹base year: 1975.

²includes conventional hydro and pumped storage.

³includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

- o Despite enforcement of the SIP, TSP levels could remain in violation of primary standards or even deteriorate with the scenario-projected increases. These violations may occur in St. Louis AQCR and a portion of the northern AQCR.
- o All of the state's industrial growth is projected for non-attainment areas.
- o Projected utility increases in southern counties could be subject to visibility protection statutes.

Figure 7-22

MISSOURI - POTENTIAL AIR QUALITY IMPACT AREAS

Description

Ninety percent of the state's electrical output is generated from coal. Most of Missouri's coal is used for mine-mouth steam electric power generation; the rest of the coal burned in the state is imported from the Midwest, Wyoming and Oklahoma.

Missouri has two counties that have not achieved primary sulfur dioxide standards and seven counties that have at least partial non-attainment designations for TSP. Air quality problems are most pronounced in the metropolitan St. Louis areas and surrounding counties.

There are two national parks in Missouri, totaling over 20,000 acres, which are subject to PSD Class I air quality limitations. These areas are located on the southern border of the state.

Background Issues

- o Violations of primary and secondary SO₂ and TSP standards are presently occurring in the St. Louis area.
- o Visibility-protected areas in the southern part of the state have the potential for affecting development in this area.

Scenario-Induced Changes

- o Approximately one-fourth of the state's projected coal growth is sited in non-attainment areas, and could be restricted by air quality regulations. These areas are located in the metropolitan St. Louis Interstate AQCR.
- o All of the projected increases in industrial fuel uses are sited in the metropolitan St. Louis Interstate and the northern Missouri AQCRs.

Water Quality/Availability Issues

- o Effluents from projected energy-related activities would contribute minimal additions that should not result in additional stream violations or alter waste load allocations. Sufficient water exists in areas projected for energy increases to serve energy and other users, and the impact of additional mining activity in the northwestern counties will be minimal if Best Management Practices and the state's strict mining laws relating to water quality are followed.

Solid Waste Impacts

- o Industrial solid waste generation will increase by nearly 300%; however, no significant problems are foreseen.
- o Solid waste disposal problems should not constrain utility development, although transportation costs may increase.

Background Issues

- o In the southern half of the state, the permeable limestone topography makes it difficult to find environmentally acceptable landfill sites.
- o Industrial coal usage was slightly greater than 1 million tons in 1975 and less than 2 acres was required for land disposal.

Scenario-Induced Changes

- o Industrial coal use will almost double and residuals will increase by almost 300% according to the scenario. No significant solid waste disposal problems are foreseen, however.

Figure 7-23

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1. Significant increase in land requirements for waste disposal along with high population density
2. Significant fraction of municipal wastes due to coal
3. Significant increase in industrial waste due to FGD sludges
4. Significant increase in TDS of municipal sewage due to FGD sludges

o Land requirements for industrial waste disposal are projected at 10 acres per year.

o Indicators show three counties where disposal of industrial wastes might be difficult.

o Solid waste disposal problems should not constrain projected utility development, although additional costs may be incurred for waste transportation or landfill liners in environmentally sensitive areas.

Ecological and Land Use Impacts

o Surface mining activities are projected to disturb 21,000 acres by 1990. Agricultural lands are most likely to be affected.

o New power generating facilities could require the conversion of agricultural land and natural habitats.

Figure 7-24

Description

Forty-seven percent of Missouri is cropland. The major crops are soybeans and corn, and it is the only state in the region where cotton is grown (300,000 acres). The Ozarks in the southeastern part of the state are largely forested with 1.4 million acres of National Forest. Recreational value of these lands is high.

Background Issues

o Land use control is not favored in Missouri, and the county zoning ordinances that do exist contain many exceptions for strip mining and public utilities. Therefore, siting of new facilities may not be a major issue at the local level.

Figure 7-25

GREATEST POTENTIAL FOR ECOLOGICAL IMPACTS - MISSOURI

Scenario-Induced Changes

- o Surface mining of coal is projected to occur in the northern and western parts of the state, where croplands dominate land use. It is projected that about 15,000 acres will have been disturbed from 1975 to 1985, and 21,000 acres by 1990. Land use by surface mining is projected to drop from 1,600 acres per year in 1975 to about 1,200 acres per year in 1990. Reclamation of agricultural lands to their original row crop productivity will be costly.
- o New utilities projected by the scenario are likely to disturb both farmlands and natural habitats.
- o Projected mine-mouth coal-fired plants could require longer transmission distances to the major urban load centers. Transmission lines may cause long-term disruption of some agricultural activities such as center-pivot irrigation systems, crop dusting, and the use of large farm equipment.
- o Sulfur dioxide levels high enough to cause damage to vegetation are projected for the St. Louis and Kansas City areas, but there is little acreage in SO₂-sensitive crops in the affected region.

Figure 7-26

Socioeconomic Impacts

o Severe socioeconomic impacts are projected for one scenario-defined site for energy development in Missouri. The number of available workers in this county and those adjacent to it may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Description

The population of Missouri is 4.7 million with a density of 69 people per square mile. The primary employment sector is trade, followed by manufacturing and the mineral processing industries. The manufacturing industries (largely aircraft and chemical processing) generate the greatest income; they are located primarily in the St. Louis area and thereby utilize the intersecting transportation networks of rail, highway and water.

Background Issues

o Missouri has 14 high assimilative capacity counties, 23 moderate, 35 low, and 43 extra low. This correlates to 31% of the high assimilative capacity counties within the region, 35% of the moderate, 31% of the low, and 23% of the extra low.

o The Missouri counties identified as projected sites for future energy developments have either a low, moderate or high assimilative capacity.

Scenario-Induced Issues

o The majority of the projected developments are expected to generate no adverse socioeconomic impacts since they are sited in counties more capable of absorbing the required population growth and public service demands.

o Severe socioeconomic impacts are likely in one county (Macon) were about 7% of the total energy growth (14% of the projected increase in coal-fired capacity) projected for the state is sited. An in-migration of 1,027 basic workers could be required. This would increase the county population by 1,951, or nearly 12%.

o Since new energy facilities are also projected for adjacent counties, the potential is high for larger and more severe regional impacts than calculated in this analysis. The actual siting pattern and staging of these facilities are crucial factors in determining the extent of impact.

o No infrastructures are currently established to mitigate the potential for socioeconomic impact. Many of the adjacent counties may experience similar effects on a small scale and without proper management, control and planning these could also suffer adverse impacts.

Figure 7-27

Health and Safety Impacts

- o Energy related occupational health impacts in Missouri are likely to be minimal.
- o Despite a 40% increase in fossil fuel electricity generation, deaths from sulfate exposure are expected to decrease 20% due to sulfur emission controls.

Background Issues

- o Ground water supplies in heavily industrialized portions of St. Louis and Jefferson County have been contaminated by industrial wastes.
- o St. Louis, Jefferson, Franklin, and St. Charles counties in eastern Missouri, all heavily populated areas, have been designed non-attainment areas for primary oxidant standards.⁸

o Cardiovascular and respiratory diseases, both subject to aggravation by fossil fuel atmospheric emissions, accounted for 61% of total deaths in Missouri in 1973.¹⁷

Scenario-Induced Changes

o Occupational health impacts from fossil fuel extraction and conversion to electricity are expected to be small in Missouri. Low levels of oil, gas, and coal extraction and use of lower risk surface coal mining techniques will keep impacts minimal.

Figure 7-28

RANGE OF POTENTIAL ACCIDENTAL DEATHS IN MISSOURI COAL MINES
DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

o Despite a 26% decrease in coal production, coal mining will account for the majority of energy related occupational health impacts in Missouri.

Figure 7-29

RELATIVE CONTRIBUTION TO ENERGY-RELATED OCCUPATIONAL DEATHS IN MISSOURI
OF MAJOR ENERGY ACTIVITIES UNDER THE MID-MID SCENARIO

- o Public deaths from sulfate exposure will decrease by approximately 20% during the scenario timeframe because of sulfur emission controls.

Figure 7-30

NEBRASKA

The scenario projects an additional 2,796 MW of electrical generating capacity in Nebraska by 1985 and 4,734 MW by 1990. No coal mining is projected to occur in the state.

Table 7-6

PROJECTED INCREASES¹ IN ELECTRICAL GENERATING
CAPACITY (MW) - NEBRASKA
MID-MID SCENARIO

	Coal	Oil	Gas	Nuc.	Hydro ²	Other ³	Total
1975-1985	1792	70	-68	0	1002	0	2796
1975-1990	1955	634	-68	1150	1063	0	4734

¹ base year: 1975.

² includes conventional hydro and pumped storage

³ includes solar, combined cycle, and "other".

Air Quality/Visibility Impacts

- o Eastern border counties are likely to experience increasing levels of particulates. Ambient TSP concentrations, already over primary standards, could increase despite emission reductions obtained by enforcement of the SIP.
- o Continued violations of air quality standards could restrict one-third of proposed coal growth, most of which will occur in the southern part of the state.

Figure 7-31 NEBRASKA - POTENTIAL AIR QUALITY IMPACT AREAS

Description

Coal burned in Nebraska is typically low in sulfur content (less than 0.8%); the state receives most of its coal from Wyoming with small amounts imported from Kansas, Utah, and Colorado. There are currently no violations of primary SO_2 standards in the state; three counties on the central eastern boarder are in violation of primary NAAQS for TSP.

Background Issues

- o Nebraska has naturally high levels of particulates due to fugitive dust, wind, and drought.
- o Several counties in the eastern part of the state have persistent particulate problems.

Scenario-Induced Changes

- o 1990 TSP violations of NAAQS are projected to continue mostly in the eastern half of Nebraska. One-third of the scenario-projected increases in coal-fired generating capacity and nearly two-thirds of the projected oil capacity is sited in non-attainment areas (Omaha-Council Bluffs Interstate and the Lincoln-Beatrice-Fairburg Interstate AQCRs). Selective fuel purchasing policies will mitigate air quality problems caused by emissions.

- o Over 80% of the proposed industrial growth in Nebraska will occur in non-attainment areas. Fuel use, emission limitation, and offset requirements may be necessary for these plants to meet new source review requirements.

Water Quality/Availability Issues

- o Severe fluctuations in flows along the Platte River and high demand for water by agriculture may require additional storage capacity in the Platte River Basin.

Description

Nebraska's water resources are under heavy demand from agriculture.¹⁸ Irrigation with surface water is extensive throughout the state and use of ground water is increasing particularly in the western and central areas where pivot irrigation systems have become widespread.

Water for energy development may conflict with agricultural demand and could become a site specific issue. Currently, 95% of cooling water for the power industry is provided by surface waters. The prevalent opinion in the state is that the discharges most likely to affect water quality are power plants.

Background Issues

- o During summer low flows, many Nebraska rivers, particularly the Platte, are intermittent. Pooling is common and available flows are due to effluents and irrigation return flows.

Figure 7-32

NEBRASKA RIVER BASINS

WHITE HAT BASIN	PLATTE BASIN
NIOBARA BASIN	REPUBLICAN BASIN
MISSOURI BASIN	LITTLE BLUE BASIN
ELKHORN BASIN	BIG BLUE BASIN
LOUP BASIN	NEMAHA BASIN

- o Nebraska water quality agencies are considering waste load allocation plants designed to reduce the impact of effluents during low flows. Advanced waste treatment and extensive holding ponds are under consideration.

- o The state has not developed an assessment of the level of trace metals in streams and, therefore, no analysis of this problem is available.
- o Effluent limitations for the power industry require off-stream cooling for facilities constructed after 1974.
- o Under Nebraska water rights laws, domestic uses of water have preference over all other uses; agricultural uses have priority over manufacturing and electricity generation.

Scenario-Induced Changes

- o Scenario-projected energy development may impact agricultural water use in the Platte River Basin. Existing reservoirs were constructed for irrigation water storage and may be inadequate for the projected energy increase. Sufficient surface supplies exist for the projected increase in the eastern Nebraska area.

Solid Waste Impacts

- o Industrial coal usage, even with large projected increases, will be low relative to other states. Indicators do not show any counties likely to experience problems disposing of the residuals.
- o Acreage requirements for utility waste disposal are low and should not pose significant problems.

Background Issues

- o Present industrial coal use is less than 200,000 tons per year (compared to 17 million tons per year for Ohio and even 2 million tons per year for Minnesota). Land use for waste disposal is less than two-tenths acre per year.
- o The Platte River Valley, from the western tip to the mouth, is not a desirable location for solid waste disposal. The area is productive agriculturally and the groundwater level is often only 6-10 feet below the surface.

Scenario-Induced Changes

- o Installed coal-fired utility capacity is projected to double to 3,000 MW by 1990. Land use requirements for waste disposal are estimated at 18 acres per year or about 550 acres for the lifetime of the plants. Land use for disposal will not exceed 250 acres in any single county.
- o Assembling enough land at new plants for on-site disposal is not a problem. Although solid waste may have to be hauled off-site at older plants, the greater quantity of open space near even metropolitan areas usually allows for disposal relatively close to the plant.
- o Industrial coal usage is expected to increase by nearly 800% for the period 1975-1990; however, this still only amounts to 1.4 million tons per year (compared to 21 million tons per year for Ohio).

- o Land requirements for industrial disposal are projected at less than 2 acres per year.
- o Criteria relating to land availability and adequacy of sewer systems do not indicate any counties likely to experience problems.

Ecological and Land Use Impacts

- o Projected increases in generating capacity in Nebraska are relatively small, and would likely require the conversion of cropland or rangeland. The state contains critical habitat for the whooping crane, an endangered species; concern for preservation of this habitat may be a site-specific issue for projected energy development. Sulfur dioxide concentrations high enough to cause damage to soybean, wheat, and hay crops are projected to continue at their 1975 level or increase in the Omaha area.

Figure 7-33

Socioeconomic Impacts

- o Severe socioeconomic impacts are projected for three scenario-defined energy development sites in Nebraska. The number of available workers in these counties and those adjacent to them may not be sufficient to fill all the newly created jobs. These areas may experience shortages of local public services as well as price effects on private sector goods.

Figure 7-34

Description

Nebraska ranks among the top ten states in the country in agricultural production. Manufacturing, trade, food, and farm-related industries provide a high percentage of the employment. To supply the energy for these economic sectors and the population, Nebraska relies on two large electric power companies in the southeastern and central portions of the state.

The state population is 751,000 or 10 people per square mile, and per capita income is \$6,106 with half of the total labor force employed in small independent industries. Since 1970 the size, employment, and value added of these establishments has increased by more than 35%.¹⁰

Background Issues

- o See regional section on Background Issues.
- o Nebraska contains four high assimilative capacity counties, 8 moderate, 15 low and 66 extra low. This is equivalent to 9% of the high assimilative capacity counties in the region, 12% of the moderate, 13% of the low, and 35% of the extra low.

- o The Nebraska counties identified for future energy developments have either a low or extra low assimilative capacity.

Scenario-Induced Changes

o Projected energy developments are sited in the eastern and southwestern quadrants of the state, which have principally low and extra low assimilative capacity counties. Of the affected counties, Lincoln, Otoe and Washington counties are suffering from a declining basic workforce which is not expected to supply the required manpower during construction of the projected nuclear and coal facilities. 12,000 new in-migrants are calculated to remain for two or three years, which could cause a severe financial and cultural strain on these small farm communities.

o Lincoln County could require a long-term population increase of 1% during the operation period.

o When the average regional public costs for the particular size and type counties are calculated, the new permanent residents (365) may incur additional public costs in excess of \$210,000 annually.

o There are no infrastructures presently established to mitigate either the construction or long term (operation) increases in population and their coexistent socioeconomic impact.

o The scenario sites 85% of the projected 1990 coal-fired capacity increases and 100% of the nuclear increases for the state within these three counties. This corresponds to 58% of the total generating capacity increases sited in Nebraska by the scenario.

Figure 7-35

Health and Safety Impacts

- o Energy related occupational health impacts are expected to be minimal in Nebraska because of low levels of electricity generation and natural gas production and no coal extraction. The moderate levels of oil production and refining projected in Nebraska present relatively low health risks.
- o Public health impacts from sulfur released through fossil fuel use will be minimal because of low levels of utility and industrial fossil fuel use.

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FEDERAL REGION 8

LOS ALAMOS SCIENTIFIC LABORATORY

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Program Manager	Donald W. Morris
Visibility, Local Air Quality, and Long-Range Air Trans- port	David Nochumson Mike Williams Mona Wecksung Carolyn Mangeng Flavio Gurule
Water Availability and Quality	David Abbey Colleen Olinger Fred Roach
Ecology and Land Use	Virginia Parsons Ann Stroup
Local and National Socio- economics	Donald Rapp
Health and Safety	H. William Lorber
Solid Waste	Ellen Heckler
Institutional	Sharla Vandevender (Sandia Laboratories)
Technical Editing	Elizabeth Ronquillo
Word Processing	Pat Aragon

FEDERAL REGION 8

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REGIONAL OVERVIEW - REGION 8

Federal Region 8, comprised of the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming, is a significant producer and exporter of most energy resources consumed in the US today. Wyoming and Montana will continue to be major energy-producing states. Although Colorado will be a major consumer as its population continues to grow, the state will manage to export 30% of its energy products. Solar, including wind, and geothermal resources in the region will account for some local energy needs as experimentation in these areas is realized by the private sector.

Land area in the region is 20% of the total US area, yet the region constitutes only 3.5% of the nation's population. Population density is quite low—only 3.4 people per square mile in Wyoming, for example—and is clustered in the metropolitan districts of Denver, Salt Lake City, and other smaller, urbanized areas.

Growth trends are higher than in the rest of the US, with recreational and resource development the key factors in these increases. There is considerable concern as to the adequacy of the region to supply goods, services, and natural resources to the growing population. A great deal of land is in federal ownership or trust, leaving little private land available for development. Water rights are not necessarily tied to land ownership, as these rights are a separate property. Riparian laws associated with water in the East do not apply to this region.

Environmental sacrifices may be made as energy resource development continues to increase in the region. Regional concerns about the effect that energy development will have on environmental quality include some fear that economic benefits from energy development may be offset by damage to other economic activities tied to the environment, especially agriculture, recreation, and tourism. It would be a case of regenerative resources displaced by ones that are nonrenewable.

THE REGIONAL SCENARIO

The energy supply and demand scenario for Federal Region 8 is summarized in Table 8-1 and its corresponding pie charts (Fig. 8-1). These projections were the basis for community-level utility, industrial, and mining siting patterns developed by ORNL, BNL, and MITRE, which, in turn, provide the baseline for the impact assessments.

The Mid-Mid Scenario for Region 8 is inconsistent with utilities' plans for energy development in the region. Several utility plants already under construction were not included in the scenario. Also most existing and planned plants were shown operating at a small fraction of potential capacity. Because of the assumption that all electric power is generated in the federal region where it is used, the model does not allow for interregional transfer of electricity. Over 50% of the region's planned capacity is owned by investor utilities from outside Federal Region 8 and will be used by their customers. These omissions and assumptions have the effect of understating actual production levels and environmental impacts for each of the issues in the region.

Table 8-1

REGION 8's PROJECTED ELECTRICAL GENERATING CAPACITY,
INDUSTRIAL FUEL USE, AND COAL AND URANIUM PRODUCTION

	1975	1985	1990	1975-1990 Total Change (Δ)
<u>ELECTRICAL GENERATING CAPACITY (Megawatts)¹</u>				
Hydro, Conventional	5,017	6,155	6,155	1,138
Hydro, Pumped Storage	162	530	530	368
Coal Steam	8,150	14,436	16,176	8,026
Nuclear	0	330	330	330
Gas Turbine	30	360	360	330
Gas Steam	252	247	226	-26
Oil Turbine	610	2,390	2,660	2,050
Oil Steam	1,054	1,168	1,167	113
Geothermal	0	0	900	900
Solar	0	0	300	300
TOTAL	15,275	25,636	28,704	13,529
<u>INDUSTRIAL FUEL USE (10¹² BTU)²</u>				
Bituminous Coal	49.5	212.1	331.7	282.2
Metalurgical Coal	82.5	91.7	97.1	14.6
Coal	132.0	303.8	428.8	296.8
Middle Distillates	34.6	116.3	186.3	151.7
Residual Oils	37.4	33.9	43.4	6.0
Liquified Gasses	9.8	40.5	67.3	57.5
Oil	81.8	190.7	297.0	215.2
Natural Gas	241.9	165.8	61.3	-180.6
TOTAL	455.7	660.3	787.1	331.4
<u>COAL PRODUCTION (10⁶ Tons)³</u>				
Deep Mines	10.84	51.59	126.24	115.40
Surface Mines	58.71	353.70	487.57	428.86
TOTAL	69.55	405.29	613.81	544.26
<u>URANIUM PRODUCTION (10³ Tons of U₃O₈)⁴</u>				
	11.6	21.9	23.3	35.7

¹Supplied by ORNL.

²Supplied by ORNL from IR&T disaggregation data.

³Supplied by BNL.

⁴Estimates supplied by EIA.

Figure 8-1

Region 8's Electrical Generating Capacity, Industrial
Fuel Use, and Coal Production, In Percent

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

Many energy issues cannot be limited to state or even regional boundaries. This section includes impacts that are the product of national or multiregional developments. Specifically, they are visibility effects due to long-range transport of pollutants, national socioeconomics, and national water policies.

Long-Range Transport/Visibility

Secondary pollutants, especially particulate sulfates, can be transported over distances of hundreds to a few thousand kilometers before they are removed by precipitation scavenging and dry removal processes. Air pollution sources located outside the region can contribute to air quality problems within the region. Distant, extraregional sources can contribute to visibility impairment, acid rain, elevated levels of photochemical oxidants, air pollution-related health effects, and possible climate modification in a region. Except for visibility impairment, those effects related to long-range transport of air pollutants are much less of a problem in Federal Region 8 than in the eastern US because of the much higher air pollutant emission densities in the East and because of west to east average air flow across our country.

A plot of visual range versus the light extinction coefficient, according to the Koschmieder relationship, is shown in Fig. 8-2. The light extinction coefficient is related to the capacity of atmospheric particles and gases to scatter and absorb light. The visual range plot has a large negative slope at high values of visual range (very good visual air quality) and a small negative slope at low visual range (very poor visual air quality). This relationship between visual range and light extinction indicates that areas with very good visual air quality are the ones most sensitive to degradation by air pollution. Federal Region 8 has an abundance of areas with very good visual air quality and, thus, is very sensitive to visibility degradation caused by the growth of air pollutant emissions.

National Socioeconomic

The plans for extensive development and conversion of coal resources represent the major source of socioeconomic impacts in 22 of the region's 23 impacted counties. Only Sweetwater County, Wyoming, is expected to be able to accommodate growth because of existing governmental infrastructure.

Overall construction capital requirements will pose a constraint on the implementation of the Mid-Mid Scenario. The massive capital investment required of a few major companies in a few western states may find severe competition in capital markets.

Figure 8-2

Visual Range Vs. the Light
Extinction Coefficient.

The need to concentrate the necessary labor supply in a timely manner will require a national manpower training program clearly designated to provide skilled miners and construction workers as well as mining and electrical engineers.

Related impacts may occur in other parts of the country to avoid delays in almost every supply category from mining equipment, draglines, trucks, and railroad cars, to electrical transformers and substation components, generators, turbines, and even manpower.*

National Water Availability Issues

As discussed on page 8-6, water availability is not an important national consideration in terms of constraining energy policy options. Water development in the West does conflict with national interests to preserve streamflows on Federal lands, protect endangered species and deliver adequate quality water to Mexico.

*For further information, see the Government Accounting Office, Report to Congress, "Rocky Mountain Energy Resource Development: Status, Potential, and Socioeconomic Issues," EMD-77-23 (July 1977).

REGIONAL ISSUES

Visibility

In the past, industrial process facilities and smelters in particular have been the major contributors to visibility impairment in Federal Region 8. As sulfur dioxide emission control technology is installed, less polluting smelter processes replace existing ones, and new energy facilities come on-line, energy facilities will become a more significant contributor to visibility impairment in the region. Of the projected energy facilities to be located in the region, the major source categories projected to contribute to impairment of visual air quality are coal-fired utility and industrial boilers.

Regional haze is projected to occur in 15 Class I areas located in Colorado and the Dakotas. Plume blight could affect four Class I areas located in Colorado and Wyoming.

Information on power plants now under construction or permitted indicates that the capacity in place by 1985 in Federal Region 8 is substantially greater than that projected for the Mid-Mid Scenario. This unaccounted-for capacity can cause significant impairment affecting Class I areas due to plume blight and regional haze.

Local Air Quality

Federal Prevention of Significant Deterioration (PSD) regulations will constrain scenario-projected utility siting in Utah, Montana, and North Dakota. Parts of North Dakota currently are being impacted from air quality degradation occurring in Canada along the Poplar River Basin north of Fort Peck, Montana.

Our analysis shows that state ambient air quality standards and emission regulations in Region 8 may constrain development where national standards would not be violated. Wyoming, Colorado, and Montana, in particular, have adopted ambient air quality standards that are stricter than federal primary standards.

Violations of air quality standards for SO₂ and Total Suspended Particulates (TSP) occur primarily in Region 8's metropolitan areas. In addition, agricultural activities and nonanthropogenic sources of windblown dust often produce violations of 24-hour ambient TSP standards.

Nonferrous metal smelters are major sources of air pollution in this region. The introduction of highly efficient, constant sulfur dioxide control technology by smelters will depend on the economic vitality of the industry or may be postponed by nonferrous smelter orders obtained under Sec. 119 of the Clean Air Act.

Air Quality Control Regions (AQCR) contain more than one county and may contain counties from more than one state. The results of the local air quality analysis in RIIA-I can be distorted seriously by aggregation to the AQCR level; many issues are site and industry specific.

Water

The key water-related issues are that water shortages may constrain energy development and that water use for energy production may have a negative impact on other users. Table 8-2 shows projected consumption for electricity generation by subbasin compared with available supply and projected use in other sectors (from lead-lab analysis). The projection assumes use of conventional cooling systems and streamflows. Most striking is that in no subbasin is the projected use for electricity generation greater than 5% of the remaining surface water available. This is not the last word on water-related issues, however.

Table 8-3 shows water use for coal production and conversion in New Mexico's San Juan Basin. Water use varies depending on coal quality, meteorological conditions, and environmental regulations. But the key consideration is that conservation technologies (especially dry cooling) are available at a relatively small increment in product prices. In any case, far less costly sources of supply are usually available. Thus, it is reasonable to conclude that water availability is not a significant constraint to development.*

Water use for energy production affects in-stream uses, water quality, and existing water users. Assuming containment of liquid wastes by industrial users, the principal water quality effect is from mining—modification of surface runoff and shallow aquifers. The effects on in-stream values—recreation, fisheries endangered species, and aesthetics—are mostly local and site specific. (A LASL survey of critical stream reaches is nearing completion.) The effect on existing users is twofold. First, water development or reallocation (transfer) affects the quality of existing water rights—the reliability in time, quantity, and quality. While surface water users are generally given adequate protection under state law, groundwater users are not. They face the prospect of falling water tables and well yields and higher pumping costs. Second, water transfers from agriculture to the energy industry have economic and social impacts not borne by the parties to the transfer. Considering the vast discrepancy between the value of water use in agriculture and industry,** the parties suffering economic losses (farm equipment dealers, ditch companies, etc.) could be compensated easily, but there is no guarantee of compensation. Furthermore, some individuals reject notions of value based on economics.

Ecology/Land Use

Throughout Region 8, constraints to energy development may result from the enforcement of regulations such as the Federal Endangered Species Act

*See David Abbey, "Water Supply/Demand Alternatives for Electricity Generation in the Colorado Basin," Los Alamos Scientific Laboratory report LA-7662-MS (1979); and D. Abbey, "Water Use for Coal Gasification: How Much is Appropriate?," report to DOE's Assistant Secretary for Environment (1979).

**See M. Gisser et al., "Water: Agriculture vs. Energy Development in the Four Corners Area," Los Alamos Scientific Laboratory report LA-7643-MS (1979).

Table 8-2

REGION 8'S PROJECTED WATER USE FOR ELECTRICAL GENERATION IN 1985 AND 1990

ASR ^a Number	Basin Name	Available Supply (10 ⁶ gal/d)	Projected Consumption for Energy (10 ⁶ gal/d)		Projected Water Consumption by the Energy Sector As a Percentage of Available Supply		Projected Water Consumption by All Sectors As a Percent- age of Available Supply	
			1985	1990	1985	1990	1985	1990
1004	Yellowstone	12,256	10	14	0.1	0.1	93.9	92.7
1007	North and South Platte	13,982	20	20	0.1	0.1	96.6	102.1
1102	Arkansas	2,780	9	10	0.3	0.4	93.4	85.7
1302	Rio Grande	670	4	4	0.4	0.4	89.6	82.9
1401	Green	4,568	42.4	43.4	1.0	1.1	88.9	89.6
1402	Upper Colorado	7,230	1	1	--	--	59.2	64.1
1403	San Juan	9,493	41	38	1.6	1.4	105.5	106.3
1501	Little Colorado	288	10	8	4.5	3.3	65.3	69.5
1502	Lower Colorado Mainstem	15,103	29	31	1.7	1.7	92.3	92.9
1503	Gila	3,273	23	65	0.4	1.1	86.0	83.3

^aBasins with no projected energy facilities or those primarily outside the Rocky Mountain Region are excluded.

Table 8-3

WATER USE FOR COAL PRODUCTION AND CONVERSION IN THE SAN JUAN BASIN
(Activities Scaled to Coal Input of 9.3×10^6 TPY)

Activity	Acre-Feet/Year
Surface Coal Mine ¹	< 2500
Rail Transportation	Nil
Slurry Pipeline ²	6,800
2,300 MW Coal-Fired Electric Plant ³	26,450 (All-Wet Cooling) 10,600 (40% Wet/60% Dry) 4,600 (10% Wet/90% Dry) 2,300 (All Dry Cooling)
250 Million Cubic Feet/Average Day ⁴	7,700 (High Wet Cooling)
High BTU Gas Plant (Lurgi)	5,400 (Low Wet Cooling)

¹ Could be lower in wet years or with use of trickle irrigation.

² 8,600 Btu/lb Coal: Slurry 50% (Wt.) water.

³ 80% annual capacity factor, 33% thermal efficiency, wet flue gas desulfurization.

⁴ Assumes extensive waste water treatment and recovery.

of 1973, the Surface Mining Control and Reclamation Act of 1977, and various state laws.

Although many rare and endangered species are found within the region, direct energy development impacts on these species will probably be limited to degradation of fish habitat in streams. Indirectly, the increase in population that accompanies energy development can lead to increased game law violations and habitat destruction from construction-related activities, such as the mining of streambeds for gravel.

Increased SO₂ levels from coal-fired electricity generating facilities may adversely affect crops, endangered plant species, and wildlife habitat containing sensitive plant species.

Both federal and state laws require revegetation of mined areas to the appropriate land use, which in the western states has generally meant grazing. Because of the aridity of the region, irrigation is usually necessary for reclamation in addition to the usual soil amendments, seeding, and mulching. The cost of these reclamation processes is high and their success has been limited.

Socioeconomic

The 1985 Mid-Mid Scenario projects nearly 70,000 new jobs related to coal development in the 40 counties of the Western States. Between 1986 and 1990, another 80,000 new jobs will be added, bringing the total to nearly 150,000 new jobs. In 1990, 92% of the new jobs will be concentrated in the 23 counties of the region. These counties will experience over 10% population growth in at least 1 year of the development period.

Figure 8-3

Water Resources Council Aggregated Subregions (ASR) in Region 8.

Table 8-4

ENDANGERED FAUNA OF FEDERAL REGION 8 AS OF 1978 BY STATE STATUS

NAME							NAME								
COMMON	SCIENTIFIC	COLORADO	MONTANA	NORTH DAKOTA	SOUTH DAKOTA	UTAH	WYOMING	COMMON	SCIENTIFIC	COLORADO	MONTANA	NORTH DAKOTA	SOUTH DAKOTA	UTAH	WYOMING
MAMMALS															
Bat, fringed	<i>Myotis thysanodes</i>	X						Loon, arctic	<i>Gavia arctica</i>		X				
Bear, grizzly	<i>Ursus horribilis</i>	X						Murrelet, ancient	<i>Synthiboramphus antiquus</i>		X				
Cougar	<i>Felis concolor</i>	X						Owl, barred	<i>Strix varia</i>		X				
Ferret, black-footed	<i>Mustela nipripes</i>	X	X	X	X	X		Owl, boreal	<i>Aegolis funereus</i>		X				
Fox, kit	<i>Vulpes macrotis</i>			X	X			Owl, flammulated	<i>Otus flammeolus</i>		X				
Fox, swift	<i>Vulpes velox</i>						X	Owl, great-gray	<i>Strix nebulosa</i>		X				
Lemming, northern bog	<i>Synaptomys borealis</i>		X					Plover, snowy	<i>Charadrius alexandrinus</i>		X				
Lynx, Canada	<i>Lynx canadensis</i>	X	X					Ptarmigan, willow	<i>Lagopus lagopus</i>		X				
Marmot, hoary	<i>Marmota flaviventris</i>		X					Rail, yellow	<i>Coturnicops noveboracensis</i>		X				
Otter, river	<i>Lutra canadensis</i>		X					Sandpiper, buff-breasted	<i>Fryngites subruficollis</i>		X				
Otter, river	<i>Lutra canadensis sonora</i>	X						Sandpiper, curlew	<i>Calidris ferruginosa</i>		X				
Prairie Dog, Utah	<i>Cynomys parvidens</i>					X		Sparrow, black-throated	<i>Amphispiza bilineata</i>		X				
Pronghorn, Sonoran	<i>Antilocapra americana</i>	X						Sparrow, sharp-tailed	<i>Amphispiza caudata</i>		X				
Shrew, Merriam's	<i>Sorex merriami</i>		X					Thrush, wood	<i>Hylocichla ustulata</i>		X				
Shrew, Preble's	<i>Sorex preblei</i>		X					Turnstone, black	<i>Arenaria melanocephala</i>		X				
Shrew, pygmy	<i>Microsorex hoyi</i>		X					Vireo, Philadelphia	<i>Vireo philadelphicus</i>		X				
Vole, sage-brush	<i>Lagurus curtatus</i>		X					Warbler, bay-breasted	<i>Dendroica aestiva</i>		X				
Weasel, least	<i>Mustela nivalis</i>		X					Warbler, black-throated blue	<i>Dendroica caerulescens</i>		X				
Wolf, gray	<i>Canis lupus monstrabilis</i>		X					Warbler, black-throated green	<i>Dendroica virens</i>		X				
Wolf, Mexican	<i>Canis lupus baileyi</i>		X					Warbler, Connecticut	<i>Geothlypis agilis</i>		X				
Wolf, Northern Rocky Mountain	<i>Canis lupus irremotus</i>		X					Warbler, magnolia	<i>Dendroica magnolia</i>		X				
Wolverine	<i>Gulo gulo</i>	X						Warbler, mourning	<i>Geothlypis philadelphia</i>		X				
Wolverine	<i>Gulo luscus</i>		X					Woodcock, American	<i>Scolopax minor</i>		X				
BIRDS															
Bittern, least	<i>Ixobrychus exilis</i>		X					Wren, short-billed marsh	<i>Cistothorus platensis</i>		X				
Bobwhite	<i>Colinus virginianus</i>		X					REPTILES AND AMPHIBIANS							
Chicken, greater prairie	<i>Tympanuchus cupido</i>	X						Frog, spotted chorus	<i>Rana clarki</i>		X				
Crane, greater sandhill	<i>Grus canadensis tabida</i>	X						Hognose, plains	<i>Heterodon nasicus</i>		X				
Crane, whooping	<i>Grus americana</i>	X	X	X	X			Salamander, Four d'Alene	<i>Plethodon vandukei</i>		X				
Cuckoo, yellow-billed	<i>Coccyzus americanus</i>		X					Snake, milk	<i>Lampropeltis triangulum</i>		X				
Eagle, southern bald	<i>Haliaeetus leucocephalus</i>	X				X		FISH							
Falcon, American peregrine	<i>Falco peregrinus anatum</i>	X	X	X	X	X		Chub, bonytail	<i>Gila elegans</i>		X				
Flycatcher, alder	<i>Empidonax alnorum</i>		X					Chub, creek	<i>Semotilus atromaculatus</i>		X				
Flycatcher, great-crested	<i>Myiarchus crinitus</i>		X					Chub, humpback	<i>Gila cypha</i>		X	X		X	X
Godwit, Hudsonian	<i>Limosa haemastica</i>		X					Chub, sturgeon	<i>Bythopsis gelida</i>		X				
Grouse, prairie sharp-tailed	<i>Pedioecetes phasianellus jamesi</i>	X						Dace, finescale	<i>Phoxinus neogaeus</i>		X				
Gull, glaucous	<i>Larus hyperboreus</i>		X					Sculpin, shorthead	<i>Cottus bairdii</i>		X				
Hawk, broad-winged	<i>Buteo platypterus</i>		X					Sculpin, spoonhead	<i>Cottus ricei</i>		X				
Hawk, red-shouldered	<i>Buteo lineatus</i>		X					Squawfish, Colorado River	<i>Ptychocheilus</i>		X			X	X
Heron, green	<i>Butorides virescens</i>		X					Sucker, blue	<i>Catopterus elongatus</i>		X				
Hummingbird, Anna's	<i>Calypte anna</i>		X					Trout, lake	<i>Salvelinus namaycush</i>		X				
Hummingbird, ruby-topaz	<i>Thryslampis mosquitos</i>		X					Trout, perch	<i>Peropsis omiscomayensis</i>		X				
Jaeger, parasitic	<i>Stercorarius parasiticus</i>		X					Wormfin	<i>Plagopterus argentissimus</i>					X	
Junco, grayheaded	<i>Junco capiceps</i>		X												

NOTE: Only fauna are listed here, and only those fauna listed as endangered in Federal Region 8.

SOURCE: The Regional Environmental Data Books for the Rocky Mountain and Midwest Regions.

Table 8-5

SOCIOECONOMICALLY IMPACTED COUNTIES^a IN FEDERAL REGION EIGHT:
A COMPARISON OF GROWTH ABOVE BASE POPULATIONS AND PUBLIC COSTS
AS PRESENTED IN THE RIIA-I MID-MID SCENARIO

Code ^b	County	1978 Base Pop.	Peak Year Pop.	Peak Year Projected Population	% Over Normal Base Growth ^a	Annual \$/Capita for Local Gov't Services ^c
COLORADO						
1	Gunnison	7,649	1990	22,735	240.24	\$424
2	Huerfano	6,550	1989	7,493	13.48	\$ 72
3	Los Animas	16,541	1988	18,029	30.73	\$169
4	Moffat	9,797	1982	28,224	201.42	\$599
5	Pitkin	11,147	1983	23,438	47.64	\$182
6	Rio Blanco	5,582	1989	16,789	146.79	\$368
7	Routt	11,828	1987	53,210	128.16	\$347
MONTANA						
8	Big Horn	11,116	1988	17,042	33.98	\$149
9	Rosebud	11,843	1981	22,378	41.70	\$151
NORTH DAKOTA						
10	Bowman	5,205	1987	5,287	12.63	\$ 64
11	Dunn	4,804	1987	5,336	21.00	\$ 98
12	McLean	11,726	1982	17,909	42.24	\$193
13	Mercer	6,680	1988	10,975	44.96	\$183
14	Oliver	2,409	1983	3,663	52.83	\$196
SOUTH DAKOTA: No counties listed as impacted.						
UTAH						
15	Emery	8,345	1981	17,699	72.20	\$229
16	Kane	5,635	1988	57,983	850.46	\$525
17	Sevier	12,576	1987	19,295	17.97	\$ 91
18	Wayne	1,808	1989	14,497	512.98	\$518
WYOMING						
19	Campbell	14,605	1988	52,155	211.93	\$399
20	Carbon	15,539	1988	38,373	34.54	\$151
21	Platte	8,045	1988	11,997	28.13	\$130
22	Sweetwater	37,745	1982	62,339	10.33	\$ 62
23	Uinta	11,144	1990	33,679	52.33	\$211

^aIncludes only counties that will experience a greater than 10% growth per year, entirely as a result of energy development described in the Mid-Mid Scenario.

^bThese numbers correspond to those in the counties on the adjacent map.

^cAnnual cost of public services and facilities for social welfare, hospitals, police, fire, sewage, solid waste disposal, recreational services, general government, water treatment, libraries, and education. Costs are based on SEAM Model average costs for Federal Region 8.

Figure 8-4

Counties^{a,b} with Severe Socioeconomic Impacts in Federal Region 8
As Identified in the RIIA-I Mid-Mid Scenario

^aThe counties are identified by matching the code numbers with the adjacent table.

^bIncludes only counties that will experience a greater than 10% growth per year, entirely as a result of energy development described in the Mid-Mid Scenario.

Nearly 15,000 MW of new generating capacity are sited in 11 of the 23 coal-producing counties in five states. The typical household in the impacted communities will pay an average of \$840 per year for required basic local government services. This ranges from approximately \$217 per year in Sweetwater County, Wyoming, to nearly \$2100 per year in Moffat County, Colorado.

The sparsely-populated Western States will experience profound direct and indirect socioeconomic impacts associated with the migration of workers and their families. Commercial centers and transportation services near the mine sites and conversion facilities will experience indirect impacts from construction material supply and maintenance services. Local residents generally will resist major changes in their lifestyles and will be reluctant to vote for additional tax assessments to provide for community services necessary to accommodate rapid growth.

Health and Safety

Federal Region 8, simply because its air is clean and its land sparsely-populated, will experience minimal public-health effects from increased coal use. Although the effects on the general public will be slight, burning coal to generate electricity and run synthetic natural gas plants will have a greater impact on those persons who have migrated to the region because of respiratory health reasons.

Public safety depends on the action taken by the general public and their local governmental bodies. In heavily-populated, industrialized states (for example, many in the East), the public and their representatives are more experienced in coping with public safety hazards than their counterparts in Region 8. Therefore, Region 8's lack of experience is expected to cause growing public safety concerns.

Items listed below are matters for concern but are not likely to constrain energy development in the region.

- o Increased coal use, combined with Region 8's inexperience in handling public safety hazards, will threaten public safety.
- o Per Btu supplied, coal mining is the energy supply activity most hazardous to workers.
- o Occupational health and safety are mainly controlled by national industry policies; regional considerations are secondary.
- o Total risk to public health from airborne sulfates is projected to double under the scenario; still the overall effects on public health will be minimal.

Solid Waste

Solid waste problems in Federal Region 8 are a function of land form, aridity, and patterns of land ownership; these vary radically from county to county.

In the eastern plains region of the Dakotas, Montana, Wyoming, and Colorado, mitigation of solid waste problems is relatively simple. In the mountains, however, almost all of the underground mining is being planned for areas where land forms are quite rugged. In these areas, partly because of difficult terrain, federal land control approaches totality, populations are miniscule, and waste controls are rare and expensive. Land legally appropriate for the disposal of wastes from underground mines is limited or distant from most mine sites. The situation is further complicated by the effects of historical mining practices, which have left whole valleys unreclaimed after 50 years or more.

Table 8-6

A COMPARISON OF PUBLIC AND PRIVATE LAND OWNERSHIP,
1970 CENSUS
(Thousands of Acres)

<u>State</u>	<u>Urban Areas</u>	<u>Farmsteads, Farm Roads, and Lands</u>	<u>Total</u>	<u>Acreage of State</u>	<u>% of Land in Private Ownership</u>
Colorado ¹	365	35,902	36,267	66,486	54%
Montana ¹	93	62,158	63,141	93,271	68%
North Dakota ²	84	42,357	42,441	44,452	95%
South Dakota ²	106	45,978	46,084	48,882	96%
Utah ¹	273	10,610	10,883	52,696	21%
Wyoming ¹	61	34,272	34,333	63,343	54%

SOURCES: Regional Energy/Environment Data Book Drafts, 1978, Rocky Mountain¹ and Midwest² Regions.

Another type of waste problem arises in those western counties of Utah with desert conditions. Here, as in the mountains, tiny populations cluster near water sources, most of the land is public domain, and the disruption or contamination of limited water supplies carries the potential for disaster for many miles. Typhoid continues to be a serious problem in all three types of terrain because approved solid waste disposal facilities are inadequate or nonexistent for more than 50% of the population, federal regulations notwithstanding.

Institutional

Many of the institutional issues that affect power generation in Federal Region 8 are applicable to more than one state, if not to all of the states.

The criteria by which state utility commissions determine the need for new electricity generating stations are broadening to encompass a larger number of issues of concern to both rate-payers and special interest groups. Today, utility commissions in Montana and Colorado are looking beyond markets and rates and becoming increasingly concerned with three additional issues: the resolution of environmental concerns, power export policies, and the distribution of benefits and costs.

Coal and electric power export policies are growing in importance in several Region 8 states, especially in Montana, which has an implicit policy of "strip and ship." Other states, less sensitive about the environmental effects of power generation, are concerned that the export of electricity not adversely impact state residents through higher base rates that subsidize construction of new capacity for out-of-state consumers. Much of the new generating capacity in the West is being built to serve the expansion of the coal and uranium mining industries. Present power customers are justifiably asking why they should subsidize these export industries.

The inventory of Bureau of Land Management (BLM) and US Forest Service roadless tracts through the region has two significant impacts on the use of federal land for energy development: it removes all roadless areas from use for the duration of the study period, and it removes tracts ultimately designated for wilderness from productive use forever. Both of these activities make energy facility siting and access more difficult, increase the lead-times needed for planning and construction, and ultimately increase project costs.

The BLM leasing moratorium is also delaying coal production. Opponents of the leasing moratorium have argued that many existing BLM leases do not contain a sufficient amount of economically recoverable coal. Moreover, it is becoming increasingly difficult for a coal operator to assemble an economic mining unit without including federal land. The moratorium on BLM leasing has made it difficult for western utilities to obtain reliable sources of coal.

Western utility managers are concerned about the costs of air pollution control technology required by federal legislation and the compatibility of this technology with power generation equipment requirements. Lead-time may be extended for the construction of new power generating sources by the ambient air monitoring required by PSD regulations.

Siting of fossil-fueled power generating facilities must comply with Prevention of Significant Deterioration (PSD) regulations, which are especially restrictive for Class I area airsheds. In addition to the designation of some Indian lands as Class I areas (including the Northern Cheyenne Reservation in Montana), national park lands and wilderness areas also are designated Class I. National forests and monuments as well as potential Bureau of Land Management wilderness areas are being studied for possible Class I designation.

In several of Region 8's states, institutional issues are influenced by the actions, concerns, and legal status of Indian tribes. These include the Navajo in Utah and the Northern Cheyenne, the Crow, and the Federated

Salish and Kootenai Tribes on the Flathead Reservation in Montana. With the exception of the Crow, who generally favor energy development, the actions of Indian tribes have limited the sites available for power and mining and increased the financial risks of project development.

Recent Indian assertiveness is motivated in part by the desire for sovereignty, but also by a desire to protect the environment, control the use of resources, improve reservation communities, increase Indian employment, and increase tribal revenues. Indian tribes are employing several institutional tools to achieve their goals: disapproving power plant sites and transmission corridors, imposing taxes, renegotiating mineral leases, withholding right-of-way permits, and obtaining Class I area air quality designations. Both the Navajo Land Administration Department and the Environmental Protection Commission can disapprove proposed transmission corridors and power plant sites because they find the development proposals dangerous or environmentally unsound.

The Crow and Northern Cheyenne have gone to court for higher royalties on their coal leases. The court found the royalties to be too low and the coal companies are appealing this decision. The Navajo Tribe successfully renegotiated its coal leases with El Paso Natural Gas and Consolidation Coal Corporation. Now the Navajo Land Administration Department is using right-of-way permits as leverage to renegotiate other coal leases. The new permit conditions are still under consideration, but are likely to be much more stringent.

STATE ISSUES

COLORADO

The RIIA-I Scenario projects electrical generating capacity and industrial fuel use as well as coal production for Colorado, as shown on Table 8-7 and its companion pie charts (Fig. 8-5).

Visibility

- o Medium to high impairment of visual air quality is projected to occur in 11 of the 12 Class I areas located in the state.
- o The projected tripling by 1990 of sulfur dioxide emissions from the state's industrial and utility fossil fuel combustion facilities is a major factor contributing to visibility impairment.
- o The long-range transport of particulate sulfates into the state also is expected to be a major factor contributing to visibility impairment.

Table 8-7

ENVIRONMENTAL IMPACTS^a OF THE EIA TREMDLONG MID-MID SCENARIO ON FEDERAL REGION 8

Energy Source	Air		Water		Land		Health & Safety ^c	Social and Economic			
	Quality	Visibility	Quality	Availability ^b	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
COAL											
-Electric	M	H	L	L	M	M	L	M	H	H	L
OIL	L	L		L	M	L	L	L	L	L	L
GAS	L	L		L	L	L	L	L	L	L	L
NUCLEAR	L	L		L	M	M	L	L	L	L	L
CONSERVATION											
-Energy Efficiency Improvements	L	L	L	L	L	L	L	L	L	L	L
-Urban Waste	L	L	L	L	L	L	L	L	L	L	L
-Cogeneration	L	L	L	L	L	L	L	L	L	L	L
SOLAR	L	L	L	L	L	L	L	L	L	L	L
GENERAL											
-Utility	M	H	L	L	M	M	L	H	H	H	M
-Industry	L	H	L	L	L	L	L	L	L	L	L
-Mining	L	L	M	M	M	L	L	H	H	H	M

^a Criteria for ranking impacts are found in Table AP-1.^b Includes groundwater.^c Includes health effects not covered by air quality.

Table 8-8

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN COLORADO
(Capacity in Megawatts)

	1975	1985	1990	Total Change
<u>Electrical Generating Capacity and Industrial Fuel Use</u>				
¹ Hydro, Conventional	452 (11.8%)	552 (7.5%)	552 (6.7%)	100
² Hydro, Pumped Storage	162 (4.2%)	530 (7.2%)	530 (6.4%)	368
³ Coal Steam	2,405 (63.0%)	4,146 (56.4%)	4,526 (54.7%)	2,121
⁴ Nuclear	0 (0%)	330 (4.5%)	330 (4.0%)	330
⁵ Gas Turbine	0 (0%)	180 (2.5%)	180 (2.2%)	180
⁶ Gas Steam	250 (6.6%)	182 (2.5%)	161 (1.9%)	-89
⁷ Oil Turbine	403 (10.6%)	1,339 (18.2%)	1,624 (19.6%)	1,221
⁸ Oil Steam	144 (3.8%)	70 (1.0%)	70 (0.9%)	-74
⁹ Solar	0 (0%)	20 (0.3%)	300 (3.6%)	300
TOTAL	3,816	7,349	8,273	4,457
<u>Coal Production</u>				
Deep Mines	84	427	456	372
Surface Mines	109	716	1,402	1,393

Figure 8-5

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

Description:

The current visual air quality in the nonurban areas of the state is superior to that experienced in most other states in the US. The long-range transport of light-scattering aerosols (sulfates, in particular) is an important factor contributing to the light extinction budgets in nonurban areas of the state. The median visual range based upon measurements at four nonurban/suburban sites for the period 1974-76 ranged from 70 to 90 miles. Median visual ranges calculated for the 12 Class I areas in the state for baseline year 1977 ranged from 74.5 to 82.9 miles.

According to measurements taken at airports, visibility in the state generally has deteriorated over the past 20 years. From 1953-55 to 1970-72, median visual range changed -13% in Denver, -12% in Colorado Springs, -4% in Grand Junction, and +35% in Pueblo. This deterioration is most likely related to increased concentrations of anthropogenically-generated light-scattering aerosols in the atmosphere, which are caused by human activities that accompanied economic and population growth during the period.

Figure 8-6

COLORADO'S PROJECTED VISUAL
AIR QUALITY IMPACTS
FOR CLASS I AREAS

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. The state has an abundance of such areas.
- o The 12 Class I areas in the state are covered by recent Congressional legislation (Public Law 95-95, Subpart 2, Sec. 169A), which declared as a national goal the protection of visual air quality in mandatory Class I Federal areas where impairment in visual air quality results from manmade air pollution. Regulations that quantitatively define impairment and that define measures to prevent future impairment and remedy existing impairment are required to be promulgated by August 1979.

Scenario-Induced Issues

o By 1990, 1 Class I area is projected to have high impacts, 10 to have medium impacts, and 1 to have low impacts. Calculated visual range and its percent change for the 12 Class I areas in the state are shown in Table 8-9.

o Eleven Class I areas are projected to have medium to high regional haze impacts. One Class I area—Weminuche Wilderness—is projected to have a greater than 20% decrease in median visual range from 1977 to 1990, rated as high impacts. Ten Class I areas—Eagles Nest Wilderness, Flat Tops Wilderness, Great Sand Dunes Wilderness, La Garita Wilderness, Maroon Bells-Snowmass Wilderness, Mesa Verde National Park, Mount Zirkel Wilderness, Rawah Wilderness, Rocky Mountain National Park, and West Elk Wilderness—are projected to have a 10-20% decrease in median visual range from 1977 to 1990, rated as medium impacts.

o High impairment from plume blight could affect Mount Zirkel Wilderness and Flat Tops Wilderness due to 1140 MWe of increased coal steam capacity projected by the scenario to be sited in Moffatt County.

o The state's substantial projected growth of emitted sulfur dioxide, which converts to particulate sulfates, is a major factor contributing to the projected impairments. Sulfur dioxide emissions are projected to increase from 1975 to 1990 by 139.1% and 670.5% for utility and industrial fossil fuel combustion facilities, respectively.

o Air pollution sources located outside of the state are predicted to have a major impact on impairment of visual air quality in the state. Of the state's predicted area-weighted sulfate concentrations, which are caused by sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities, 66% was due to emissions from sources located outside the state.

Table 8-9

COLORADO: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)				
	Calculated			Percent Change From 1977 To	
	1977	1985	1990	1985	1990
Black Canyon of the Gunnison Wilderness	75.4	69.5	68.8	- 7.8	- 8.8
Eagles Nest Wilderness	80.6	66.1	64.9	-18.0	-19.5
Flat Tops Wilderness	80.5	69.9	68.7	-13.2	-14.7
Great Sand Dunes Wilderness	75.0	67.9	67.0	- 9.2	-10.7
La Garita Wilderness	79.8	70.2	69.4	-12.1	-13.0
Maroon Bells-Snowmass Wilderness	75.1	62.8	61.7	-16.4	-17.9
Mesa Verde National Park	77.7	69.8	69.3	-10.1	-10.8
Mount Zirkel Wilderness	82.9	69.1	68.0	-16.6	-18.0
Rawah Wilderness	82.6	73.9	72.7	-10.5	-11.9
Rocky Mountain National Park	79.7	66.3	64.4	-16.8	-19.2
Weminuche Wilderness	77.9	56.4	55.3	-27.6	-29.0
West Elk Wilderness	74.5	63.5	62.8	-14.9	-15.8

Local Air Quality

- o Continued TSP and SO₂ violations are projected for several areas in six AQCRs. (See Figure 8-7.)
- o Thirty-four percent of the projected industrial SO₂ emission increases will occur in counties already in nonattainment for SO₂.
- o The large number of Class I areas in Colorado may constrain energy development.

Figure 8-7

Description

According to state ambient air quality data and Mid-Mid Scenario projections, there will be continuing nonattainment for TSP in parts of seven AQCRs and continuing nonattainment for SO₂ in two of those areas. Because SO₂ monitors have only recently been installed and operational, there are few recorded violations of ambient SO₂ standards and 1975 data exist for only three counties. More violations of SO₂ standards might have been predicted had baseline year SO₂ concentrations been available to include in modeling calculations.

Background Issues

- o The air quality throughout urban and industrialized areas of Colorado is characterized by violations of state and federal TSP standards.
- o Violations of state Total Suspended Particulate (TSP) standards are widespread in Colorado.

Scenario-Induced Issues

- o Thirty-four percent of the projected industrial SO₂ emission increases will occur in counties already in nonattainment for SO₂.
- o Continuing nonattainment for TSP is projected in AQCRs 35, 36, 37, and 38, which contain the metropolitan areas of Grand Junction, Denver, Boulder, Greeley, Pueblo, and Colorado Springs.
- o No Prevention of Significant Deterioration (PSD) increment violations, however, are predicted in the Mid-Mid Scenario.
- o Approximately three-fourths of the proposed industrial growth in Colorado will occur in nonattainment areas for TSP.
- o Thirty-eight percent of the projected 1990 TSP emissions and 62% of the 1990 SO₂ emissions are from utility coal combustion. Although no significant air quality issues exist for the scenario-projected utility coal expansion, serious air quality problems will arise if utility expansion proceeds as planned by the utility companies.

Water-Related Issues

- o Constraints to the development of new water supplies include funding challenges to new storage projects and enforcement of environmental legislation, especially the Clean Water Act and the Endangered Species Act.
- o The potential for aquifer contamination and drawdown from in situ oil shale conversion must be considered on a per case basis.

Description

Colorado's principal basins are the Platte, the Arkansas, the Rio Grande, and the Colorado. The Colorado Basin, especially the Yampa and White

Subbasins, contains coal, oil shale, and uranium resources. While on paper (that is, permit applications) the Colorado River is vastly overappropriated, about 800,000 acre-feet are not presently being used. New storage projects will almost certainly be necessary to make use of this water.

In the Front Range communities of the Eastern Slope (the South Platte Subbasin), substantial quantities of water have been transferred from agricultural to municipal use. Further east, on the High Plains, irrigated acreage has expanded with the use of sprinkler irrigation and groundwater mining from bedrock aquifers.

Aside from their development potential, Colorado's rivers also support a number of highly-valued in-stream uses. The Dolores, the Yampa, and the Green, among others, are being studied for inclusion in the US Wild and Scenic Rivers System. In addition, the natural flowing waters of the Colorado River support two endangered and three threatened fishes. Blue ribbon sport fisheries abound throughout the state.

Background Issues

- o Leaching from inactive uranium mine and mill tailings is a major concern in the state.
- o The funding status of new Bureau of Reclamation water development projects is uncertain.
- o The prospect of oil shale commercialization is uncertain; so is the choice of conversion method—surface or in situ retorting.

Scenario-Induced Issues

- o Streamflows will provide most of the water for energy development, although the Platte River Power Authority intends to use Ft. Collins waste water for its Rawhide plant. While depletions for energy production constitute a very small fraction of total projected use or supply, they do affect in-stream uses (critical whooping crane habitat on the central Platte, habitat for the Colorado squawfish, and so forth), however slightly.
- o Water quality impacts from coal mining and shale oil production may be pronounced along reaches of the Yampa, the White, and Piceance Creek.

Ecological and Land-Use Impacts

- o Large areas of land disturbed by mining, power plant construction, transmission corridors, and associated boomtown development adversely affect croplands, natural vegetation, and fauna including nine endangered animal species and five endangered plant species. Reclamation of steep and often arid slopes is rarely successful in restoring original plant communities, leading to destruction of habitat and changes in species composition.

Figure 8-8

- o Erosion problems in transmission corridors contribute to degradation of water quality and may affect endangered fish, riparian habitats, and recreational values in downstream national parks.

Description

Colorado encompasses mountain, prairie, and high plateau with vegetation ranging from grasslands and scrub to arctic-alpine regions extending above timberline. The high altitudes, steep slopes, and arid nature of the western counties, where most energy development will take place, contribute to the difficulty of mitigating land disturbances. The popularity of Colorado as a recreational resource and, increasingly, as a place of permanent residence has brought many ecological idealists to the political fore. Preservation of the natural environment is a major issue in many areas and has temporarily stopped the development of new mines in at least one case.

Background Issues

- o The erosion of disturbed lands degrades water quality in the Yampa, Green, and Colorado River tributaries, which harbor four endangered species of fish.
- o Of the 65,000 acres disturbed by mining prior to 1975, only 14,000 acres have been successfully reclaimed.
- o In boomtown areas, game law violations and land disturbance from off-road vehicles have increased sharply.

Scenario-Induced Issues

- o The threat of energy development activities to nine endangered animal species and five endangered plant species may constrain achievement of the scenario.
- o Primary development is in two northwestern counties, which have traditionally been recreation- and ranching-oriented areas.
- o SO₂ increases may diminish crop values in one county and limit forage species for the prairie sharp-tailed grouse, which survives in Colorado only in that one county.

Socioeconomic Impacts

- o Severe socioeconomic impacts will result from rapid population increases in sparsely-populated counties. The burden of amenity development for newcomers and transients rests largely with the current populations.
- o Limited availability of private lands in certain development areas is likely to lead to grossly inflated property values.

Description

Most energy development in Colorado will occur in areas with small, rural-based populations. The local labor force will be totally inadequate to meet the demands of the new industries. An influx of relatively prosperous wage earners into what have been basically farm and ranch communities will drive prices for goods and services out of reach of the local people on fixed incomes, as demand for limited resources escalates.

Background Issues

- o Local socioeconomic impacts are defined by the demographic, economic, and social changes associated with the siting, construction, and operation of energy-generating facilities. The interdependencies among labor supply, local public capital, and the availability of accessible sources of goods and services define the most important spheres of socioeconomic impact.
- o Characteristic socioeconomic trends attributable to energy developments include the following.
 - Construction of energy facilities creates an almost instantaneous demand for employees.
 - If the local labor force is insufficient to fill these demands, new workers and their families create rapid increases in local populations.
 - The timing of energy facility construction and operation and the availability of local labor determine the levels of population increase that may be realized in a given county.

— The direct demands of the industry and the increased incomes paid to workers expand wholesale, retail, commercial, industrial, and service employment and, concomitantly, population.

— The larger the demographic differences between the new and existing populations, the more severe are sociocultural problems relating to social organization and particular service needs.

— Revenue imbalance arises due to the immediate need for services (for example, schools, sewers, police, fire, utilities, and hospitals) and the delayed collection of revenues during plant construction.

— Shortfalls in public revenues and subsequent inadequacies in the provision of public services may have the undesirable consequence of stimulating population turnover, thereby worsening socioeconomic impacts.

— The provision of public services and facilities determines the quality of life that will be experienced by both the new and existing population living in the county.

— If the quality of life decreases enough because of these problems, the productive labor force may leave, resulting in lower productivity in the energy industry, less provision of services, and further social dissolution.

o Increases in population of 10% or more during any given period are considered severe. While the literature will ascribe a 7-15% increase range, the 10% figure used in this analysis is based on Gilmore and Duff's study,* which indicates that such a change is sufficient to result in social problems such as increased crime, divorce, out-migration, labor turnover, etc.

o The capacity for counties to assimilate new employment and population growth is a function of base population size and density, manufacturing employment, and distance to the nearest trade center.

o As a rough guide, counties with different assimilative capacities can absorb, without adverse population in-migration, the following types of energy activities.

— Extra low assimilative capacity: no commercial scale energy facility or mine.

— Low assimilative capacity: small mining operations.

— Moderate assimilative capacity: single plants or mines of moderate size.

*See John S. Gilmore and Mary K. Duff, Boom Town Growth Management: A Case Study of Rock Springs--Green River, Wyoming (Westview Press, Boulder, Colorado, 1975).

Figure 8-9

Figure 8-10

Figure 8-11

Figure 8-12

*No new electric utility capacity is projected for this county.

Figure 8-13

*No new electric utility capacity is projected for this county.

Figure 8-14

*No new electric utility capacity is projected for this county.

Figure 8-15

*No new electric utility capacity is projected for this county.

— High assimilative capacity: single large-scale facilities or multiple facilities of smaller sizes.*

- o The Colorado counties identified as potential sites for future mines and energy-generating facilities span the range from extra low to low assimilative capacity.

- o Colorado has a long history of mining boomtowns that quickly became ghost towns when the mineral resource was exhausted. The state and local governments are now determined to plan for orderly development and consumption of their resources.

Scenario-Induced Issues

- o Of 16 counties identified in the scenario, 7 will observe population impacts in excess of 10% growth in one or more years of development activity.

- o Most of the proposed development will take place in four counties with extra low to low population assimilative capacity.

- o Socioeconomic impacts are expected to be most pronounced in Gunnison, Moffat, Rio Blanco, and Routt Counties, where 71% of the scenario's 56,177 projected new jobs are found.

- o Two of the most heavily-impacted counties—Rio Blanco and Moffat—are also subject to future impacts from oil shale deposits in the area.

- o All 16 counties identified in the scenario have mining activities for other minerals now in operation.

- o Two counties—Moffat and Routt—are expected to observe over 300% actual growth over the 12 years of the scenario.

Health and Safety Impacts

- o Public health costs due to emissions from the state's coal-fired power and gasification plants are expected to be twice that of New Mexico, a producer of more energy but much less densely-populated.

Description

Colorado is more subject to health and safety impacts than other states in the region because of its greater population and large number of mining activities.

*The above general descriptive statement (five bullets) was drafted by Energy and Environment Systems Division of Argonne National Laboratory, May 1979

Background Issues

- o Clean air and associated lack of respiratory problems are important parts of the Colorado "image," which affects tourism and migration.
- o Respiratory disease (notably "black lung") is not considered here because it is thought to be preventable, provided coal dust concentrations in inhaled air are to be held to a maximum of 2 mg/m^3 in accordance with present standards.
- o Mine safety estimates are less uncertain than those of air pollution-caused health effects largely because the former are based on ample experience and because data have been easy to measure (e.g., deaths and injuries). We assume here that improvements in mine safety will not be forthcoming until after 1990.

Scenario-Induced Issues

- o Degraded health from increased air pollution will cost the state both in dollars and lost productivity in terms of person-days of work per year.
- o From 1975 to 1990, there will be an order of magnitude increase in coal mining deaths in Colorado.
- o Public health effects from airborne sulfates in Colorado are expected roughly to double from 1975 to 1990, as coal utilization increases greatly but stringent emission controls are implemented.

Figure 8-16

Figure 8-17

Figure 8-18
SOLID WASTE GENERATION FROM
INDUSTRIAL COAL USE
IN COLORADO

Figure 8-19
LAND USE FOR COAL PRODUCTION
IN COLORADO

Figure 8-20
TOTAL AREA USED FOR INDUSTRIAL
ASH AND SLUDGE DISPOSAL
IN COLORADO

Figure 8-21
TOTAL AREA USED FOR UTILITY
ASH AND SLUDGE DISPOSAL
IN COLORADO

Solid Waste Impacts

- o Inactive Uranium mine and mill tailings are considered a major solid waste problem in Colorado.
- o Increasing local objection to new energy projects is projected because of problems caused by inadequate waste disposal facilities in the past.
- o In some areas, urban, mining, and industrial wastes will have to be transported considerable distances to find disposal sites that meet federal and state standards.

Description

Much of Colorado is steep, mountainous terrain encompassing fragile alpine ecosystems, easily-damaged watersheds, and habitat for endangered species. Either because of this steep terrain or the large amount of federally-owned land in most of Colorado's energy impacted areas, there is little appropriate land available for disposal of urban wastes or mine tailings related to underground mining.

Background Issues

- o Uranium mine and mill tailings are contaminating water supplies and being used as gravel supplies and building sites.
- o Colorado no longer allows mine wastes to be dumped on steep slopes that contain critical watersheds.
- o Mine waste leaching contributes to the total dissolved solids (TDS) and total suspended solids (TSS) loads of the Colorado River; the levels of this pollution are controlled by interstate compact.
- o Successful reclamation of mine spoil piles in the mountainous areas of Colorado is difficult. Surface mining had destroyed approximately 65,000 acres by 1965, of which 14,000 acres still have not been reclaimed.
- o In some areas, reclamation permits are being withheld from the energy industry because of limited availability of appropriate land for mine wastes.
- o Whole valleys in Ouray and San Juan Counties have been filled with mine tailings, through which streams filter.
- o Gunnison County contains slopes that usually exceed 45 degrees. In addition, less than 38,000 acres of the county's 2 million acres are available for private development.

Scenario-Induced Issues

- o Water contamination from increased human and mine wastes will cause severe problems for hundreds of miles downstream.

o In Gunnison County, six new coal mines and one uranium mine will increase the population 57.8% by 1985. In this area of high altitudes, steep slopes, and the headwaters of tributaries of the Colorado River, waste disposal will be difficult. As a result, these energy developments may be constrained.

o Routt County (6,592 population in 1970) will receive 28,000 temporary and 3,100 permanent new residents according to the scenario. Moffat County (6,332 population in 1970) will acquire 26,000 new, permanent residents due to energy development. Gunnison County (7,578 population in 1970) is expected to get 16,000 new residents. The capability or willingness of such small base populations to finance waste facilities alone for these levels of growth will constrain development.

Figure 8-22

LAND USE IN COAL MINING AND CLEANING - COLORADO
(Scenario numbers often total more than 100%.)

Institutional Issues

o The Mid-Mid Scenario will not be constrained by existing institutional issues.

o The most important institutional issues related to power plant siting in Colorado are those involving the resolution of environmental concerns and the permitting process.

The primary environmental concern in Colorado is the protection of air quality. Issues that have arisen include EPA's formulation of regulations, the relationship between EPA headquarters and its Denver regional office, and the handling of air quality programs by the state's Department of Health.

Industry officials have criticized the state permitting process for requiring too many permits and being too lengthy. While there is no coordinated permitting process in the state, Colorado is developing an administrative process for a more coordinated review. State officials feel that the existing siting procedures will be shortened when more experience is gained and a solid data base is established. However, problems of high staff turnover and overlapping state and federal jurisdictions (especially between EPA and the State Air Pollution Control Division) are expected to continue.

MONTANA

The RIIA-I Scenario projects electrical generating capacity and industrial fuel use as well as coal production for Montana, as shown on Table 8-10 and its companion pie charts (Fig. 8-23).

Table 8-10

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN MONTANA
(Capacity in Megawatts)

	1975	1985	1990	Total Change
<u>Electrical Generating Capacity and Industrial Fuel Use</u>				
¹ Hydro, Conventional	2,069 (74.8%)	2,968 (63.1%)	2,968 (54.9%)	899
² Coal Steam	554 (20.0%)	1,584 (33.7%)	2,284 (42.2%)	1,730
³ Gas Turbine	22 (0.7%)	102 (2.2%)	102 (1.9%)	80
⁴ Oil Steam	120 (4.3%)	50 (1.1%)	50 (0.9%)	-70
TOTAL	2,765	4,704	5,404	2,639
<u>Coal Production</u>				
Deep Mines	0	0	0	0
Surface Mines	409	1,296	1,799	1,390

Visibility

o No significant impairment of visual air quality is projected for the 12 Class I areas located in the state.

Description

The visual air quality in nonurban areas of the state is generally superior to that experienced in most other states in the US, but is subject to significant variation. The long-range transport of light-scattering aerosols (sulfates, in particular) is an important factor contributing to the light extinction budgets in nonurban areas of the state.

Visibility is poorest in the northwestern part of the state. The median visual range based upon measurements made at three nonurban/suburban sites for the period 1974-76 ranged from 41 to 65 miles. Median visual range calculated for the 12 Class I areas in the state for baseline year 1977 ranged from 38.4 to 77.6 miles.

Figure 8-23

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

Figure 8-24

MONTANA'S PROJECTED VISUAL
AIR QUALITY IMPACTS
FOR CLASS I AREAS

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. There is an abundance of such areas in the state.
- o The state's 12 Class I areas are protected against impairment of visual air quality according to recent Congressional legislation.

Scenario-Induced Issues

- o All 12 Class I areas in the state are projected to have low impacts. Calculated visual range and its percent change for these areas are shown in Table 8-11. No large fossil fuel combustion facilities are projected by the scenario to be sited in counties located near the 12 Class I areas. The projected changes in median visual ranges from 1977 to 1990 are calculated to decrease less than 10%.
- o Sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities are projected to be relatively low in 1990, although a growth of 294% is projected from 1975 to 1990.
- o The states imported fraction of the area-weighted particulate sulfate concentration due to the utility and industrial fossil fuel combustion facilities is predicted to account for 77% of the total.

Table 8-11

MONTANA: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)				
	Calculated			Percent Change From 1977 To	
	1977	1985	1990	1985	1990
Anaconda-Pintlar Wilderness	38.4	39.0	38.5	1.4	0.2
Bob Marshall Wilderness	73.7	75.5	75.2	2.4	1.9
Cabinet Mountains Wilderness	51.4	54.6	54.1	6.3	5.4
Gates of the Mountain Wilderness	59.7	60.3	60.0	0.9	0.4
Glacier National Park	77.6	79.5	78.6	2.4	1.3
Medicine Lake Wilderness	73.7	73.3	72.2	-0.5	-2.1
Mission Mountain Wilderness	72.3	73.5	73.1	1.6	1.1
Red Rock Lakes Wilderness	71.1	70.0	69.5	-1.4	-2.1
Scapegoat Wilderness	59.7	60.3	60.0	0.9	0.4
Selway-Bitterroot Wilderness	54.2	58.5	58.3	7.9	7.4
U.L. Bend Wilderness	72.9	71.5	70.4	-2.0	-3.4
Yellowstone National Park	67.2	65.4	64.9	-2.7	-3.5

Local Air Quality

- o There is continuing nonattainment for SO₂ in three counties through 1990 and continuing nonattainment projected for TSP in four counties through 1985, and in two of these counties through 1990. (See Figure 8-25).
- o Designation of Indian reservations as Class I areas will constrain siting of new energy facilities.

Description

Smelters are major sources of SO₂ emissions, exceeding state and federal ambient air quality standards both locally and in adjacent counties. There is a large number of Class I areas in Montana. With one important exception, however, Class I areas are not seriously impacted by scenario-projected industrial and utility emissions. SO₂ emissions from the projected power generating units in Rosebud County would exceed the PSD increment for the Northern Cheyenne Indian Reservation, now designated as a Class I area. It should be noted that permission has been denied for the construction of this projected capacity in Rosebud County.

Figure 8-25

Background Issues

- o Violations of ambient air quality standards (AAQS) occur primarily in metropolitan areas and in the vicinity of industrial process plants.
- o Smelter emissions should be reduced by 1990 through compliance with state regulations. New sources, however, will be constrained by offset requirements.

Scenario-Induced Issues

- o Scenario-projected industrial emissions are small and will not constitute violations of state or federal AAQS.

- o The expansion of coal-fired power plants constitutes 55% of the projected SO₂ emissions increase in Montana.

- o The utility expansion in Rosebud County will be constrained by the proximity of a newly-designated Class I area. More efficient control technology might reduce emissions to meet PSD requirements.

Water-Related Issues

- o Groundwater and surface water development and water reallocation (transfer) are greatly constrained by Montana statutes. Conversion facilities will probably require extensive use of water conservation technologies and imaginative or expensive sources of supply.

- o Water quality impacts of coal mining are a major concern.

Description

The Yellowstone River Basin, especially the Powder and Tongue River Subbasins, encompasses immense low sulfur, strippable coal reserves (the Ft. Union formation). While rapid expansion of mining is a possibility, air quality constraints and the attitudes of Montanans favor the export of coal by rail rather than conversion at the minemouth. (Export of water in a coal slurry pipeline requires consent of the legislature.)*

Virgin annual flow of the Yellowstone is about 8 million acre-feet/year; present use is about 2.4 million acre-feet/year. In 1979, acting under authority of the Water Use Act of 1973, the state Department of Natural Resources and Conservation reserved streamflows for fish, wildlife, and water quality equivalent to about 5.5 million acre-feet/year. In addition, the Crow and Northern Cheyenne have potential claims to as much as 1 million acre-feet/year. Thus, new surface water application for energy conversion facilities are not promising.

Water from Ft. Peck Reservoir on the Missouri River is an alternative source of supply, but it is not clear who has leasing authority—the state or the Bureau of Reclamation. The immense, deep, groundwater resources of the Madison formation are another possible source for development.

Background Issues

- o Montana is perhaps the most restrictive state in the West with respect to the transfer of water rights from agriculture to industry. A strong burden of proof rests on the transferee to demonstrate that rights of existing users will not be impaired.

- o Montana statutes seem to prohibit groundwater mining.

*For further information, see George Gould, "State Water Law in the West: Implications for Energy Development," Los Alamos Scientific Laboratory report LA-7588-MS, p. 217 (1979).

- o Montana statutes require that turbidity not be increased above "natural" levels.

Scenario-Induced Issues

- o Modification of runoff patterns and drainage from coal overburden and reclaimed plots add to existing dissolved and suspended solids concentrations in portions of the Big Horn, Tongue, and Powder Rivers.

Ecological and Land-Use Impacts

- o The state has many endangered species of plants and small plains animals. Conflicts at the state and national level can be anticipated as these species continue to decrease in number. Grassland species will be most affected by coal mining activities.
- o The northern floodplain forest ecosystem provides riparian habitat, an uncommon ecotype in this area, and contains critical habitat for many grassland species. Local problems can be anticipated from the effect of predicted SO₂ levels on sensitive species of fescue grasses, some endangered. These are essential to the natural grasslands habitat and maintenance of grazing values. Problems are anticipated in the west-central area of Montana by 1985.

Figure 8-26

Description

Montana provides critical habitat for a number of animals such as the grizzly bear, which has been eliminated from most of its native range by increasing human populations.

The relatively flat and open high plains of central and eastern Montana will accommodate planned coal mining activity, whereas the rugged mountainous terrain in the western part of the state is scheduled for hydroelectric development.

Background Issues

- o One hydroelectric project has been halted by litigation brought by sportsmen and environmentalists in an attempt to preserve wildlife habitat and environmental values. Other projects face intense opposition for similar reasons.
- o Deterioration of water quality in terms of total dissolved solids (TDS) and total suspended solids (TSS) in the Yellowstone River system is affecting both wildlife habitat and crops.
- o Constraints on water use by the mining industry will compound the difficulty of reclaiming strip-mined lands.

Scenario-Induced Issues

- o Peaking use of reservoirs causes fluctuation of reservoir water levels, destroying wildlife habitat and recreational value along shorelines.
- o Hydroelectric facilities alter wild river flow, decreasing the recreational value as a wild river but possibly increasing some other recreational values, such as boating.
- o Increased TDS and TSS loadings in eastern Montana rivers, which are already marginal in quality, may threaten the existence of critical habitats, bringing mining development into conflict with federal and state wildlife and water quality regulations.
- o SO₂ damage to crops in Deer Lodge County is expected to reach \$1.2 million by 1990. The annual dollar value of these crops (1977) is \$1.9 million.

Socioeconomic Impacts

- o Two counties will experience sharp increases in population. A 40% increase in one county will be followed by a rapid decline over a 3-year period. Problems of financing amenities may delay development.
- o All major projects presently in the planning or permitting stage are highly controversial largely because of widespread opposition to export of electricity.

Description

In Montana, the energy production plans are likely to have primary impact on Big Horn and Rosebud Counties. In Big Horn County, 1.59 million acres belong to the Crow and Northern Cheyenne Indian Reservations. The four

major new strip mines are just on the edge of the Crow Reservation, in an area where over half of the non-Indian land is federally-owned. The population of the county increased only 8.4% between 1970 and 1975.

Background Issues

(See Section on Colorado.)

- o Both impacted Montana counties have low assimilative capacity.
- o Energy-related litigation in Montana includes Montana Power's challenge of the Northern Cheyenne Reservation as a Class I air quality area; EPA's challenge of a lower court ruling that Colstrip III and IV projects are not subject to PSD regulation; and a citizens' group claim that there are irregularities in the state's siting process.
- o Montana Power has had difficulty in obtaining transmission corridor rights of way from both state and federal agencies.
- o Opposition to hydroelectric development has been so intense that new projects are likely to be blocked for the foreseeable future.

Scenario-Induced Issues

- o Significant delay and the potential for permanent blockage of energy development result from unfavorable local perception of the projects, state environmental standards, and legislative and executive actions of state government.
- o Interest groups concerned about the socioeconomic and air quality impacts of the construction of generating units intended to export power will make development of each successive power unit increasingly difficult through litigation. Pressure is being applied to cancel or reduce the size of plants that do not primarily serve Montana's needs.

Figure 8-27

BIG HORN COUNTY, MONTANA
LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-28

ROSEBUD COUNTY, MONTANA
LOW ASSIMILATIVE CAPACITY

Health and Safety Impacts

- o Impacts in Montana as a result of scenario-induced changes are expected to be limited largely to the occupational safety hazards of the energy extractive industries.

Figure 8-29

Figure 8-30

Solid Waste Impacts

- o Increased populations will cause severe solid waste disposal problems in counties with low permanent populations and much federally-owned or -controlled land.
- o Leaching, wind erosion, and fires at landfill and mine dump sites will impact the Yellowstone River and Indian reservations, thus diminishing air quality and water quality.

Description

In western Montana, the rugged terrain and large areas of federal or Indian lands severely limit the availability of suitable mine and urban waste disposal sites. The ability of the towns in energy-impacted areas to provide waste disposal services is limited by the willingness of these small base populations to accept a doubling and tripling of their financial burden. Eastern Montana, part of the Great Plains, must protect its limited and multi-use water supply, even though it has no other problems in finding waste disposal sites.

Background Issues

- o Montana does not have state laws governing solid waste disposal, but a local permit is required. About 61% of the population is served by locally-approved waste facilities, the best percentage in the region.
- o Leaching from old mine wastes has affected the water quality in the Powder River for many years.
- o Butte, Montana, has been concerned over the former use of uranium mine tailings as gravel in the walls of school buildings and as fill for macadam in its city streets. In addition, many of the old mill and mine tailing sites have not yet been identified.
- o Montana has an overt policy of "strip and ship" and, therefore, has little problem with utility and industrial ash and sludge.
- o The enforcement of reclamation regulations in the Great Plains part of Montana has been quite effective, including the burial of coal wastes before the overburden is dropped on a long-wall cut.
- o Montana coal has little need for cleaning. Policy requires burial of cleaning wastes in land already disturbed by surface mining.

Scenario-Induced Issues

- o New hydroelectric plants are projected to produce 900 additional MWe of electricity in Lincoln County by 1990. Libby, the county seat, had a population of 3,286 in 1970. The capability of such a town to provide the infrastructure for the population needed to construct three major hydroelectric plants without assistance is doubtful.

Figure 8-31

Figure 8-32

Figure 8-33

TOTAL AREA USED FOR INDUSTRIAL
ASH AND SLUDGE DISPOSAL
IN MONTANA

Figure 8-34

TOTAL AREA USED FOR UTILITY
ASH AND SLUDGE DISPOSAL
IN MONTANA

Figure 8-35

LAND USE IN COAL MINING AND CLEANING - MONTANA

Institutional Issues

o Protection of Class I area airsheds will constrain projected utility expansion in Rosebud County.

o Institutional issues that may arise beyond 1990 or in the case of an accelerated scenario are state policies on the export of electricity and on the determination of need, as described in the following paragraphs.

The state is likely to play an increasingly important role in the determination of need; any project built for the export of power will be highly controversial. Montana has an implicit "strip and ship" policy, and questions its responsibility for satisfying the power needs of other states. Without an explicit export policy, it is difficult to define the need for additional generating capacity to be constructed in the state. The difficulty in addressing this question has complicated siting proceedings for all interest groups. As a result, the Department of Natural Resources and Conservation has introduced legislation that would provide them with an in-house forecasting capability to help define the need for additional capacity.

Disagreement with the need for new power plants is based only partly on the export of power issue. Environmentalists also believe that the industry has not adequately supported conservation and alternative technologies, which they believe will reduce the need for new large-scale generating capacity. The opposition is also a reaction to the federal forecasts of the early 1970s, which alarmed Montanans by suggesting that vast coal resources would be exploited and that many new power plants would be built.

The major environmental issues relate to air quality management. Environmental regulations will probably be maintained in their present form; however, the available airshed will be diminished. A major issue is the designation of the Northern Cheyenne Reservation, near the Colstrip units, as a Class I air quality area and the potential for other such designations. Class I designations seriously limit the areas in which power plants may be located and affect the air pollution control technologies that must be utilized.

NORTH DAKOTA*

The RIIA-I scenario projects electrical generating capacity and industrial fuel use as well as coal production for North Dakota, as shown on Table 8-12 and its companion pie charts (Fig. 8-36).

Figure 8-36

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table next page.

*Parts of this section were provided by Argonne National Laboratory.

Table 8-12

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN NORTH DAKOTA
(Capacity in Megawatts)

	1975	1985	1990	Total Change
<u>Electrical Generating Capacity and Industrial Fuel Use</u>				
¹ Hydro, Conventional	459 (19.0%)	459 (12.1%)	459 (10.9%)	0
² Coal Steam	1,221 (50.6%)	2,088 (54.9%)	2,498 (59.3%)	1,277
³ Gas Turbine	8 (0.3%)	58 (1.5%)	58 (1.4%)	50
⁴ Gas Steam	2 (0.1%)	0 (0%)	0 (0%)	-2
⁵ Oil Turbine	60 (2.5%)	170 (4.5%)	168 (4.0%)	108
⁶ Oil Steam	664 (27.5%)	1,029 (27.1%)	1,028 (24.4%)	364
TOTAL	2,414	3,804	4,211	1,797
<u>Coal Production</u>				
Deep Mines	0	0	0	0
Surface Mines	115	778	1,200	1,085

Visibility

- o High to medium impairment of visual air quality is projected for the two Class I areas located in the state.
- o The long-range transport of particulate sulfates into the state is expected to be a major factor contributing to visibility impairment.

Figure 8-37

NORTH DAKOTA'S PROJECTED VISUAL
AIR QUALITY IMPACTS
FOR CLASS I AREAS

Description

The visual air quality in nonurban areas of the state is not as good as in similar areas in the Rocky Mountain portion of the region, but is generally

Description

The visual air quality in nonurban areas of the state is not as good as in similar areas in the Rocky Mountain portion of the region, but is generally superior to that found in most other states in the US. The long-range transport of light scattering aerosols (sulfates, in particular) is a major factor contributing to the impairment of visual air quality in urban and nonurban areas of the state.

Visibility is best in the western part of the state where the two Class I areas are located. According to an isopleth map* of median visual ranges for the US for the period 1974-76, median visual ranges in the state ranged from less than 25 miles in the eastern part of the state to greater than 45 miles in the western part. (These numbers are subject to substantial uncertainty because the data used to draw the isopleth were scant in this area.) Median visual ranges calculated for the two Class I areas in the state for baseline year 1975 ranged from 67.2 to 75.3 miles.

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. Good visibility is found in the western part of the state.
- o The two Class I areas in the state are protected against impairment of visual air quality according to recent Congressional legislation.

Scenario-Induced Issues

- o Lostwood Wilderness is projected to have a 10-20% decrease in visual range from 1975 to 1990, rated as a medium regional haze impact.
- o Theodore Roosevelt National Monument is projected to have a greater than 20% decrease in visual range from 1975 to 1990, rated as a high regional haze impact.
- o Calculated visual range and its percent changes for the two Class I areas in the state are shown in Table 8-13.
- o Air pollution sources located outside the state are predicted to have a major impact on the impairment of visual air quality in the state. The state's imported fraction of the area-weighted particulate sulfate concentration due to utility and industrial fossil fuel combustion facilities is predicted to account for 83% of the total.
- o Sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities in the state are projected to grow 54.7% during the period 1975-90.

*J. Trijonis and D. Shapland, "Existing Visibility Levels in the US," Technology Service Corporation, Santa Fe, New Mexico (1978).

Local Air Quality

o North Dakota's entire proposed coal growth is adjacent to PSD Class I protected areas. PSD regulations are likely to place significant constraints on such growth.

Table 8-13

NORTH DAKOTA: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)			Percent Change From 1975 To	
	Calculated				
	1975	1985	1990	1985	1990
Lostwood Wilderness	76.3	64.8	62.2	-15.1	-18.6
Theodore Roosevelt National Memorial Park	68.0	50.3	4 .0	-26.0	-31.0

Figure 8-38

NORTH DAKOTA'S AIR QUALITY CONTROL REGIONS
(NO PROJECTED NONATTAINMENT AREAS IN 1990)

Description

North Dakota has no counties that have failed to achieve primary or secondary sulfur dioxide and particulate air quality standards. Air quality throughout the state appears to be sufficiently good to allow increased combustion while maintaining standards. Approximately 75,000 acres of North Dakota have been designated as PSD Class I. Lostwood National Wilderness area is located on the northwestern border. Theodore Roosevelt National Memorial Park is located on the central western border of the state. About 77% of the state's fossil fuel for electrical generation comes from coal; 17% comes from natural gas. North Dakota uses local fuel ranging in sulfur content from 0.4 to 0.7%.

Background Issues

o North Dakota has over 75,000 acres of PSD Class I designated area. This region will be protected with stringent limitations on new emissions within the designated area. Surrounding areas will be influenced by PSD regulations.

Scenario-Induced Issues

- o All of North Dakota's proposed coal growth must comply with PSD regulations.

Water-Related Issues

- o At least until 1990, the quantity of water consumed for energy production will be trivial compared to available supply.
- o Substantial coal mining activity may affect water quality and streamflow patterns on the prairie/badland streams of the western Dakotas.

Description

Sustantial lignite resources of the Ft. Union formation, south and west of the Missouri River, are likely to fuel minemouth electricity and coal gasification facilities. Several streams run through the coalfields—the Little Missouri, the Heart, the Cannonball, and the Knife. The Little Missouri, running through Theodore Roosevelt National Park, is a state-designated Wild and Scenic River. Segments of the Heart, the Cannonball, and the Knife Rivers are designated Class I by the North Dakota Game and Fish Department for high-valued fishery, aesthetic, and other in-stream resources.

The principal sources of water available for energy development are Lakes Skakawea and Oahe, storage facilities of the Bureau of Reclamation on the Upper Missouri River. The Bureau proposes to lease up to 1 million acre-feet to industrial users from these and four other reservoirs in the Upper Missouri River Basin. One million acre-feet represents 3.5% of the average annual flow of the Missouri River at Sioux City, Iowa. Groundwater from the Madison formation represents an alternative source of supply.

Background Issues

- o American Natural Resources submitted an application to the state for 335,000 acre-feet/year, enough for over thirty 250 million ft³/d coal gas plants. The magnitude of the request unnecessarily aroused the concern of many North Dakotans.*
- o Non-point source pollution is a problem, particularly on the intermittent streams of the western Dakotas.

*For further information, see William Humm and Edward Selig, "Water Availability for Energy Industries in Water-Scarce Areas: Case Studies and Analyses," prepared by Energy Resources Company for US Department of Energy, Division of Policy Analysis (1979).

Scenario-Induced Issues

- o According to Argonne National Laboratory, western Dakota's streams will experience a tenfold increase in total dissolved solids concentrations from coal mining (22 mg/l in 1975 to 220 mg/l in 1990).

Ecological and Land-Use Impacts

- o Ninety-eight percent of North Dakota's land is used for agricultural development, much of it in grain production. Large acreages will be impacted by surface mining, creating erosion and reclamation problems in those areas. There are three endangered plant species and two endangered animal species in North Dakota, the northern kit fox and the black-footed ferret, which may be affected by energy development, and, therefore, may constrain industrial development.

Figure 8-39

NORTH DAKOTA'S AREAS WITH THE GREATEST
POTENTIAL FOR ECOLOGICAL IMPACTS

Socioeconomic Impacts

- o Severe socioeconomic impacts are projected for five scenario-defined sites for energy development in North Dakota. The number of available workers in these and adjacent counties is insufficient to fill all the newly-created jobs. These areas will experience shortages of local public services as well as subsequent price effects on private sector goods.

Description

North Dakota is the eighth most sparsely-settled state within the US, averaging only 8.7 persons per square mile. The primary industry is agriculture, with 98% of the 69,280 square miles devoted to the production of barley, flaxseed, wheat, rye, and oats; agricultural employment was 46,071 in 1975. The fuel sector, excluding processing, employs 1,413 persons out of the total state employment of 313,702.

Through its legislative powers, North Dakota has already dealt with some of the social and economic problems encountered in the accelerated pace of energy developments and coal extraction rates. It has established programs and policies to subsidize and compensate the communities for the fiscal impacts they have already experienced. These impacts resulted from increased drilling for oil and natural gas, development of coal mined to generate electric power, and construction of extra-high voltage lines and direct current transmissions to markets.

Background Issues

(See Section on Colorado)

- o All five North Dakota counties identified as potential sites for future mining or energy-generating facilities have extra low assimilative capacity.
- o North Dakota has adopted administrative tools to provide impact mitigation assistance to local governments.

Scenario-Induced Issues

- o The scenario projects additional construction and expansion where existing energy developments are presently causing impacts.
- o The impacted counties—Dowman, Dunn, McLean, Mercer, and Oliver—are situated in the west-central and southwestern sections of the state and are projected to absorb 100% of the coal generating capacity, 80% of the oil, and 95% of the new mining identified in the state scenario.
- o These identified counties are characterized as coal resource rural areas with very small populations and nonindustrialized economies, and without accessible commuting distances to trade centers.
- o The intense coal development and minemouth generating facilities risk potentially adverse socioeconomic impacts, fiscal difficulties of expanding services and providing consumer goods, shortages of housing, social disruption, and dissolution and interference with agricultural land and activities.
- o The construction period population influx is estimated to be 12,078 persons, of which 5,624 are required for the operation of the minemouth generating plants and for mining activities. The weighted average construction phase population growth occurring in each of the five impacted counties is 38.4%, whereas the permanent in-migrants account for an average 16.9% increase.
- o During operation of the new generating facilities and mines, all five counties require additional in-migrant labor beyond the construction phase. This additional growth will significantly increase public expenditures for education, water treatment, sewage, and hospitals, with smaller increases for all other public services analyzed in the scenario.

Figure 8-40

BOWMAN COUNTY, NORTH DAKOTA
EXTRA LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-41

DUNN COUNTY, NORTH DAKOTA
EXTRA LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-42

MC LEAN COUNTY, NORTH DAKOTA
EXTRA LOW ASSIMILATIVE CAPACITY

Figure 8-43

MERCER COUNTY, NORTH DAKOTA
EXTRA LOW ASSIMILATIVE CAPACITY

Figure 8-44

- o It is presently uncertain whether the established programs within the state would mitigate the scenario-projected profile of fiscal and employment impacts attributable to the energy developments.

Health and Safety Impacts

- o Occupational health impacts of projected energy-related development in North Dakota will be minimal.
- o Public health impacts also will be minimal.

Description

North Dakota is sparsely-settled and has low levels of coal production (mostly surface).

Background Issues

- o Health issues are restricted to occupational safety hazards associated with energy-extractive industries.
- o Relatively low-risk surface techniques of coal extraction will keep accidents and incidence of respiratory disease low.

Scenario-Induced Issues

- o From 1975 to 1990, coal production in North Dakota will increase by an order of magnitude, with subsequent doubling of its population's exposure to airborne sulfates.
- o Occupational hazard levels in terms of deaths per year are low under the scenario, relative to those in other states in the region.

- o Oil production and refining and the low levels of natural gas production and electricity generation under the scenario will not contribute significantly to occupational or public health effects.

Figure 8-45

ESTIMATED RANGE IN DEATHS IN NORTH DAKOTA FROM SO₂ EXPOSURE DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE UNDER THE MID-MID SCENARIO

Figure 8-46

RANGE OF ESTIMATED ACCIDENTAL DEATHS IN NORTH DAKOTA COAL MINES DUE TO IMPLEMENTATION OF THE MID-MID SCENARIO

Solid Waste Impacts

- o Although a significant percentage increase in industrial solid waste generation is projected, the actual amount is relatively small and no disposal problems are foreseen.
- o Land requirements for utility solid waste disposal should pose no significant problems.

Description

Most of North Dakota is part of the Great Plains, and thus, has plenty of appropriate disposal sites, if erosion problems are avoided. However, the presence of the Black Hills, several Indian reservations, and national parks could delay permit approval for solid waste sites.

Background Issues

- o Industrial coal use is low—only 90,000 tons in 1975.
- o Land use for industrial solid waste disposal amounted to 0.1 acre in 1975.

Scenario-Induced Issues

- o Industrial coal use is projected to increase by over 600% for the period 1975-90; however, coal use in 1990 still only amounts to 660,000 tons/year.
- o Land use for industrial disposal will increase by over 800%, but this will amount to slightly over 1 acre/year.
- o No waste disposal problems are projected for North Dakota.

o Installed coal-fired capacity is projected to increase to 2500 MW by 1990, a 166% increase over 1975. Disposal requirements for the lifetime of the new plants amount to 558 acres.

Figure 8-47

Figure 8-48

Figure 8-49

SOUTH DAKOTA*

The RIIA-I scenario projects electrical generating capacity and industrial fuel use as well as coal production for South Dakota, as shown on Table 8-17 and its companion pie charts (Fig. 8-50).

Table 8-17

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN SOUTH DAKOTA
(Capacity in Megawatts)

	1975	1985	1990	Total Change
<u>Electrical Generating Capacity and Industrial Fuel Use</u>				
¹ Hydro, Conventional	1,615 (66.8%)	1,615 (52.5%)	1,615 (52.7%)	0
² Coal Steam	577 (23.9%)	483 (15.7%)	483 (15.8%)	-94
³ Gas Turbine	0 (0%)	20 (0.7%)	20 (0.7%)	20
⁴ Gas Steam	0 (0%)	65 (2.1%)	65 (2.1%)	65
⁵ Oil Turbine	143 (5.9%)	877 (28.5%)	864 (28.2%)	721
⁶ Oil Steam	84 (3.5%)	19 (0.6%)	19 (0.6%)	-65
TOTAL	2,419	3,079	3,066	647
<u>Coal Production</u>	0	0	0	0

Figure 8-50

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

*Parts of this section were provided by Argonne National Laboratory.

Visibility

- o High impairment of visual air quality is projected for the two Class I areas located in the state.
- o The long-range transport of particulate sulfates into the state is expected to be a major factor contributing to visibility impairment.

Figure 8-51

SOUTH DAKOTA'S PROJECTED VISUAL
AIR QUALITY IMPACTS
FOR CLASS I AREAS

Description

The visual air quality in nonurban areas of the state is not as good as in similar areas in the Rocky Mountain portion of the region. The long-range transport of light-scattering aerosols (sulfates, in particular) is a major factor contributing to the impairment of visual air quality in urban and nonurban areas of the state.

Visibility is best in the western part of the state where the two Class I areas are located. The median visual range based upon measurements made at two nonurban/suburban sites for the period 1974-76 ranged from 20 to 45 miles. Median visual ranges calculated for the two Class I areas in the state ranged from 60.2 to 66.9 miles for baseline year 1975.

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. Good visibility is found in the western part of the state.
- o The two Class I areas in the state are protected against impairment of visual air quality according to recent Congressional legislation.

Scenario-Induced Issues

- o The two Class I areas—Badlands Wilderness and Wind Cave National Park—are projected to have a greater than 20% decrease in visual range from 1975 to 1990, rated as high regional haze impacts. Calculated visual range and its percent change for the two Class I areas are shown in Table 8-15.

Table 8-15

SOUTH DAKOTA: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)			Percent Change From 1975 To	
	Calculated				
	1975	1985	1990	1985	1990
Badlands Wilderness	67.7	50.1	46.8	-26.0	-31.0
Wind Cave National Park	60.8	42.2	39.0	-30.6	-36.0

o Air pollution sources located outside of the state are predicted to have a major impact on the impairment of visual air quality in the state. The state's imported fraction of the area-weighted particulate sulfate concentration for the state due to utility and industrial fossil fuel combustion facilities is predicted to account for 95% of the total.

o Sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities in the state are projected to grow 73% during the period 1975-90.

Local Air Quality

o Over one-third of South Dakota's oil growth has been proposed in a PSD Class I area.

Figure 8-52

SOUTH DAKOTA'S AIR QUALITY CONTROL REGIONS
(NO PROJECTED NONATTAINMENT AREAS IN 1990)

Description

South Dakota's air quality is sufficiently good to allow increased fossil development without violation of Federal air quality standards. Over 92,000 acres of land have been designated as PSD Class I area, thus requiring visibility and air quality protection. In 1975, the majority of the electricity generated in-state came from hydro facilities; approximately 600 MWe came from coal-fired plants. North Dakota supplies most of the coal used in the state.

Background Issues

- o South Dakota contains over 92,000 acres of protected PSD Class I area.

Scenario-Induced Issues

- o PSD protection of Class I areas may limit oil development in this state.

Water-Related Issues

- o Possible aquifer disruption and dewatering are projected in Fall River County due to underground uranium mining.
- o Uranium mining will cause heavy metal loading of the Cheyenne River.

Description

South Dakota has almost no projected energy development. An exception is the southern Black Hills. In this area, the Tennessee Valley Authority has purchased and is reopening the Burdock uranium mine in Fall River County. The mine is expected to reach full production by mid-1981. South Dakota's primary water issues stem not from energy development, but from agriculture non-point runoff.

Background Issues

- o A major concern is heavy metal pollution, particularly mercury, caused by the reopening of gold mines.

Scenario-Induced Issues

- o Water quality and availability will not be altered by scenario-projected activity.

Ecological and Land-Use Impacts

- o No adverse effects on land use or ecology from energy development are expected in South Dakota.

Socioeconomic Impacts

- o No severe socioeconomic impacts are projected for South Dakota, because the state has no scenario-defined sites for energy development.

Description

South Dakota has a population of 686,000 distributed over a land area encompassing 77,050 square miles. The state ranks among the least populated states, with a density of 8.9 people per square mile, while maintaining one of the highest per capita consumption rates. This is attributed to the fact that there are long distances between urban centers within the state, causing the transportation sector to absorb 39% of the total energy consumed. Because 95% of the state's energy needs are imported, the

residential and commercial sectors increase this dependence by consuming an additional 28% of the imported oil and natural gas.

The total labor force in the state is 314,000 persons. They are employed by the manufacturing industries (principally food and food processing activities) or agriculture. The total agricultural acreage in the state is approximately 45 million divided among 43,000 farms. One of the major new employment areas is near Edgemont, where Burlington Northern is developing facilities to haul coal from Gillette, Wyoming.

Background Issues

- o There are no pertinent background issues to be discussed.

Scenario-Induced Issues

- o The scenario does not project labor-intensive energy facility developments within South Dakota.

Health and Safety Impacts

- o No coal or natural gas extraction and only low levels of oil production, oil refining, uranium mining, and electricity generation are projected in South Dakota.
- o Energy-related occupational health and safety impacts will be small compared to those estimated for other states in the region.

Figure 8-53

ESTIMATED RANGE IN DEATHS IN SOUTH DAKOTA FROM SO_4 EXPOSURE
DUE TO UTILITY AND INDUSTRIAL FOSSIL FUEL USE
UNDER THE MID-MID SCENARIO

- o Public exposure to airborne sulfates will double because of in-flow from states upwind and conversion of local utilities to coal.

Solid Waste Impacts

- o Industrial coal use is projected to decline. No disposal problems are anticipated.

- o Installed coal-fired utility capacity will remain the same for the period 1975-90.

Description

Most of South Dakota is part of the Great Plains and, as such, has plenty of appropriate disposal sites, if erosion problems are avoided. In the Black Hills area to the west, and in the several Indian reservations, permits for solid waste sites have taken as much as 5 years to acquire.

Background Issues

- o Industrial coal use is low—only 330,000 tons in 1975.
- o Land use for industrial waste disposal amounted to less than 0.4 acre in 1975.

Figure 8-54

Figure 8-55

Scenario-Induced Issues

- o Industrial coal use is projected to decrease from the already low 330,000 tons/year to 240,000 tons/year by 1990.
- o Land use for disposal will decrease to 0.3 acre/year.
- o No waste disposal problems are projected for South Dakota.
- o No increase in coal-fired utility capacity for the period 1975-90 is projected. Disposal requirements for the lifetime of the new plants amount to 82 acres.

UTAH

The RIIA-I Scenario projects electrical generating capacity and industrial fuel use as well as coal production for Utah, as shown on Table 8-16 and its companion pie charts (Fig. 8-56).

Table 8-16

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN UTAH
(Capacity in Megawatts)

	1975	1985	1990	Total Change
Electrical Generating Capacity and Industrial Fuel Use				
¹ Hydro, Conventional	198 (17.9%)	331 (15.3%)	331 (10.0%)	133
² Coal Steam	880 (79.6%)	1,825 (84.5%)	2,075 (62.7%)	1,195
³ Oil Turbine	3 (0.3%)	3 (0.1%)	3 (0.1%)	0
⁴ Oil Steam	24 (2.2%)	0 (0%)	0 (0%)	-24
⁵ Geothermal	0 (0%)	0 (0%)	900 (27.2%)	900
TOTAL	1,105	2,159	3,309	2,204
Coal Production				
Deep Mines	176	496	1,248	1,072
Surface Mines	0	258	280	280

Figure 8-56

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

Visibility

- o No significant impairment of visual air quality is projected for the five Class I areas located in the state.

Figure 8-57

UTAH'S PROJECTED VISUAL AIR QUALITY
IMPACTS FOR CLASS I AREAS

Description

The visual air quality in nonurban areas of the state is superior to that found in most other states of the US. The long-range transport of light-scattering aerosols (sulfates, in particular) is an important factor contributing to the light extinction budgets in nonurban areas of the state. The median visual range based upon measurements made at three nonurban/suburban sites for the period 1974-76 ranged from 74 to 81 miles. Median visual ranges calculated for the five Class I areas in the state for baseline year 1977 ranged from 76.4 to 81.1 miles.

Sufficient historical data were available to calculate the historical trend of visibility for Salt Lake City. According to airport measurements over a 20-year period from 1953-55 to 1970-72, median visual range changed -27% for Salt Lake City. This deterioration is most likely related to increased air pollution emissions that accompanied the economic and population growth in the Salt Lake area.

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. There is an abundance of such areas in the state.
- o The five Class I areas located in the southern part of the state are protected against impairment of visual air quality according to recent Congressional legislation.

Scenario-Induced Issues

o All five Class I areas in the state are projected to have low impacts. The calculated visual range and its percent change for these areas in the state are shown in Table 8-17. The scenario projects that no large fossil fuel combustion facilities will be sited in counties located near the five Class I areas. The projected changes in median visual ranges from 1977 to 1990 for these areas are calculated to decrease less than 10%.

Table 8-17

UTAH: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)				
	Calculated			Percent Change From 1977 To	
	1977	1985	1990	1985	1990
Arches National Park	76.4	72.5	72.3	-5.2	-5.4
Bryce Canyon National Park	81.1	81.3	80.9	0.1	-0.3
Canyonlands National Park	77.3	73.9	73.7	-4.5	-4.7
Capital Reef National Park	77.9	75.1	74.8	-3.6	-3.9
Zion National Park	81.0	81.7	81.4	0.8	0.4

o Sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities are projected to be relatively low in 1990, although a growth of 221.6% from 1975 to 1990 is projected.

o The state's imported fraction of the area-weighted particulate sulfate concentration due to utility and industrial fossil fuel combustion facilities is predicted to account for 67% of the total.

Local Air Quality

o Nonattainment for TSP will continue in the Wasatch Front AQCR where metropolitan area source emissions and industrial process emissions produce high ambient particulate levels. (See Figure 8-58).

o Scenario-projected utility expansion may be constrained by PSD requirements.

Description

In all but three counties, current and projected ambient air quality meet the national and state standards. There will be continuing nonattainment, however, in counties containing metropolitan areas and industrial processing plants. Dispersion modeling of utility emissions projects violations of federal ambient SO₂ standards in Emery County, although no Class I areas will be adversely affected.

Figure 8-58

Background Issues

- o Air quality outside of the metropolitan AQCR 220 is excellent.
- o The high concentration of Class I areas in the southern third of Utah must be considered in the siting of future utility and industrial facilities.

Scenario-Induced Issues

- o The scenario projects a net decrease in TSP emissions; however, control of metropolitan area sources may not achieve national ambient air quality standards to bring the Wasatch Front AQCR into attainment by 1990.
- o Three-fourths of the scenario-projected utility expansion may be constrained by PSD regulations applied to Class II areas. Efficient control of SO₂ emissions may meet state and federal requirements.

Water-Related Issues

- o Water development projects in Utah are under attack on a variety of fronts—protection of endangered fishes, reserved Indian water rights, federal funding cutbacks, and salinity controls. The state wants to develop its full entitlement to Colorado River water.

Description

Most coal and oil shale resources are found in the Colorado Basin. About 500,000 acre-feet/year of Colorado River water are available for

development under interstate compact agreements. Much of the Green River, from Fontanelle Dam to the confluence with the Colorado mainstem, and the Colorado River, from the Colorado state line to Lake Powell, provide habitat for the endangered Colorado squawfish and the humpback chub. Waste water discharges from industrial users are prohibited by agreement with the EPA. Thus, non-point source pollution—dissolved and suspended solids—is the primary water quality concern.

Background Issues

- o Utah has probably the greatest free-market orientation among the Western States, that is, water is regarded as an economic resource.
- o Several tributaries of the Colorado River—the Price and San Rafael Rivers and Muddy Creek—presently have high concentrations of dissolved solids.

Scenario-Induced Issues

- o The Intermountain Power Project purchased 40,000 acre-feet/year from irrigators along the Sevier River for a 3,000 MW electric plant at Lyndyll, at a cost of \$40 million (\$1,750/acre foot). The Washington Post used this fact to illustrate the coming demise of irrigated agriculture in the West.

Ecological and Land-Use Impacts

- o The fragile ecosystem of arid southwestern states, including Utah, are very slow to recover from disruption, whether mechanical (as in the case of transportation and mining activities) or chemical (as in the case of airborne pollutants from fossil fuel use). In view of the four new fossil fuel generating plants projected for Utah, clean air and undisturbed ecosystems must be considered potentially scarce resources, especially in the Colorado Plateau region of the state.

Description

Utah contains some 60,000 acres of waterfowl habitat in the form of marshes, an unusual ecotype for Region 8. These areas are created by internal drainages in the north, central, and western areas of the state. The Colorado River and its tributaries, which drain the southern and eastern sections of Utah, harbor several nationally endangered species of fish. Another endangered Utah resident is the black-footed ferret, which has recently been sighted by game biologists in eastern Utah.

Background Issues

- o Environmentalists within the state have little backing from the public in pursuing environmental/energy issues.

Figure 8-59

UTAH'S 1990 LAND-USE CHANGES
BY SURFACE MINING OR UTILITY CONSTRUCTION

Scenario-Induced Issues

- o SO_2 damage to crops in Salt Lake County is estimated at \$5.4 million by 1990. This will be a significant impact because most of the land holdings in the county are small, and the crops produced are essential fresh food sources for human and dairy animal consumption.
- o Utah's tule marshes are critical habitat for some endangered species of migratory waterfowl. SO_2 concentrations in the area of these marshes may threaten the survival of this ecosystem. In addition, alteration of surface flow or aquifer pumping may threaten the existence of the marsh habitat. Federal and state endangered species regulations may come into play in siting energy development.

Socioeconomic Impacts

- o Proposed development may be blocked in part in all but one county because of unacceptable demands upon local governments.

Description

During 1970-75, Utah's population grew 3.5%. However, with the development of new mines and power plants will come large increases in resident populations, both transients of construction phases and permanent residents for operational phases. The small base populations of the impacted counties probably will be neither able nor willing to pay for amenity development for the influx of new residents.

Background Issues

(See Section on Colorado.)

- o Two Utah counties—Emery and Sevier—have low assimilative capacities, whereas Kane and Wayne Counties have extra low capacity.
- o The state government has not adopted any significant impact assistance programs for local governments as a direct response to energy-development activities.
- o The state government has tended to encourage energy resource development to provide the taxes necessary to finance community facilities and services by local initiative.

Scenario-Induced Issues

- o Kane County will experience a population change of over 475% above the baseline population in 4 successive years.
- o Wayne County will observe a population change of over 400% in one year, followed by over 800% in the next 3 years.
- o Emery County population will peak at 70% in 3 years followed by 3 years of total decline.
- o Only Sevier County is expected to be able to accommodate the scenario projections.

Health and Safety Impacts

- o Greatly-increasing production through 1990, as assumed in the scenario, is forecast to cause steadily-increasing numbers of injuries and deaths annually unless new, stringent measures are taken.
- o Rapid population influx will expose a larger number of persons to the localized public health hazards associated with mining and conversion activities and related transportation problems.
- o Because the Salt Lake City area carries a heavy pollution load that already constitutes a public health hazard, public opposition to energy development growth may increase.
- o Underground mining hazards will yield increasing numbers of injuries and deaths through 1990.

Description

Like Colorado and unlike the other states in the region, Utah is relatively industrialized and well populated, with a major urbanized area. The majority of Utah's coal and uranium is mined underground. Utah's voters tend to be rather well disposed to increased industrial development in the state, although concern for environmental quality is becoming increasingly manifest.

Figure 8-60

KANE COUNTY, UTAH
EXTRA LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-61

WAYNE COUNTY, UTAH
EXTRA LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-62

EMERY COUNTY, UTAH
LOW ASSIMILATIVE CAPACITY

Figure 8-63

SEVIER COUNTY, UTAH
LOW ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Background Issues

- o There will be 3.5 GWe of coal-fired generating capacity built in Utah to supply loads outside the region.

Scenario-Induced Issues

- o The scenario's projected increase in coal production and use is expected to heavily impact Utah, as shown in the following two figures.

Figure 8-64

Figure 8-65

Solid Waste Impacts

- o Energy development activities are expected to greatly accelerate growth in the next few years.
- o Federal and Federal Trust Lands comprise 69.3% of the land area of the state, limiting the areas available for disposal of urban and industrial wastes.

Description

In central Utah, 33 new coal mines and 21 uranium mines are planned. Fourteen of the uranium mines are scheduled for San Juan County. With 79% of this county's land under federal control, private land is widely-scattered. As a result, land available for urban and industrial waste disposal is limited. Also, the uranium mining sites are a considerable distance from even tiny population centers and required amenities.

Background Issues

- o Utah does not regulate solid waste disposal and does not report the percentage of people who are served by approved facilities.
- o Small existing populations in impacted counties have not required the development of waste disposal facilities beyond the complexity of local landfill and private septic tank.

Scenario-Induced Issues

- o According to the scenario, the 87,000 acres presently used for coal production will increase to 2 million acres by 1990.
- o The scenario projects 231 acres per year for mine waste disposal. The lack of available land appropriate for waste disposal may constrain the scenario.
- o The total area of Wayne County is 1.6 million acres, 81% of which is federally-owned land. The small base population, with few existing public services, will need financial assistance to absorb the solid waste costs of the new population required to service the combination of a strip mine, a 10 million ton underground mine, and the Intermountain Power Project.
- o Most valleys in the impacted areas include at least an intermittent watercourse that provides critically-needed water supplies for people downstream. If either the RIIA-I or the BOM projections are valid, a whole new waste infrastructure will be required to protect water supplies.

Figure 8-66

Figure 8-67

Figure 8-68

TOTAL AREA USED FOR INDUSTRIAL
ASH AND SLUDGE DISPOSAL
IN UTAH

Figure 8-69

TOTAL AREA USED FOR UTILITY
ASH AND SLUDGE DISPOSAL
IN UTAH

Figure 8-70

LAND USE IN COAL MINING AND CLEANING - UTAH
(Scenario numbers often total more than 100%)

Institutional Issues

- o Energy development projected by the Mid-Mid Scenario will not be constrained by institutional issues in Utah.
- o Institutional issues that may arise beyond 1990 or in the case of an accelerated scenario are air quality maintenance and the use of water resources, as described in the following paragraphs.

Air quality presently is the principal environmental issue in Utah. Utility siting and selection of control technology must comply with PSD protection of the large number of Class I areas in the southern third of the state.

Water use depends on the outcome of conflicting interests rather than on the small fraction of supply required for energy development. Energy, as a relatively new user, must contend with established interests.

WYOMING

The RIIA-I Scenario projects electrical generating capacity and industrial fuel use as well as coal production for Wyoming, as shown on Table 8-18 and its companion pie charts (Fig. 8-71).

Table 8-18

ELECTRICAL GENERATING CAPACITY, INDUSTRIAL FUEL USE, AND COAL PRODUCTION IN WYOMING
(Capacity in Megawatts)

	1975	1985	1990	Total Change
<u>Electrical Generating Capacity and Industrial Fuel Use</u>				
¹ Hydro, Conventional	224 (8.1%)	230 (5.1%)	230 (5.1%)	.6
² Coal Steam	2,513 (91.2%)	4,310 (94.9%)	4,310 (94.9%)	1,797
³ Oil Turbine	1 (0%)	1 (0%)	1 (0%)	0
⁴ Oil Steam	18 (0.7%)	0 (0%)	0 (0%)	-18
TOTAL	2,756	4,541	4,541	1,785
<u>Coal Production</u>				
Deep Mines	10	37	165	155
Surface Mines	479	3,449	4,725	4,246

Visibility

- o Medium impacts are projected for two of the seven Class I areas located in the state.

Figure 8-71

NOTE: Reference numbers on these pie charts correspond to those listed beside each power source in the table above.

Figure 8-72

WYOMING'S PROJECTED VISUAL AIR
QUALITY IMPACTS FOR CLASS I AREAS

Description

The visual air quality in nonurban areas of the state is generally superior to that experienced in most other states of the US. The long-range transport of light-scattering aerosols (sulfates, in particular) is an important factor contributing to the light extinction budgets in nonurban areas of the state. The median visual range based upon measurements made at two nonurban/suburban sites for the period 1974-76 ranged from 64 to 76 miles. Median visual ranges calculated for the seven Class I areas in the state ranged from 62.3 to 72.2 miles for baseline year 1977.

Background Issues

- o Visual air quality is most sensitive to degradation in areas with very good visibility. There is an abundance of such areas in the state.

o The seven Class I areas located in the state are protected against impairment of visual air quality according to recent Congressional legislation.

Scenario-Induced Issues

o A medium impairment from plume blight could effect the Bridger Wilderness and Fitzpatrick Wilderness due to a 1000-MW increase of coal steam capacity projected by the scenario to be sited in Sweetwater County by 1990.

o Impairment due to regional haze is not projected. The projected changes in median visual ranges from 1977 to 1990 for the seven Class I areas are calculated to decrease less than 10%. Calculated visual range and its percent change for these areas in the state are shown in Table 8-19.

Table 8-19

WYOMING: CALCULATED VISUAL RANGE AND PERCENT CHANGE IN VISUAL RANGE

Class I Area	Visual Range (miles)				
	Calculated			Percent Change From 1977 To	
	1977	1985	1990	1985	1990
Bridger Wilderness	72.2	68.4	67.7	-5.3	-6.3
Fitzpatrick Wilderness	70.4	69.2	68.9	-1.7	-2.1
Grand Teton National Park	62.3	59.8	59.5	-4.0	-4.5
North Absaroka Wilderness	66.6	65.5	64.9	-1.7	-2.6
Teton Wilderness	62.3	59.8	59.5	-4.0	-4.5
Washakie Wilderness	65.3	63.2	62.7	-3.2	-4.0
Yellowstone National Park	67.2	65.4	64.9	-2.7	-3.5

o Sulfur dioxide emissions from utility and industrial fossil fuel combustion facilities are projected to grow 370.4% during the period 1975-90.

o The state's imported fraction of the area-weighted particulate sulfate concentration due to utility and industrial fossil fuel combustion facilities is predicted to account for 62% of the total.

Local Air Quality

o Only one county is projected to remain in nonattainment for SO₂ through 1990. (See Figure 8-73.)

o While projected ambient TSP levels in two counties will violate state AAQS in 1985, 1990 projections do not constitute violations.

- o Increased utility emissions will exceed the PSD Class II area increment for TSP in one county by 1985.

Figure 8-73

Description

The emission increases projected by the Mid-Mid Scenario contribute to the deterioration of air quality in Natrona and Sweetwater Counties where increments constitute violations of state and national air standards. Because ambient SO₂ data for 1975 were not available for 8 of the 12 counties in this analysis, results of the model could be misleading.

Background Issues

- o Ambient SO₂ data for 1975 are unavailable; consequently, NAAQS violations for 1990 are impossible to predict accurately.

Scenario-Induced Issues

- o The major sources of pollution in Wyoming will be utility and industrial coal combustion.
- o Utility expansion in Sweetwater County will produce violations of NAAQS for SO₂ continuing into 1990. Siting of new sources in this county will be constrained by offset requirements.
- o Scenario-projected TSP emissions from industrial expansion will violate state ambient air standards in two counties in 1985; projected emission reductions will alleviate this impact by 1990.

Water-Related Issues

- o Aquifer contamination and dewatering caused by uranium mining, the conversion of water from agriculture to industrial use, and the degradation of water quality as a result of coal mining are major concerns in Wyoming.

Description

The principal subbasins in the energy fields are the Green, the North Platte, the Powder, and the Tongue. Almost 400,000 acre-feet/year are available for development on the Green, a tributary of the Colorado River. Rights to 57,000 acre-feet/year are held by industry, and the state has an agreement to contract even more water from Flaming Gorge Reservoir. Interstate compacts and court decrees greatly complicate determination of water availability in other basins, but even in the smaller plains' streams—the Cheyenne and the Belle Fourche—water supplies in excess of 10,000 acre-feet/year might be developed.

Groundwater development, especially from the Madison formation, represents an alternative source of supply. Annual recharge to this formation is about 75,000 acre-feet/year and pumping in excess of this rate—that is, mining—may be permissible.

Background Issues

- o Endangered species protection on reaches of the Green and the Platte outside Wyoming may affect development.
- o Indian reserved rights on the Bighorn, the Powder, and Tongue may constrain future water development.
- o The concentration of the nation's most attractive low sulfur, strippable coal deposits in Campbell and Converse Counties threatens to cause severe water quality degradation in the Powder, the Tongue, and their tributaries.
- o Aquifer recharge and discharge rates, well discharge rates, and water quality from the Madison formation are the subjects of an intensive US Geological Survey study.
- o Attempts of industrial users to transfer groundwater and surface water rights along the North Platte and Laramie Rivers encountered severe opposition from farmers and ranchers.

Scenario-Induced Issues

- o A lawsuit and enforcement of the Endangered Species Act forced the Missouri Basin Power Project (MBPP) to contribute \$7.5 million to a whooping crane habitat mitigation fund. Furthermore, MBPP agreed to lobby the state legislature for a statute increasing the burden of proof on water right transferees.

o A proposal to export Wyoming water in a coal slurry pipeline was vetoed by Governor Herschler, pending further study of interstate compact and other issues.

Ecological and Land-Use Impacts

o Wyoming has many endangered species of plants and animals. Although the state does have a good reclamation record, replacement flora may not provide suitable habitat for endangered animal species.

o Population increases accompanying energy development affect not only land use but also water resources within the state and agriculture in downstream states.

Figure 8-74

Description

Eastern and central Wyoming, where the majority of scenario-projected energy development will take place, are high plains country suitable mainly for grazing and dry-land farming. The availability of water in the area is limited, making surface water quality and quantity important issues in maintaining wildlife habitat and agricultural land use in competition with energy industries.

Background Issues

o Wyoming's reclamation record minimizes but does not eliminate concern over the usual problems associated with erosion of mine wastes.

o Introduction of new species in reclamation efforts, instead of slow-growing native plants, alters the suitability of the area as habitat for native fauna.

- o Endangered fish species in the Colorado River system are adversely affected by increased TDS and TSS levels, a fact that may act as a constraint on mining activities.

- o The issue of water users' rights and the protection of wildlife habitat in downstream states came to a head in the Grayrocks Dam case. An out-of-court settlement was reached, which will enable the plant to be constructed while protecting the whooping crane habitat and other interests of Wyoming and Nebraska.

Scenario-Induced Issues

- o Because extensive surface mining can disrupt or destroy critical habitat for rare and endangered species, mine development may be limited by federal and/or state endangered species law.

Socioeconomic Impacts

- o In two of the five impacted counties, the population will increase beyond the county's capacity to absorb new demands for services, thus development may be temporarily blocked.

Description

Wyoming is the least populated of the Rocky Mountain States, but the most prosperous in terms of per capita income. Primary employment is in the coal and petroleum industries. The state contains 8% of US coal reserves, currently being stripped by 15 surface mines, and very large uranium reserves. Of great national importance are Wyoming's extensive natural areas, including Yellowstone and Grand Teton National Parks, which attract over 4 million visitors yearly. Wyoming may face serious economic decline as fossil fuels and uranium reserves are depleted.

Background Issues

(See Section on Colorado.)

- o Wyoming counties identified as potential sites for future mines and generating facilities span the range from extra low to moderate assimilative capacity.

- o Wyoming is 48.6% federal land. Another 2 million acres are Indian lands. Area available for development, therefore, is restricted.

- o From time to time, the Wyoming legislature has seriously considered the desirability of limiting the amount of electrical generation in the state because of environmental considerations. The consequences of such limits would alter plans for new generating facilities and, very likely, mining activities projected in the Mid-Mid Scenario.

- o Several counties have experienced growth impacts and have the infrastructure in place to accommodate growth.

Figure 8-75

CAMPBELL COUNTY, WYOMING
LOW ASSIMILATIVE CAPACITY

Figure 8-76

CARBON COUNTY, WYOMING
MODERATE ASSIMILATIVE CAPACITY

*No new electric utility capacity is projected for this county.

Figure 8-77

PLATTE COUNTY, WYOMING
EXTRA LOW ASSIMILATIVE CAPACITY

Figure 8-78

SWEETWATER COUNTY, WYOMING
MODERATE ASSIMILATIVE CAPACITY

Scenario-Induced Issues

- o Five of the eight Wyoming counties identified in the Mid-Mid Scenario are expected to experience significant socioeconomic impacts resulting from an annual population increase in excess of 10% in at least 1 year of the development activity.
- o Campbell County will observe a population change that exceeds the baseline population in excess of 200% for 4 successive years. In this case, the change represents an absolute growth of 150% between 1978 and 1985, and 209% growth between 1978 and 1990.
- o By 1985, the average new household will pay over \$675 per year for local services. However, in the two most heavily-impacted counties, the cost of local services to the average household will range between \$1050 and \$1250 per year. As the population continues to grow, the cost of local government services will decline to an average of \$475 per year.
- o At least one county will continue to require over \$1000 per year for local government services.

Figure 8-79

*No new electric utility capacity is projected for this county.

Health and Safety Impacts

- o Occupational and public safety hazards will increase under the scenario.

- o The increased use of coal within the state will not cause major public health hazards because the state is sparsely-populated.
- o Oil and gas production and transportation will constitute additional occupational and public safety hazards.
- o Uranium mining and milling will require extra care to contain the expected increase in occupational and radiation hazards.

Description

Occupational health hazards in energy development industries will be combatted on an industry-wide level, while public safety will depend on the astuteness of individual local officials. The small and widely-dispersed populations in most areas of the state should serve to counteract many potential health and safety problems.

Background Issues

- o Residents of rural, western areas tend to have more transportation-related accidents than residents of other states. This problem is magnified by increased highway and rail haulage of coal.

Scenario-Induced Issues

- o As in other states in the region, deaths and injuries from mining activities are expected to increase dramatically through 1990.
- o Although utilities will control 85-90% of emissions, public health effects related to SO_2 are expected to double in severity through 1990.

Figure 8-80

Figure 8-81

Solid Waste Impacts

- o In Wyoming, uranium mine and mill tailings have been accumulating since 1948. Hundreds of old spoil piles have been ignored for many years.
- o The western half of the state includes the Continental Divide, the Tetons, and Yellowstone National Park, which implies the need to protect the nation's major watersheds.

Description

Wyoming is more than 50% federal or Indian land, which may be unavailable for use as mine, mill, or urban waste disposal sites. In some areas, the visual impact of waste disposal may be a problem because of the proximity of development to national parks or scenic areas.

Background Issues

- o There are no state laws governing solid waste disposal, but a local permit is required.
- o In some areas, waste disposal has meant dumping into arroyos without benefit of treatment or fill.
- o Septic tanks are the common sewage treatment system in many counties. Only 37% of the population is served by approved facilities.
- o One county is scheduled to open seven new uranium mines and three uranium mills by 1980. A natural gas processing plant, a coal strip mine, and a power plant are also planned.
- o The influx of people needed to run these facilities will present a major waste disposal problem for the area even if the facilities themselves do not. Other counties will experience similar impacts.

Scenario-Induced Issues

- o There are 6,407 acres projected for surface coal mining by 1990 as compared with 557 in 1975.
- o As a result of the scenario, the Wyoming legislature is contemplating a "strip and ship" policy comparable to that in Montana. Industry and utility fuel consumption will continue to be minimal.

Institutional Issues

- o Current institutional issues in Wyoming will not constrain energy development as projected by the Mid-Mid Scenario.

Figure 8-82

Figure 8-83

o Institutional issues that may arise beyond 1990 or in the case of an accelerated scenario are the cost and availability of water rights, possible legislation to limit export of electric power, and financing problems, as described in the following paragraphs.

The water rights issue revolves around three concerns: the absolute amount of water available, its highest and best use, and the rights of surface water users in downstream states. The Office of the State Engineer and the University of Wyoming are currently conducting research to create a better definition of the size of the state's water supply. There appears to be little interest in addressing the issue of highest and best use in the absence of an actual shortage. Although the state has a large supply of marketable water rights, only those companies that acquired their water rights many years ago (for example, Pacific Power and Light) are in a good position to develop new facilities. The issue of the rights of water users and the protection of wildlife habitat in downstream states came to a head in the Grayrocks Dam case. An out-of-court settlement was reached, which will enable the plant to be constructed while protecting the whooping crane habitat and the other water interests of Wyoming and Nebraska.

The Wyoming legislature is edging toward passage of legislation that would limit the amount of electric power that can be exported to other states relative to the amount that is consumed in Wyoming. The principal motivation behind this legislation is environmental. Early versions of the bill would have set the amount to be consumed in Wyoming as high as 20%. Passage of this legislation would make power generation in Wyoming uneconomical for the state's major generators, all of whom serve out-of-state markets.

Until recently financing problems were not significant for electric power companies. The states where Wyoming's energy is consumed are becoming increasingly resistant to the utilities' plea for rate increases to underwrite developmental costs. This means that development costs must be paid out of the utilities' current cash flow, or from outside borrowing. Additional

Figure 8-84

TOTAL AREA USED FOR INDUSTRIAL
ASH AND SLUDGE DISPOSAL
IN WYOMING

Figure 8-85

TOTAL AREA USED FOR UTILITY
ASH AND SLUDGE DISPOSAL
IN WYOMING

Figure 8-86

LAND USE IN COAL MINING AND CLEANING - WYOMING
(Scenario numbers often total more than 100%.)

1975 TOTAL: 556.89 ACRES

1990 TOTAL: 6407.3 ACRES

1985 TOTAL: 4578.5 ACRES

- 1 LAND USE BY WASTES FROM COAL CLEANING
- 2 SUBSIDENCE LAND FROM UNDERGROUND MINING
- 3 LAND USE BY WASTES FROM UNDERGROUND MINING
- LAND DISTURBED BY BY SURFACE MINING

financing charges cause project costs to escalate. Costs for pollution control, even when financed with tax-exempt industrial development revenue bonds, also add significantly to the cost of the project.

In Wyoming, the response to all of this has led to (1) curtailed long-term plans for additional generating capacity, (2) the formation of mineral mining subsidiaries to develop and sell utility coal and uranium holdings to other companies that are better able to use them, and (3) the seeking of foreign investors to supply utility capital needs. All these reflect growing constraints on the funding of additional conventional power generating facilities in this state.

FEDERAL REGION 9 LAWRENCE BERKELEY LABORATORY

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Program Manager	Will Siri
Project Coordinator	Richard Sextro
Air Quality	Michael Messenger Richard Sextro
Water Availability	Mohamed El-Gasseir Ronald Ritschard
Water Quality	Mark Henriquez Ronald Ritschard Mohamed El-Gasseir
Ecology	Peter Gleick Peter Deibler John Holdren
Land Use	Kendall Haven
Solid Waste	Kendall Haven
Local Socioeconomic	Karen Tsao Stanton Smith* Kendall Haven
Institutional	Yvonne Ladsen Tony Usibelli Richard Sextro
National Socioeconomics	Jayant Sathaye Henry Ruderman
Health and Safety	Richard Sextro Will Siri
Computer Services	Peter Chan

Arizona Analysis provided by LASL Staff

*Present address: California Energy Commission,
Sacramento, CA 95825

FEDERAL REGION 9

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REGIONAL OVERVIEW - REGION 9

Federal Region 9, comprised of the states of California, Nevada, Arizona, and Hawaii, has 12 percent of the total U.S. population and consumed a total of 6.7 Quads (one Quad is 10^{15} BTU) in 1975, or 9 percent of the total U.S. energy consumption.¹ The major portion of the population of this region is centered in six coastal counties in California, with smaller concentrations in Sacramento, Las Vegas, Honolulu, Phoenix and Tucson. These urban areas are also responsible for the bulk of the energy consumption in Region 9 in the form of electricity and natural gas in the residential and commercial sectors, natural gas and petroleum products in the industrial sector and gasoline and other petroleum fuels for transportation.

Regional production of oil and natural gas occurs primarily in California, and 95 percent of the regional refining capacity is located in the densely populated and industrialized counties of California. In the scenario, imports of crude petroleum (from both foreign and domestic sources) continue to increase through 1990, as the regional dependence upon oil increases slightly from the 1975 level. Regional production of liquid and gaseous fuels increases in the scenario, reversing recent trends primarily due to stepped-up off-shore production of both fuels.

Environmental issues presently play an important role in regulatory and political decision-making, and under the conditions postulated by the scenario, the importance of environmental regulation will not be diminished.

Siting of new facilities and expansion of existing activities will face difficulties in both urban and rural areas. Emission offsets will be required in many areas that are presently non-attainment. In those rural areas where air quality standards are met, existing and proposed Prevention of Significant Deterioration (PSD) Class I air areas will act as additional siting constraints. Water availability in these areas is often a significant problem. While programs are presently being implemented to attain clean air and water standards in many areas, these efforts have just begun, and it is not clear whether new or expanded energy activities have been incorporated into future plans for achieving clean air and water goals.

REGIONAL SCENARIO

Energy supply and demand figures for Region 9 are summarized in Table 9-1 and Figure 9-1. The present energy mix for the region changes little over the next 15 years. The level of imported energy remains close to 50 percent of total requirements throughout the time period. Nuclear energy contributes a growing fraction of overall energy supply in the future, although nuclear development in the scenario is limited. Changes in state and regional electrical energy supply are shown in Figure 9-2.

The 1975 county siting pattern of electrical generation for Region 9 is shown in Figure 9-3, with the changes to 1990 shown in Figure 9-4. Figures 9-5 and 9-6 show the locations of major fossil fuel producing areas in Region 9, and the county siting pattern for oil refining capacity.

Table 9-1

Federal Region 9 Energy Supply and Use Based on the Mid-Mid Scenario^a(10¹² BTU per Year)

DOMESTIC PRODUCTION				DOMESTIC FUEL CONSUMPTION			
	1975 ^b	1985	1990		1975 ^b	1985	1990
Crude Oil +NGL	1914	2254	2182	Oil	3665	4263	4554
Natural Gas	322	418	456	Natural Gas	2213	1945	2100
Coal	157	263	268	Coal	247	397	409
Nuclear ^c	0	0	0	Nuclear	65	359	611
Hydro & Geothermal ^c	510	773	822	Hydro & Geothermal	510	773	822
Solar Electric ^c	0	< 1	11	Solar Electric	0	< 1	11
Total Domestic Supply	2903	3709	3739				
IMPORTS TO REGION 9*				END USE CONSUMPTION ^d			
Crude oil and products	1751	2517	2881	Residential	928	805	816
Natural gas	1391	1527	1644	Commercial	671	600	611
Coal	90	134	141	Industrial ^e	1127	1610	1901
Nuclear ^c	65	354	611	Transportation	2382	2831	3063
Total imports	3797	4532	5277	Total	5108	5846	6391
TOTAL SUPPLY	6700	8241	9016	(Solar space heating ^f	0	30	51)
EXPORTS FROM REGION 9							
Oil (to PAD 3)	0	508	509				
Percent Net Imports	57	45	53				

NOTE: The difference between fuel consumption and end-use consumption is mainly due to conversion losses, particularly in the generation of electrical energy and in petroleum refining.

* From both foreign and domestic sources.

a) Approximate supply figures since allocation of oil supplies within PAD 5 is not known.

b) Supply figures from LASL report LA-6770 (1977).

c) Nuclear, hydroelectric, solar electric, and geothermal production figures are calculated in a fossil fuel equivalent basis, using 10000 BTU/kWh.

d) Figures from PIES, and include delivered electrical energy.

e) Industrial sector does not include refinery fuel consumption.

f) Solar space heating values shown for comparison purposes; this energy resource is counted as a reduction in demand rather than a source of supply.

Figure 9-1

The 1990 siting projections differ little from the 1975 locations with expansions of major fuel production occurring in already producing regions. New oil refining capacity additions are expected to be located at or near existing sites.

Comparisons of Federal Region 9 and national energy use per capita are shown in Figures 9-7 and 9-8. It is significant to note that overall energy use per person is projected to be nearly constant in this region as compared with the nation as a whole. Analysis of energy demand per person by end-use sector shows that Region 9 presently uses about 20 percent less energy than the U.S. average in the residential and commercial sectors, and only 50% of the industrial energy. Energy use in the transportation sector in Federal Region 9 is slightly greater than the national average. These trends are projected to continue in this scenario, with even greater differences developing between regional and national energy use per person for the residential, commercial and industrial sectors. By 1990, the scenario projects that regional energy use in these sectors will be only half the comparable U.S. average.

Fuel use per capita shown in Figure 9-8 also indicates regional differences, particularly for coal and nuclear. The Region 9 coal use is about six times smaller than the national average, and nuclear fuel use is about three times smaller. These ratios are projected to remain about the same to 1990. Oil use in Region 9 is about equivalent to the national average in 1975, but the

Region 9 Electrical Generating Capacity by State

Figure 9-2

Figure 9-3

1975 Total Generating Capacity
by County
(in Megawatts)

Figure 9-4

Change in Total Generating Capacity
by County 1975 to 1990
(in Megawatts)

Figure 9-5

Figure 9-6

Figure 9-7

Figure 9-8

projected per capita use in 1990 is about 85 percent of the national average.

Finally, average growth rates in population, employment and energy use are shown in Figures 9-9, 9-10 and 9-11 for each BEA region within Region 9. The growth rates can be compared with the respective national averages. While Nevada and Arizona have population growth rates much higher than the national average, the overall Region 9 average is 1.3 percent, or only slightly higher. Similarly, those areas with high growth in employment (see Figure 9-10) are relatively low in total employment, and have only a slight effect upon the regional average of 1.7 percent. Energy use almost uniformly shows a growth rate less than the national average, and as noted earlier in Figure 9-7, the whole of Region 9 is much less energy consumptive per capita than the national average.

REGIONAL SCENARIO CRITIQUE

The application of the Mid-Mid scenario to Region 9 raises several issues. As noted in the preceding section, per capita energy use in Region 9 is less than the national average. The regional energy growth rate is to be about 1.8 percent per year to 1990, while the comparable national projection is 2.9 percent. At the same time, actual population growth in this region as well as various population projections for states within the region continue to show increases above the national average. While there have been recent actual decreases in per capita energy consumption in the several end-use sectors, it is not clear what factors in the MEFS regional projections motivate the implicit projected energy savings.

A more significant problem in terms of the actual scenario is the fuel allocation among various users. Coal use, as an example, is projected to grow at less than the national average. As a result, several utility coal projects in Region 9 that are now in the planning stage or actually under construction do not appear in the detailed state-by-state scenario.

The projection of increasing gasoline usage within the transportation sector is contrary to most state or regional projections, where the increasingly efficient automobile mileage standards result in a gradual decline in projected gasoline use beginning in the early or mid 1980's. The result of the scenario projection is to double or triple vehicle miles, and consequently overall emissions increase considerably.

Another set of issues raised by the scenario are the state- and county-level details with regard to both siting and the type of facility projected. Electrical utilities within the region presently plan to increase the number of coal-fired power plants beyond the scenario projections. In addition, the scenario postulates fuel switching from oil to natural gas in some existing utility broilers, and the construction of additional natural gas-fired electrical generators. However, utilities currently plan to use oil in existing facilities, and move away from natural gas entirely for new generating units.

The siting of new pumped storage facilities depends critically upon local geographical or topographical conditions, and both major new pumped storage facilities projected for California are not likely to be constructed

Population Growth 1975 to 1990
by BEA Region
(Average Annual Change in Percent)

Figure 9-9

Figure 9-10

Figure 9-11

for this reason alone. In addition, the factors used to allocate further pumped storage facilities to this region appear not to take the economics of present and future generating facilities into account. The Pacific Intertie is available for peak-load power and energy (with off-peak energy returns to the Pacific Northwest) and is a more economically attractive resource.

Finally, in the more densely populated areas of the region (where most of the regional energy consumption occurs) effects of end-use energy consumption play a significant role in determining environmental impacts. While transportation and industrial sector fuel-use impacts are analyzed here, the implicit land-use patterns necessary to achieve these fuel use totals are not.

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACTS

While many national energy issues will have impacts at the local or regional level this section is limited to those impacts due to activities that occur both within and outside Region 9. Specifically, they are air quality effects due to long-range transport of pollutants, the direct and indirect socioeconomic issues in this region due to national energy construction or operational activities, development of offshore natural gas and oil areas, and disposal of nuclear wastes. These effects are summarized as part of Table 9-2.

Impacts of Long-Range Transport upon Air Quality and Visibility

Key Scenario-Induced Findings

- o Possible violations of PSD Class I standards for SO₂ due to long-range transport are projected for Class I areas in southern California, mainly due to SO₂ emissions in the Los Angeles urban area. In addition, a number of counties projected to have fuel-burning installations also have Class I areas, and violations of PSD Class I standards are possible.
- o Emission sources in Nevada and Arizona contribute to SO₂ problems in the adjoining states of New Mexico and Utah. A major component is process sources in southern Arizona.
- o Visibility calculations show no significant visual impairment in Class I areas of the region, although visibility impacts in the Grand Canyon are possible.
- o Local particulate or SO₂ background conditions may contribute to violations of PSD Class I requirements, or to visibility impairment.

Description

Long-Range Transport:

Region 9 receives little or no pollutant transport from other regions (Hawaii is not factored into either the LRT or visibility analysis), but does

Table 9-2

Environmental Impacts of the MID-MID Scenario in Region 9*

	AIR	WATER		LAND		HEALTH & SAFETY	SOCIAL AND ECONOMIC			
Energy Source	Quality	Quality	Availability	Ecology/ Land Use	Solid Waste	Occupational and Other	Local Sociologic Factors	Local Economics	National Economics	Legis- lative/ Institu- tional
Extraction (production) Coal Oil Gas										
Transportation of Fuels Oil Imports (ports, tankers) Gas Imports (ports, tankers) Transmission Lines Pipelines										
Conversion Refineries Gasification Facilities Electric Generation Nuclear Coal Oil Gas Solar Geothermal Hydroelectric										
End Use Industrial Coal Oil Gas Residential/Commercial Transportation Sector										
TOTAL SCENARIO	L**					L**			L**	

*This table summarizes only those issues affecting more than one state in the region.

**Regional impacts indicated by national level assessments.

contribute to levels of sulfur oxides and particulates in adjoining regions, most notably Utah and New Mexico. For projected 1990 SO₂ emissions, the utility and process sources tend to dominate in this region, and transport calculations show effects in agricultural regions of California from emissions in the San Francisco Bay Area and South Coast Basins. For Nevada and Arizona, SO₂ from utility sources tend to be transported northeasterly, extending, in some cases, into the neighboring states of Utah and New Mexico. At present, process sources, primarily smelters in southern Arizona, have wide-ranging air quality impacts extending over a major portion of southern Arizona and into New Mexico. Due to uncertainties in application of control technologies for these sources, they were not included in the 1990 transport analysis.

The region has 44 mandatory Class I air areas² (42 excluding Hawaii) where PSD allowable annual increments for SO₂ and particulate matter are 2 µg/m³ and 5 µg/m³, respectively (Figure 9-12). The transport calculations show possible violations of the SO₂ standards in Class I areas of southern California, although significant local background conditions could result in violation of the SO₂ increments in the southeastern desert area of California, and in parts of Arizona (Figure 9-13). Concentrations of sulfate follow similar patterns in the region as for SO₂. For particulate emissions the transport problems tend to be smaller, although for utility emissions in Nevada and Arizona, the combination of particulate and sulfur oxides creates potential visibility problems noted below.

Visibility:

Visual air quality has been identified as an important value for all Class I areas in this region. Visual range calculations by LASL based on 1990 scenario emission conditions for each Class I air area in the region show no change over the calculated 1977 baseline value for any of the 42 areas. However, variations in the calculated visual range among the various areas indicate that existing 1975 air quality conditions apparently contribute to visibility impairment in some Class I air areas within the region. Moderate visual impairment from plume blight could affect Grand Canyon National Park due to the increased coal capacity in Coconino County. It is also important to note that emissions in Nevada and Arizona could add to air quality problems in Class I air areas in surrounding states, and violations of the PSD Class I increments are possible in those areas where local background concentrations are already high.

National Socioeconomic Effects

Key Scenario-Induced Findings

- o Investment in new energy facilities in the region declines in the late 1980's while it continues growing in the rest of the country.
- o The capital and personnel requirements for energy facility construction are not large compared to those resources available in the region, thus no regional economic constraints on energy development are foreseen.
- o At its peak, employment in energy related construction amounts to less than one percent of the current (1975) employment in all sectors.

Figure 9-12

Figure 9-13

Figure 9-14

o A decline in nuclear power plant construction results in a phase-out of demand for nuclear construction skills. At the same time, with the increase in solar systems a different mix of occupations results, where manual skills requirements increase due to this changing mix of facilities.

o Indirect secondary impacts are small in general, although certain specific sectors related to energy equipment are more heavily impacted.

o Region 9 will continue to be a net exporter of energy-related materials and services.

Description

Direct Impacts:

The direct impacts presented in this section and shown in Table 9-3 include estimates of expected capital and manpower requirements for the construction and operation of energy facilities in California, Nevada and Hawaii.³ These estimates are presented as annual averages for the time periods 1976-80, 1981-85, and 1986-90.

Average annual investment in the energy industries will increase from \$4.4 billion in the first time period to \$4.8 billion in the second, and then decline to \$3.6 billion in the third. This may be compared with a total capital investment of \$30 billion (1977 dollars) in this region in 1972. The decline in energy investment in the third five-year period contrasts with the steady increase in energy investment in the country as a whole. In all three time periods oil exploration and development accounts for 25 percent or more of the capital investment. Oil refineries and electricity transmission and distribution facilities are the two other major activities, requiring a maximum of roughly \$1 billion each during the second period.

In addition to construction capital, energy facilities in this region require substantial expenditures for operation and maintenance. These expenditures, exclusive of fuel costs, will grow steadily from an average annual expense of \$4.3 billion in the first period to \$6.3 billion in the third period.

Personnel requirements for energy industries will follow the same temporal pattern exhibited by capital costs. Construction personnel increases during the second period and then declines in the third period, whereas operating personnel increases steadily through the third period.

The maximum requirements occur in the second period, where over 25 percent of the construction force working on energy projects will be required for constructing oil refineries. Other sectors absorbing significant construction effort include solar heating; electricity and gas transmission; and distribution; and oil recovery and development.

The large increase in personnel for refineries and solar heating affects the specific types of skills needed for energy facility construction in general. The requirement for chemical engineers, for example, almost doubles between the first and the second period, while the requirement for pipefitters increases by 55 percent. In contrast, no new construction of nuclear power plants reduces the average annual construction requirement for nuclear engineers to nearly zero by the second period.

During the second period, in which personnel requirements peak, the average annual employment for construction and operation would amount to 29,700 and 84,500 man-years respectively. As a comparison, the number of wage and salary workers in the construction industry in 1975 was 303,300 and in other non-agricultural establishments it was 7.5 million. Hence the fraction of workers engaged in energy facility construction will amount to about one percent of the total employment in 1975.

Indirect Impacts:

In general, the secondary impacts of energy facility construction are small compared to the total employment, income and output in the region. The secondary impacts for the 1986-90 period, which are the largest, amount to less than two percent of the totals in 1972. Furthermore, they amount to less than 15 percent of the employment, income and output in the region that is attributable to all construction activities.

Some sectors, however, are subject to relatively large impacts. These sectors are those directly related to construction such as fabricated plate work, steam engines and turbines, and motors and generators. For all of these sectors, the construction related impacts are less than 60 percent of the 1972 levels. Thus there do not appear to be any economic constraints to the projected energy development activities.

The significance of these impacts depends on the overall state of the economy. If we are in a period of high unemployment in the region, then energy facility construction could increase employment by nearly two percent. If we are in a period of low unemployment in the region, then workers would have to be bid away from other industries, which would add to inflationary pressures.

Table 9-3

Direct and Indirect Scenario Impacts in Region 9

	ANNUAL AVERAGE		
	1976-80	1981-85	1986-90
Capital Invested (10^6 1977 \$)			
Materials	1,100	1,250	940
Equipment	<u>660</u>	<u>740</u>	<u>500</u>
Materials and Equipment	1,760	1,990	1,440
Construction Labor	790	930	740
Other (escalation, working capital, land)	<u>1,870</u>	<u>1,930</u>	<u>1,460</u>
Total	<u><u>4,420</u></u>	<u><u>4,850</u></u>	<u><u>3,640</u></u>
Employment (man-years)			
Direct Construction	25,000	29,000	24,000
Direct Operation	68,000	84,000	102,000
Indirect	<u>113,000</u>	<u>128,000</u>	<u>140,000</u>
Total	<u><u>206,000</u></u>	<u><u>241,000</u></u>	<u><u>266,000</u></u>
Regional Gross Output (10^6 1977 \$) Caused by Nationwide Expenditure On			
Materials and Equipment	3,560	4,060	4,390
Manpower	1,570	1,780	1,950
Ratio of Regional Gross Output to Capital Investment In			
Materials and Equipment	2.02	2.04	3.05
Manpower	1.99	1.91	2.64
Regional Value Added (10^6 1977 \$) Caused by Nationwide Expenditure On			
Materials and Equipment	1,726	1,960	2,130
Manpower	850	960	1,050
Ratio of Value Added to Investment In			
Materials and Equipment	0.98	0.98	1.48
Manpower	1.08	1.03	1.42

For all three time periods, the gross output and value added generated in the three-state region by construction of U.S. energy facilities exceeds the investment occurring in these states. This implies that the region is a net exporter of materials and services required for energy-related construction. The ratio of value added to investment increases from the first to third period, as the investment in the three-state area decreases, while that in the rest of the country increases.

Offshore Oil and Gas Development

Current oil and gas development in the region totals 80×10^6 barrels of oil and 23×10^9 cubic feet of gas (1975), including producing areas just off-shore in California state lands, and some production in Outer Continental Shelf (OCS) tracts off southern California. About 25 percent of the gas and 20 percent of the oil were produced from OCS lands in 1975. The scenario projects increased off-shore gas and oil production and makes no distinction between state lands (up to 3 miles from shore) and OCS development. The 1990 projections are nearly 150×10^9 cubic feet of natural gas, or an increase of about 6 to 7 times. Total oil production stays about the same as in 1975. In either case, however, on-shore impacts will occur, and are discussed in the section on Land Use.

Storage of Nuclear Wastes

There are no plans at present for the construction and operation of high-level nuclear waste storage facilities within the region. However, the operation of present and new nuclear power plants in Region 9 may ultimately depend upon the development of such facilities either in the region, or elsewhere. A low-level radwaste facility has been in operation near Beatty, Nevada. The State of Nevada has proposed that the nuclear weapons test site near Mercury, Nevada might be a suitable high-level waste repository in the event nuclear weapons testing is phased out.

At present, the spent fuel has been accumulating at nuclear power plants. The scenario does not specify the location or method for nuclear waste storage, and the assessment here does not include either shipment or storage of radwastes.

It should be noted that the apparent lack of clear federal programs for waste storage, and the remaining technical uncertainties have resulted in state initiatives to slow nuclear power development. As discussed in the section on Institutional and Political issues, California has adopted legislation requiring that no new nuclear plants be constructed until the nuclear waste issues are resolved.

REGIONAL ISSUES SUMMARY

Local Air Quality

Key Scenario-Induced Findings

- o Continued violation of ambient air quality standards in urban areas are expected.

- o Mobile sources will continue to dominate air emissions in most urban areas in the region.
- o Facility siting will be constrained in many rural non-attainment areas due to lack of emission tradeoffs.

Description

Regional air quality problems are important factors shaping decisions on facility siting, technology and fuel choices. Under the scenario assumptions the present trends continue, with most urban industrial areas continuing to violate ambient air quality standards for one or more pollutants. Mobile sources continue to dominate the air pollution picture in these urban counties (except for SO_x), and reductions in industrial or utility emissions will be masked by increasing mobile source emissions.

In parts of Region 9, rural siting of facilities will be constrained due to non-attainment status where violations of air quality standards are often due to pollution transport; hence, emission offsets necessary for facility siting will be difficult to obtain. More than half the counties in the region with Class I air areas are also fuel-burning counties (either industrial or utility) raising the possibility of potential conflicts with PSD Class I increments.

The only major pollutant in the region for which emissions are projected to decrease is H_2S , even though the scenario projects increasing geothermal activity. However, the presently uncontrolled H_2S emissions are expected to be controlled and new facilities are expected to use scrubbers resulting in a large decrease in overall H_2S emissions from 1975 to 1990.

Water Quality and Availability

Key Scenario-Induced Findings

- o Available fresh water in the region is, in general, over-committed, and future water demands will require displacement of existing users or development of new sources.
- o Water for energy facilities may require regional or interbasin water transfers, or use of waste water from agricultural or urban users.
- o Widespread problems due to water quality violations are not projected, although site-specific impacts are possible.

Description

Possible site-specific water quality impacts have been identified depending upon the water sources and actual discharge conditions. However, overall regional water quality impacts do not appear to present insurmountable problems.

Water availability issues in this region focus on the questions of freshwater availability and competing uses. Several proposed site choices appear to be doubtful unless water sources other than fresh water are available, such as

agricultural or municipal waste-water. The use of such water raises secondary impact issues of the effect of cooling tower drift and blowdown on surrounding land uses.

Ecology

Key Scenario-Induced Findings

- o Although ecological impacts are generally site specific, broader problems such as impacts upon sulfur-oxide sensitive crops will be important as fuel burning is projected to increase. The Central and Imperial Valleys in California, and parts of Nevada have large acreages of sulfur-oxide sensitive crops.
- o Habitat areas for rare endangered species may be important constraints in siting of facilities, especially in California where all counties have one or more endangered species.

Description

Regional ecological issues associated with the scenario are generally site-specific, though several potential generic issues have been identified. Agricultural effects of SO₂ could be a significant issue since agriculture is a major economic activity in the region, especially in California. Although overall SO₂ emissions are not expected to increase enormously, additions to the existing SO₂ levels in agricultural areas may pose problems from effects that are not well understood at present. Future hydroelectric and geothermal development, may be constrained by ecological impacts, but require a more detailed site-specific analysis because of the site-specific nature of the resources. Finally, siting conflicts with rare and endangered species habitat are possible in many areas of the region. Much of the land disturbed by strip mining in Arizona has not been reclaimed, creating pressures upon rare and endangered species in that area.

Land Use

Key Scenario-Induced Findings

- o Coastal zone impacts related to energy development are projected to increase as oil and gas production and refining activities increase.
- o Air emissions and new demands for water supplies resulting from rural energy facility siting may impact highly productive agricultural lands.

Description

The major scenario-related land use issues in the region involve those projected facility sites which conflict with other high-priority uses particularly in the coastal zone and in agricultural lands. The increasing consumption of oil in the region will induce greater pressures upon the California coastal zone for energy-related development such as refineries, ports and related facilities. At the same time, pressures for coastal zone protection have also increased, and future energy facility siting impacts are primarily related to H₂S or SO₂ impacts upon crops or to competition for water.

Solid Waste

Solid waste residuals are not expected to be a serious regional problem, however, this presupposes that waste material will be disposed of in a way that will not affect water quality.

Local Socioeconomic

Key Scenario-Induced Findings

- o Local issues may be significant, especially where development of a particular resource is highly location-dependent. Important examples are potential siting and development conflicts with Indian tribal cultures in Arizona, and impacts upon community infrastructures in geothermal resource areas of California.
- o Energy related development in the coastal zone (OCS, LNG, ports, refineries, marine biomass plants, or electric power plants) will significantly impact rural communities in central and northern California.

Description

At the regional level, the scenario presents no major socioeconomic issues for the region. Locally, the socioeconomic issues will be very important, especially in cases where the energy resource is highly location-dependent, as in geothermal or coastal development. Local employment and population impacts appear to be small or moderate except in rural coastal counties which may be impacted by a combination of off-shore and on-shore energy development. However, sociological factors have been identified that will be important considerations in future development in the region. Among the most important of these are potential conflicts with Indian tribal cultures in Arizona, and potential changes in community infrastructures due to geothermal development in predominately rural areas in California.

Institutional and Political

Key Scenario-Induced Findings

- o The increased use of natural gas as power plant boiler fuel will face institutional constraints.
- o Energy supply economics will influence decisions by private and public institutions, and these decisions may not be consistent with the scenario assumptions and projections.
- o Local governments and regional and state coastal commissions can significantly curtail coastal zone energy development via broad land use permitting authority.

Description

Public awareness and debate over environmental issues in the region have resulted in the establishment of local and statewide institutions to resolve

energy and environmental problems such as the California Energy Commission, or the Hawaii State Energy Office. Efforts to comply with existing or new standards or to site new facilities will involve these institutions and the issues identified in this report would require participation by these institutions for their resolution. Potential constraints to a number of specific energy developments proposed in the scenario have been identified.

While each state in the region has a unique set of institutions, there are issues that appear to be common to all. The use of natural gas for new power plants, as proposed in the scenario, appears to be infeasible, primarily because the long-term availability of natural gas is uncertain, and federal and state regulatory actions have given a low priority to gas use in utility boilers. A considerable fraction of land in the region is under federal control and energy facility or transmission line siting will require federal actions and approvals as well. Finally, there is a unique division of institutional authority between federal, state, and local governments concerning energy development in the coastal zone. As a result both offshore and onshore energy development will be subject to review and permitting processes in excess of that required for inland sites. This local control may result in significant delay or restrictions on energy developments associated with the scenario.

Finally, economics of various energy supply sources influence both private and public institutional decision making. Some of the scenario proposals appear economically less viable than alternatives (including conservation and improved efficiencies) and, as such, might not be implemented.

Health and Safety

Key Scenario-Induced Findings

- o Public health and occupational effects of projected energy development do not change significantly from those in 1975.
- o The analysis of risks is incomplete and contains large uncertainties.
- o Increases in non-sulfate urban air pollutants are likely to have measurable human health impacts due to the large population concentrations in these areas.

Description

Health and safety impacts related to energy development have been estimated by BNL for both occupational and health risks to the general public. These estimates for energy activities in Region 9 are summarized here; estimates for individual states within the region are not presented. Certain risks are unique to a given state or area, such as occupational risks in Arizona due to coal mining, or health and safety impacts in California due to oil and gas production, transport and processing. On the other hand, the estimates of health effects due to exposure to airborne sulfate are based on national damage functions, and no effects due to local pollutant mixes are estimated.

The uncertainties associated with health and safety analyses have been discussed extensively elsewhere and will not be repeated here. The importance of the analysis is to indicate whether energy development as projected by the scenario will significantly increase occupational risks or risks to the general public. While comparisons with other activities might be made, e.g., risks due to smoking, the absolute impact estimates contain a number of uncertainties and should be used with caution. Indeed, public health impacts due to energy use would probably dominate the assessment. Deaths from automobile accidents in the states of Region 9 totaled 5500 in 1975. Inasmuch as the scenario projects increased gasoline consumption, implying increases in either the number of motor vehicles, or the number of vehicle miles travelled per automobile, or both, public exposure to risks associated with motor vehicle travel will also rise.

Occupationally-related effects of the scenario change little from 1975 to 1990; the largest single impact is the expected doubling of deaths from 3 to 6 annually due to oil production work. Public health risks, in the BNL analysis, are largest for exposure to airborne sulfate. However, the analysis considers only utility and industrial emissions and not other sources of sulfur oxides, such as refineries or process sources; hence regional sulfate health risks actually appear to decrease. The overall estimates of public health impacts due to energy production in Region 9 show no significant change between 1975 and 1990. With the uncertainties associated with the sulfate health damage function, there is no statistically significant difference between the 1975 and 1990 health impact estimates.

There are, however, additional health issues that should be noted. First, recent studies have shown an increase in the occurrence of cancer in counties with petrochemical industries. While cause-and-effect linkages have not been established, the potential health impacts are energy-related, and would increase public health risks. Second, as noted elsewhere, sulfur oxides are not as significant an issue in Region 9 as in other regions of the country. However, other air pollutants related to energy production and use also have health effects, whose impacts are not assessed here.

Finally, risk assessments of the nuclear fuel cycle are uncertain, as confirmed, in part, by the recent NRC decision regarding reactor safety risk assessments. There are three nuclear power plants currently operational or under construction in the region (and included in the scenario) that are located near large population centers - Palo Verde near Phoenix, Rancho Seco near Sacramento, and San Onofre in the Los Angeles-San Diego corridor. In the event of a catastrophic accident at any one of these facilities, large populations would be potentially at risk. No quantitative assessment of this risk has been done here.

STATE ISSUES

CALIFORNIA

The issues presented here summarize site-specific or county-level assessments aggregated to the state level. In doing so, the intensity of specific localized impacts diminished somewhat in the waiting process necessary to produce an assessment representative of an entire state. California is the major energy user in Region 9, accounting for 83 percent of the regional energy consumption in 1975 and 80 percent projected for

1990. Not surprisingly, many of the present and projected regional environmental problems also occur in California, and environmental and regulatory constraints to energy development and use are therefore likely.

The issue areas and findings are summarized below and discussed in more detail in the following subsections.

Local Air Quality

Key Scenario-Induced Findings

- o 84 percent of California's population currently resides in counties classified as non-attainment areas for particulates, oxidants, or carbon monoxide, and by 1990, 89 percent will reside in areas projected to be non-attainment for these pollutants.
- o Implementation of the scenario will exacerbate current air quality problems due to continued growth in motor gasoline consumption and resulting growth in refinery capacity and tanker shipments.
- o Retrofit control strategies will mitigate existing H₂S air quality problems associated with the development of geothermal power at the Geysers field in Northern California.
- o Particulate emissions are projected to increase from 50 to 200 percent at the county level from 1975 to 1990, and all twelve of the major industrial counties will remain in non-attainment status (See Figure 9-15).
- o Sulfur dioxide emissions increase in 70 percent of California counties but none of the counties are projected to change from attainment to non-attainment status (See Figure 9-15).
- o Hydrocarbon emission levels in most counties are projected to remain the same or decrease slightly from 1975 to 1990 (Figure 9-16).
- o Despite small decreases in emissions however, the majority of the fuel burning counties remain in non-attainment status for the 8 hour oxidant standard (Figure 9-16).
- o Non-attainment status for carbon dioxide monoxide levels is projected for 20 of the 30 counties studied (Figure 9-17).
- o Six of the thirty counties are projected to change from attainment to non-attainment status in 1990 for nitrogen oxides (Figure 9-16).

Description

Presently 60 percent of California counties are non-attainment for particulates, 80 percent are non-attainment for oxidants (and hydrocarbon precursors) and 40 percent are non-attainment for carbon monoxide. Land use patterns that have historically favored heavy use of motor vehicles, topographical and meteorological features that frequently cause inversion conditions, and a large share of the nation's refining capacity and chemical production are principal contributors to poor ambient air quality in this state.

Figure 9-15

Figure 9-16

Nitrogen Oxides

Hydrocarbons

California
Air Quality Attainment
Status for 1990
by Air Quality Control Region

Figure 9-17

Carbon Monoxide

California
Air Quality Attainment
Status for 1990
by Air Quality Control Region

The present analysis of 30 fuel burning counties (with either industrial or utility facilities) indicates that implementation of the scenario would exacerbate these air quality problems. A simple ratio method to forecast air quality was used, based upon estimates of emissions in 1975, 1985, and 1990.⁴ No attempt was made to account for either the spatial or temporal distribution of emissions or to define the meteorological conditions governing the dispersal of emissions.

Mobile sources are and will continue to be the major source of most air pollutants in California, although process sources contribute roughly the same level of organic gases in many counties. The scenario projects a growth rate of 1.7 percent per year for motor gasoline consumption in California, yielding a 30 percent increase over present consumption levels by 1990, and consequently resulting in large increases in vehicular emissions. The contributions of mobile sources to overall emission levels in 1975 is given in Table 9-4 for two typical counties: Alameda, as an example of an industrial urban county, and Merced, as a rural county.

Table 9-4

Mobile Sources as a Percentage of Total Emissions (1975)

COUNTY	PARTICULATES	SO _x	ORGANICS	NO _x	CO
Alameda (Urban)	35	46	51	79	99
Merced (Rural)	61	81	67	96	99.9

Particulates:

Particulate emissions from mobile sources increase dramatically. When coupled with the 20 to 30 percent increases in emissions from process sources, an overall increase in most county emission levels ranging from 50 percent to 200 percent will occur. Twenty to forty percent decreases in the emissions from the utility and industrial sectors have little impact on the overall trends due to the order of magnitude differences between mobile plus process emissions relative to these sectors in both 1975 and 1990. Air quality in all twelve of the major industrial counties is projected to continue to deteriorate, with violations of the Federal and California annual standards for total suspended particulates (see Table 9-5).

Sulfur Oxides:

Seventy percent of the fuel burning counties experience increases in SO₂ emissions, but none of the counties presently in attainment change to non-attainment status. Reductions in the level of sulfur emissions from industrial fuel-burning sources accomplished by BACT are usually counterbalanced by increased emissions from process sources or new utility

installations. Thus the five industrial counties currently in violation of the NAAQS remain in this status for 1990.

Hydrocarbons:

The projections for 1990 indicate slightly lower or, in most cases, equivalent hydrocarbon emission levels into the fuel burning counties. The relative contribution of each sector to total emissions shifts slightly during the 1980's as increased emissions from the process sector partially compensate for net decreases in emissions from mobile sources. Overall, the majority of the fuel burning counties can be expected to remain non-attainment areas for hydrocarbons in 1990 (see Table 9-5), despite small decreases in overall hydrocarbon emissions in large urban counties. It should be noted that these projections for hydrocarbons do not translate directly into reduced oxidant levels, since other chemical species, such as NO_x and particulates play a significant role in oxidant formation.

Carbon Monoxide:

Carbon monoxide (CO) levels increase substantially for all counties due to the heavy increases in motor vehicle traffic. In 1975, mobile sources accounted for roughly 97 percent of total CO levels, and the doubling of emissions in some counties will cause this percentage to approach 99 percent. The range in increases from 1975 to 1990 was 20-110 percent, but the average increase for industrial counties was 80 percent. The resulting air quality changes are shown in Table 9-5.

Nitrogen Oxides:

Increases in nitrogen oxide emissions from mobile sources lead to moderate increases in overall NO_x emissions in 1990. Emissions from industrial and utility sectors decline slightly in some counties but on the whole remain close to the 1975 baseline. Process sources of NO_x continue to increase at a rate of 1-2 percent per year, depending on the industry; chemical and refinery emissions are the major contributors to this increase. Only two of the 30 counties experience a net decrease in emissions from 1975 to 1990; these changes are summarized in Table 9-5.

Hydrogen Sulfide:

Retrofit control strategies for existing H_2S emission rates in the Geysers geothermal area and the required installation of the Stretford process for all new plants should substantially mitigate the current violations of state H_2S ambient standard of $42 \mu\text{g}/\text{m}^3$ in Sonoma and Lake Counties. A recent air quality modeling study concluded that H_2S ambient levels will be 10-50 times below the standard if the industry complies with these requirements.

Geothermal development in Imperial County poses a different set of air quality problems because the process there is liquid dominated. It appears that a steam flashing process coupled with Stretford devices will be used. Since there is no baseline H_2S data, it is impossible to predict 1990 air quality levels; however, the consensus of the experts interviewed is that there will be no problem meeting the H_2S standard in this county. Potential air quality problems may evolve if agricultural waste water with high concentrations of pesticides is utilized in the cooling towers.

Table 9-5

Trends in Primary Pollutant Attainment Status for
California Fuel Burning Counties
1975 - 1990

<u>Remains in Attainment</u>		<u>From Attainment (1975) to Violation (1990)</u>	<u>Continued Non-Attainment</u>
Static ^a or Improved Air Quality	Degraded Air Quality	Degraded Air Quality	Degraded Air Quality
<u>Industrial Counties (12)</u>			
Particulates	0	0	12
Sulfur Oxides	2	5	5
Hydrocarbons	0	0	12
Carbon Monoxide	0	3	7
Nitrogen Oxides	0	3	5
<u>Rural Counties (18)</u>			
Particulates	5	6	2
Sulfur Oxides	7	0	0
Hydrocarbons ^b	1	0	11
Carbon Monoxide	2	2	7
Nitrogen Oxides	5	3	0

(a) Static air quality is defined as total emissions ± 10 percent of 1975 baseline.

(b) No ambient oxidant data are available for six of the 18 rural counties but they are assumed to be in attainment in 1975.

Water Quality and Availability

Key Scenario-Induced Findings

- o Water quality deterioration is not expected in general, although site-specific issues, such as boron from geothermal effluents, are potential local water quality problems.
- o Refineries present localized water quality problems especially since most of the state refinery capacity is concentrated in two counties, Los Angeles and Contra Costa, and projected expansions are likely to occur at existing sites.
- o Water supply problems are associated with the scenario projections, since allocation of fresh water for cooling purposes has the lowest priority, and coastal siting restrictions make use of ocean water for cooling unlikely. However, waste water appears to be available for cooling purposes in a number of counties.
- o Geothermal development may compete with agriculture for water in certain areas, especially if water reinjection is necessary to mitigate subsidence problems.

Description

Water Quality:

In general, deterioration in the quality of inland waters will not be significant. Due to federal and state regulatory policies, it is quite unlikely that new energy facilities will be allowed to discharge chemical or thermal wastes into inland fresh water resources. There are, however, potential site-specific water quality problems that have been identified. In Imperial County water quality impacts may result from geothermal activity. Boron, a known plant toxin, has been measured at concentrations above the federal standard. A substantial increase in either or both total dissolved solids (TDS) and boron could have a significant impact on water quality if these geothermal cooling water requirements are met by diversion of irrigation waste water from New or Alamo Rivers, an increase in the salinity level of the Salton Sea, which is already existing, might be expected. Imperial County water quality will also be affected by the spent brine produced by these geothermal facilities, unless reinjection takes place.

In Lake County, where some 681 MW of geothermal development is currently forecast, existing boron levels have also been measured above the standards. Although boron transport in Lake County may differ from that in Imperial County, high levels of this substance could result in future land use restrictions.

The remaining potential state water quality impacts result from heavy metals. If it is assumed that adequate technology exists to reduce their concentrations in waste streams, or if they are contained in an evaporation pond the impacts may be negligible. However, it is not clear that such waste streams will meet existing state standards. It is expected that another mechanism for inland fresh water contamination by the new energy

facilities would be the deposition and collection by runoff of contaminants released as air pollutants. Cooling tower drift from new electric generating plants, refineries, and other facilities, particularly from geothermal power plants, is of concern when non-fresh water sources are utilized.

Impacts resulting from refinery expansion will likely be felt in Los Angeles and Contra Costa Counties, where nearly all of the California refining capacity is concentrated. Significant water impacts may occur from the expansion of wet scrubbing processes installed by refineries to meet air quality standards. Other refinery related impacts might result as a function of the quality or source of crude oil being refined and the type of process used. Processes which might impact water quality include crude distillation, coking, alkylation, sludge treating, boiler demineralizer and cooling tower blown down tank, farm operation and cleaning and storm runoff.

Water Availability:

Water availability issues in California are dominated by the question of the use of fresh water for cooling purposes. The State Water Resources Control Board has adopted a policy requiring utility companies to obtain cooling water from the following sources, listed in order of priority: 1) water waste discharges to the ocean; 2) seawater; 3) brackish water from natural sources or irrigation flow; 4) inland waste waters of low TDS; and 5) other inland waters. Federal and state regulatory policies on thermal facilities render the use of ocean water for new cooling purposes very unlikely. Oceanwater conveyance to inland sites is also not likely to occur, given uncertainties over economic feasibility and the regulatory status of conveyance facilities crossing the coastal zone.

The statewide water supply and demand situation is one of a delicate balance, with present supplemental water requirements being met by ground water overdrafts. The elimination of the supply deficit hinges upon the uncertain completion of a number of water projects or reduced consumption through water conservation. A number of major utility companies are now using (on a small scale) or have proposed plans for the utilization of waste water as the cooling medium, following regulatory agency requests to consider its use. With the exception of geothermal power generation, the new energy facilities projected by the scenario are predominantly in the heavily populated and highly industrialized coastal counties where municipal waste water appears to be available for cooling purposes.

In the coastal counties of Contra Costa, Los Angeles, and Humboldt fresh water is not available for new cooling purposes, however, there are quantities of waste water sufficient to meet the projected cooling requirements. Those projects already under construction in Los Angeles, San Diego and San Luis Obispo Counties will employ once-through cooling using seawater. Similarly, the projected facility in San Francisco appears to be an expansion of an existing power plant, and as such, once-through seawater cooling will be permitted. In San Bernadino County, it is expected that ground water will still supply the cooling needs of the facilities projected by the scenario.

Figure 9-18

Geothermal development in Imperial County will likely require the use of agricultural waste water. The TDS levels in these waters are high, however, and cooling tower drift will be a problem. In Lake and Sonoma Counties, cooling water make-up is obtained from the steam condensate. However, additional water may be required for cooling or for reinjection should potential subsidence problems materialize. These additional water requirements could go as high as 50 percent of the water currently used by agriculture.

Ecology

Key Scenario-Induced Findings

- o The additional hydroelectric facilities proposed by the scenario may eliminate anadromous fish species, because the facility can prevent seasonal migration and make spawning grounds inaccessible.
- o The projected increase in energy development in the coastal zone may result in high ecological costs as much of this increased development would likely occur in estuarine areas.
- o Acid precipitation resulting from fossil-fuel combustion has the potential to cause extensive ecological disruption in California. Trends in acid precipitation should be carefully monitored.

Figure 9-19

o The potential for conflict between energy facilities and rare and endangered species is high in California, with every county supporting one or more endangered species. New facility sites projected for Los Angeles, San Bernadino, San Diego, Sonoma, Alameda, San Luis Obispo, Riverside and Contra Costa counties may create serious conflicts with endangered species habitat.

Figure 9-20

o Crop damage (in the form of reduced yield), resulting from sulfur emissions will remain high in the South Coast Air Basin counties (Orange, San Diego, Riverside, and San Bernadino), and in Los Angeles County. San Bernadino experiences the highest percentage increases in total utility and industrial SOx emissions from 1975 to 1990.

o Crop damage from SOx emissions may occur in Central Valley counties that do not have additional utility or industrial emissions. Long-range transport of sulfates resulting from increased emissions in the San Francisco Bay Area could contribute significantly to crop yield losses in San Joaquin, Stanislaus, Merced, and Fresno counties. Fresno County ranks first in the state in agricultural production with annual crops valued in excess of 882 million dollars in 1977. At least 45 percent of the total crop value of the county is represented by sulfur-oxide sensitive crops.

Description

Large proposed increases in hydroelectric, pumped storage and geothermal generating capacity may incur major ecological costs; impacts on endangered species and habitat critical to their survival may result, and damages to agricultural crops from sulfur oxide and other residuals may occur. Less certain but of major interest is the possibility of major estuarine degradation and an increase in acid rain the western United States.

Hydroelectric and Pumped-Storage Development:

The actual development of the capacity additions projected by the scenario may be significantly constrained by concern over physical, chemical and biological impacts on aquatic and terrestrial ecosystems. Federal and state legislation designed to protect remaining wild-river areas will further restrict the number and location of sites that may be exploited.

The most serious ecological consequences will result from the construction and operation of new hydroelectric dams. The Auburn Dam Project, a major proposed facility, is expected to have severe impacts on upstream wildlife populations due to fluctuating water levels and extremely steep slopes bordering the proposed reservoir. Similar fluctuations in water levels downstream of the New Melones project, a facility now nearly completed, combined with altered water temperature, nutrient levels and turbidity will affect benthic communities and riparian habitat. Such fluctuations are characteristics of the present California hydroelectric capacity.

Another impact characteristic of hydroelectric facilities is the elimination of anadromous species of fish by the physical barrier of the dam, or by the destruction of their upstream spawning areas. The Environmental Impact Statement for the New Melones System acknowledges the presence of salmon and steelhead spawning grounds in the local service area of the Stanislaus and Tuolumne Rivers. The seasonal migration and spawning of these species could be prevented by the dam. Previous California experience with fish ladders or salmon hatcheries has been unsatisfactory.

While much of the proposed pumped-storage capacity is not site-specific, the magnitude of the systems are such that these developments are also likely to cause substantial ecosystem disruption.

Geothermal Development:

Two principal ecological difficulties will be encountered in expanded development at the Geysers area. First, development could affect the natural habitats of numerous rare, threatened, and endangered species, including the endangered American peregrine falcon. A second major obstacle to development is the nature of the terrain in the area. Steep slopes create potential for landsliding and erosion with possible negative impacts on local water quality. Ecological concerns of a crucial, but less immediate nature, include the effects of chronic H_2S emissions on vineyards and orchards, avoidance of accidental spills of saline brine with consequent groundwater degradation, dynamics and constituent pollutants of cooling tower plumes, and the control of particulate emissions. Similar problems might arise in Imperial County with the principal areas of concern including effects of emissions on crops and threats to endangered species.

Endangered Species:

The potential for conflict between energy facilities and rare endangered species is high in California. The Endangered Species Act of 1973 is further strengthened by California state legislation that protects additional

endangered and rare species. A total of 44 endangered species and 26 threatened or rare species are currently listed by federal and state agencies.⁵ Furthermore, as additional surveys are completed, new fish, wildlife and plant species are continually added to the list. This will further constrain the siting of new facilities.

Every county with energy facilities proposed in the scenario contains endangered species. The greatest potential for conflict appears to be in Los Angeles County, with major new energy facilities and 14 endangered species on the Federal list. Other counties with sizable developments and numerous endangered species are San Bernadino, San Diego, and Sonoma.

SO₂ Effects on Agricultural Crops:

A number of SO₂ sensitive crops have been identified,⁶ many of which are grown in or adjacent to counties with major SO₂ emissions. However, the effects of combustion pollutants on agricultural crops are exceedingly difficult to assess in a systematic and generalized manner, due to a lack of well-understood dose-response relationships. While the scenario does not predict significant increases in SO₂ emissions, the potentials for agricultural impacts from present SO₂ levels are beginning to be recognized. Hence problems may become apparent in the future as the dose-response issues are resolved.

In San Bernadino County, where large acreages of sensitive crops such as alfalfa, sweet potatoes, wheat, and various orchard crops are grown, SO₂ levels rise 13 percent over the 1975 to 1990 period. Similarly, due to prevailing wind patterns, many of the emissions from utilities and industries in the San Francisco area may damage crop lands of the Central Valley. The meteorological and topographical characteristics of the Central Valley act to trap pollutants so that stable or even decreasing SO₂ emissions in the surrounding area may cause continued high levels of crop damage. Rice, barley, and alfalfa are all important crops in the Central Valley, and a 1 percent reduction in rice yield translates into a \$2 million loss.

Finally, localized effects of H₂S emissions from projected geothermal development in Lake, Sonoma, and Imperial Counties on grapes and other crops may occur. However, the proposed technologies noted in the section on Ecology for reducing H₂S emissions should resolve most of these problems.

Estuaries:

Ecological impacts on estuarine ecosystems resulting from the scenario depend largely on the resolution of conflicts over coastal versus inland siting in California for electric generation and energy transportation and conversion facilities. As noted in the section on Land Use, the projected energy activity in the coastal zone is significant. Such future development activities could subject coastal estuarine areas to oil pollution effects from spills or well blowouts, the disruption of thermal balances in the vicinity of those plants utilizing once-through cooling, increased risk of catastrophic tanker oil releases, and added marine pollution from operational releases of bilge water, lubricants and oils.

Acid Rain:

Acid rain resulting from increased combustion of fossil-fuels has the potential to cause extensive ecological disruption in California. While acid rain is not currently believed to be a serious problem in the western United States, rainfall with lowered pH levels has been measured in California. The potentially serious ecological impacts of acid rain, combined with uncertainty surrounding its generation and mitigation, suggest that increases in acid rain should be carefully monitored.

Land Use

Key Scenario-Induced Findings

- o Off-shore oil development and increased oil imports projected in the scenario will require movement of greater volumes of oil through the coastal zone, inducing additional coastal zone development.
- o Rapid development of Imperial County KGRA's may be slowed by the need to ascertain the probability of major subsidence (despite rejection). Subsidence could result in salination of irrigation canals and potential risk to annual crop yields valued at approximately \$350 million.
- o The most immediate constraint on development of additional hydroelectric facilities is likely to be seismic. The Auburn Dam is a prime example of a facility delayed over concern about seismic integrity.

Description

Significant land use issues and impacts are generated in California by the scenario. Four separate impact areas have been identified: conflicts with other high priority coastal zone uses; impacts on high priority agricultural lands from geothermal energy development; seismic concerns and terrestrial habitat loss for hydroelectric development; and the land use impacts of the development of new transmission corridors.

Coastal Zone Impacts:

Land use impacts associated with expanded energy activity associated with the scenario accrue to the coastal zone as a result of expanded steam power plant activity, offshore oil and gas production, tanker transportation of oil and gas, and expanded coastal zone oil refinery activity, as Table 9-6 indicates. These increases will be concentrated in the southern coastal counties (San Diego and Los Angeles) where competing recreational and industrial land use demands are already high.

Off-shore oil and gas production is currently concentrated to the south coast (Orange County to Santa Barbara) area. However, 1985 and 1990 production levels will be augmented by production from new central and northern California fields currently undergoing the lease sale process. New facilities for bringing the oil and gas onshore will be necessary. The required increases in coastal zone refinery capacity (40 percent by 1985

and 58 percent by 1990) will conflict with other existing high priority coastal zone land uses. Based on this conflict, it does not appear that a 50 percent increase in this capacity is likely by 1990.

Finally, impacts will accrue to coastal zone land uses as a result of increased tanker traffic in the California coastal zone. The 1985 and 1990 increases in product flow, shown in Table 9-6, would require a 130 percent and 145 percent increase in tanker trips, respectively. Aside from the ecological impacts noted in the section on Ecology, new port facilities may be needed and will produce land-use conflicts.

Table 9-6

Summary of Projected Energy Activity
in the California Coastal Zone

	1975	% increase 1985 over 1975		% increase 1990 over 1975	
Steam Power Plants (MWe)	20,967	27,585	32	34,550	50
Offshore Crude Oil Production (10 ⁶ BBL/yr)	80	82	3	74.5	-6
Offshore Natural Gas Production (10 ⁹ ft ³)	19.5	128.5	560	148.9	660
Total Coastal Refinery Activity (10 ⁶ BBL/yr of feed stock)	611	856	40	963	58
Crude Oil Imports (10 ⁶ BBL/yr)	168	185	10	229	36
Total Petroleum Movement Through Coastal Zone (10 ⁶ BBL/yr)	524	613	17	760	45

Geothermal Impacts:

In the Geysers area, land use impacts are primarily of the nature of disruption of scenic areas, potential impacts due to residuals (discussed in the sections on Local Air Quality, Water Quality and Availability and Ecology), and land displacement due to secondary growth effects. In the Imperial Valley area, direct agricultural impacts from geothermal are more probable, such as actual removal of land from productive use, or competition for fresh water. The area is heavily dependent upon irrigation, hence any land subsidence due to fluid withdrawal or reinjection would have significant effects. While the acreages are small for the most part, the impacts are significant since the land, especially in the Imperial Valley, is now used for high value agriculture.

Hydroelectric Impacts:

The scenario forecasts 1000 MW of hydroelectric expansion in California. This expansion has been associated with dams currently under construction (e.g., New Melones) or with proposed future development. This increased capacity will convert approximately 42,000 acres of valuable mountain wildlife habitat into aquatic (reservoir) habitat, hence altering land use and open mountain habitat (see section on Ecology). At present it appears that the New Melones reservoir will be only partially filled due to concern about upstream loss of a stretch of white water used for recreation, as well as loss of wildlife habitat.

Recent concerns have been raised regarding seismic problems associated with reservoirs. These have been validated to some extent by recent scientific studies, and a major restudy of the feasibility of the proposed Auburn Dam (included in the scenario) has been ordered. It is likely that seismic concerns will constrain or alter proposals for new hydroelectric or pumped storage facilities.

Transmission Lines:

Land use impacts of transmission corridors can only be addressed in a quantitative sense at this time. While most of the major regional transmission corridor requirements through 1990 can be identified (e.g., expanded interties with the Bonneville Power Administration system and expanded transmission line capacity from geothermal and pumped storage development), the routes and capacities of energy transmission systems are not included in scenario information and have not been explicitly identified by regional institutions. Thus, while certain conflicts such as use of Indian lands and habitat alteration can be anticipated, these issues cannot be directly linked to the scenario.

Solid Waste

The generation of solid waste from energy activity in California is not a major issue at present. Solid waste from the industrial use of coal does not have significant land use implications; even in the two "worst case" counties within the state (Contra Costa and Los Angeles), no more than 0.001% of the county land area will be required for disposal of municipal solid wastes (MSW) is a more significant issue. Those counties where energy wastes from industry represent a significant portion of total MSW are rural, with low rate of municipal solid waste generation. One issue that might present future problems is the selection and operation of disposal sites for toxic materials, should scrubber sludge require disposal in Class I dump areas.

Local Socioeconomic

Key Scenario-Induced Issues

- o For most of the energy technologies local economic impacts will not be significant, because most labor is drawn from nearby urban complexes.

- o Development of geothermal resources in the rural counties of Imperial and Lake would alter community infrastructures, especially during construction. Increased demand for housing and services is expected, while supply would be nearly static. The relationship between local government revenues and expenditures would be initially unfavorable and result in impairment of services.
- o Shore based facilities and on-shore direct and indirect impacts activity associated with OCS development will significantly impact the character, infrastructure and economy of rural coastal communities in San Luis Obispo, Sonoma, Mendocino and Humboldt counties.
- o Production changes would be qualitative as well as quantitative, introducing new residents with different family structures, values and needs from that of the current population.
- o Geothermal development may also induce other industrial growth, further altering the local community in terms of employment and demand for services.
- o In Lake County, geothermal development may adversely affect the scenic quality of the environment, on which a significant part of the local economy is based. This possibility has created some opposition to geothermal development.
- o Geothermal development will accommodate in Imperial County as long as air and other issues do not seriously conflict with agriculture. The new jobs and new workers brought to the community are seen as a net asset by the local officials.
- o In Los Angeles, due to the air quality restrictions, the siting of replacement power plants becomes a complicated issue which is defined not only in terms of local versus remote siting but also whether county resources and efforts should be directed toward alternative resource development and greater end-use efficiencies.

Description

Two aspects of the local effects of new energy facilities were considered. The first covers impacts on the local economy, population and services; the second addresses the sociological question of whether new energy facilities will favorably or unfavorably impact the local 'way of life' or community values.

With regard to the first set of issues, the impacts of specific technologies and siting choices are best described on a generic basis. Except for geothermal development, major new energy facilities projected for the State are not anticipated to have significant impacts on employment or services. Some projects are already completed, and the construction work force impacts have been absorbed in the adjacent major urban complexes. At least two large oil refinery expansions are anticipated to be undertaken at existing California refineries during the 1980s. However, the refineries are located in major urban areas, San Francisco and Los Angeles, and they are not likely to have a significant effect on the local economy. If the

construction of a major LNG import facility (included in the scenario) proceeds as planned at Point Conception, a rural coastal area south of Santa Barbara, there will be some construction impact on local employment and services, but these are not considered a significant obstacle to the project. A more serious state-wide economic effect might result, however, if LNG, as anticipated, costs twice as much as existing pipeline gas imports from Texas and Canada. These extra costs will be borne by regional gas consumers and an adverse depressive effect on the economy might occur.

There are three counties in which the changes due to energy development required by the scenario are extensive. For these, the sociological as well as the economic impacts were examined, with particular attention to possible changes in community infrastructure and the social environment.

Development of geothermal resources as projected by the scenario will have its predominant impacts in two rural California counties. In both of these counties, Lake and Imperial, the introduction of a new industry would alter the community infrastructure, especially during the construction phase, through changing the balance of revenues and expenditures and the relationship between supply and demand of commodities such as housing and services. In both areas, aggregated impacts on employment, population in-migration and demand for services due to construction necessary for geothermal development are expected to be moderate. However, the income differential between established employment and that derived from the new development and introduction of new residents with potentially different needs and values could change the social environment, perhaps impacting people in marginal economic situations. The development of geothermal facilities may also induce growth of other industrial projects, changing the local infrastructure still further.

Lake County is a sparsely populated, relatively isolated area with an economy based on agriculture, recreation and retirement. There are no geothermal facilities in the county at present, although development in the adjacent county is quite large. The demographic changes introduced by development may temporarily overload the public services before the benefits of development can be accrued. Residents of the county are concerned that geothermal development may impair the scenic qualities which support recreation. As a result, there is no general agreement among county residents about the benefits and risks of geothermal development.

Imperial Country is more dependent upon agriculture than Lake County. While some of the concerns about change are the same, e.g., the timing of benefits and risks, the areas of risk are different. To the extent that geothermal development does not present serious conflicts with agriculture (the potential air, water and land use issues are discussed elsewhere) the county is prepared to accommodate these projects. The changes of employment that geothermal development would bring, both new jobs and new workers, are viewed as definite benefits by local residents, although these changes would have little positive effect on the agricultural workers' social environment.

By contrast, major changes are also projected by the scenario for Los Angeles County, the most heavily populated area in the state. These

changes consist mainly of replacing oil fossil fuel plants with new ones within the urban area, although there are an additional 366 MW for which no definite site can be assigned. The concern for air quality and health impacts may make siting of such additional plants a complicated political issue. If they were replaced in the rural, northern part of the county, the social effects would be similar to those described for Lake and Imperial Counties. For the development projected within the urban area, the local economic impacts such as employment or services will be negligible. However, in build-up regions, the physical changes and their direct social impacts are less but the issues of associated changes in community structure and values are no less important than in rural areas.

Institutional and Political

Key Scenario-Induced Findings

- o The state's nuclear safety legislation prohibits any nuclear development beyond present projections (4470MW increase by 1990) until an adequate federal nuclear waste program is developed.
- o The Mid-Mid scenario's 4470MW increase in nuclear capacity by 1990 reflects two plants presently under construction. Since the Three Mile Island incident, increased opposition from the Governor's office and local environmental groups has seriously jeopardized the licensing and operation of these plants.
- o A significant portion of the projected oil and gas requirements for Region 9 will impact the California coastal zone, due to resource exploration and extraction on state coastal lands or off-shore OCS developments, and to expanded port and refinery operations necessary to handle the increased use of these fuels. Policies adopted by the California Coastal Commission and local counties will restrict the development of new energy facilities in large portions of the coast.
- o The Governor's office and various state regulatory agencies support a diversified energy mix. Geothermal, solar, coal gasification, wind, cogeneration and biomass are all elements seen as alternatives to, or supplements to, oil, gas and nuclear energy sources.

Description

The California Energy Resource Conservation and Development Act of 1974, the most comprehensive state energy resource act in the country, gives the state a substantial role in the advance planning of the new energy facilities. This act attempts to resolve the conflict between two important societal interests; 1) the need for adequate electrical power, and 2) the need to prevent further environmental degradation. The major utilities, the principal state agencies dealing with energy issues, the Governor's Office and the general public all have significant roles in electrical energy planning. In addition, the Act is one of the first such planning and permitting procedures to explicitly recognize the importance of energy conservation as an element in state energy policy development.

The State Energy Act applies to about 25 percent of the projected capacity additions in the scenario. (The remainder is primarily either already under construction or hydroelectric and pumped storage, for which the act does not apply.) Before these projects are approved, a number of institutional issues will require resolution. Among them are:

1. Conflicts between the State Energy Act, which is the Energy Commission's legal authority, and other state and federal laws and regulations will constrain the power plant siting process. These conflicts have led to jurisdictional disputes among some of the agencies regarding permit authority and enforcement procedures.

2. Air pollution trade-off procedures are not generally specified, but worked out on a case-by-case basis. Complicating factors in such negotiations include the unresolved issues of interpollutant or interbasin trade-offs.

3. Political traditions of home rule, or 'selective' local compound jurisdictional questions. Citizen acceptance of energy and environmental plans is encouraged and local citizens are provided certain rights in the power plant siting process.

Aside from these institutional questions, there is a number of energy-related state issues that will influence the implementation of the scenario. Among these issues are the nuclear safety laws, which require no new nuclear power plants be built until an adequate federal nuclear waste program is developed. These laws were central to the recent controversy involving the proposed Sundesert nuclear power plant.

In this case the utility submitted the application for Sundesert to the Energy Commission for the first leg of the site certification process in 1976, just after the State legislature enacted the nuclear fuel cycle statutes. It soon became apparent that these statutes (which were to become effective in January 1977) would directly conflict with the construction of Sundesert. The Energy Commission, responsible for implementing the nuclear fuel bills, held extensive hearings on nuclear waste management and on alternatives to Sundesert. The diversity of participants included: county and city governments, citizens groups, state agencies such as the Public Utilities Commission and the Air Resources board, the major utility companies and, in the background, the Governor's office and some important members of this administration.

At the conclusion of this process, the Energy Commission found that there was no existing or foreseeable means of handling nuclear waste, and furthermore that there were alternatives to the construction of the Sundesert nuclear power plant. The Commission then voted to recommend that Sundesert not be legislatively exempted from the nuclear waste laws, thereby making California the first state in the country to block a nuclear power plant based on the waste disposal question.

In the aftermath of this decision, the Governor has proposed a diversified energy mix based on geothermal, solar, coal gasification, wind, cogeneration and biomass. Various state regulatory agencies, including the Energy Commission, the Public Utilities Commission (PUC), and the Air

Resources Board support elements of these proposals, but there are differences among these agencies as to details and implementation strategies.

Electrical utilities in the state are proposing on the other hand, to double their present supplies from neighboring states such as Nevada, Arizona and New Mexico, primarily from coal or nuclear baseload projects in cooperation with other out-of-state utilities. (Some of these proposed plants are included in the scenario). Most of these proposed projects will require both local and federal approvals, and for California private utilities, approval from the California PUC will also be necessary.

Scenario related energy development in the California coastal zone also poses institutional problems. Upcoming OCS lease sales in central and northern California will result in substantial permanent on-shore development of port and general support facilities. Port and refinery expansions, new power plant proposals, and an LNG terminal facility planned for a rural part of the central California coast. All are partially dependent on compliance with Coastal Commission and local siting and zoning regulations. These regulations preclude development over a large part of the California coast and should affect OCS and LNG development included in the scenario. More detailed analytical efforts are required to assess the full range of impacts local institutions can have on coastal scenario implementation. However the present perception is that considerable constraints will be placed on energy-related development in the central and northern coastal areas.

NEVADA

Nevada has both the lowest population and lowest overall energy consumption of any state in the region; however, it has the highest regional per capita energy consumption, even allowing for the fact that two-thirds of the coal use in Nevada is used for electric power generation destined for California markets. In part, the high per capita consumption is due to the large per capita transportation energy demand. The scenario basically continues these trend.

Air Quality

Key Scenario-Induced Findings

- o The two major urban areas are presently in non-attainment status for particulates, hydrocarbon and carbon monoxide, due primarily to mobile source emissions. The scenario projections for gasoline use will aggravate this situation.
- o Without emissions offsets, additional industrial or utility plant expansions in these areas will be constrained.
- o Sulfur oxides are presently not a serious problem in Nevada, with the closing of a large copper smelter, and are not expected to be a major issue in the future projected by the scenario.

Figure 9-21

Description

Emissions from mobile sources in Nevada have led to non-attainment status for particulates, hydrocarbons (oxidant) and carbon monoxide in the two major urban areas, Las Vegas and Truckee Meadows near Reno. A growth rate of 3.2 percent per year projected by the scenario for gasoline consumption is likely to aggravate the current problem, and calculations indicate that the average current emissions (in gms/mile) exceed federal standards by about an order of magnitude.

Particulates:

Four of the six fuel burning counties studied here (Clark, Lander, Lyon, and Nye Counties) were non-attainment for particulates in 1975. It appears likely they will remain so until at least 1987 (the Congressional deadline for attainment for mobile source emissions nationwide) and more probably into the early 1990's if the present growth rate of cars remains the same. Process sources currently contribute to 50 to 70 percent of total emissions in each of these counties but this proportion will shift drastically toward mobile sources. Future industrial development in both Washoe and Clark counties is likely to be significantly constrained due to the requirements of offsets. Officials from the Tahoe region and Las Vegas have indicated they will try to slow this growth in mobile sources impacts using traffic control strategies outlined in the Clean Air Act.

Sulfur Dioxide:

The closing of the copper smelter in White Pine County in 1976 ensures that all the counties in Nevada will remain in attainment status for the 1980's assuming that no major new process sources come on line. Overall emission levels decrease slightly in most counties as BACT is implemented for industries.

Hydrocarbons:

Reductions in the formation of smog for the non-attainment areas in Nevada (Las Vegas and Truckee Meadows) is contingent upon the enforcement of existing and proposed emission standards for motor vehicles. Current lax enforcement policies are likely to be strengthened by the requirements which began July 1, 1977. If the standards are met, there will be a 50 percent reduction in overall HC emission for Clark County and similar decreases in other urban areas. All other counties in Nevada are assumed to be in compliance with federal oxidant standards although there are no air quality monitoring stations in many of these counties.

Nitrogen Oxides:

All counties are assumed to be in attainment status in 1975, although only one county monitored NOx ambient concentration. Despite a 50 percent increase in NOx emissions in Clark County, the area should remain in attainment status although the increased emissions will definitely aggregate the oxidant formation problem alluded to earlier. In sum, no counties are expected to violate the NAAQS if standards for new motor vehicles and the new inspection program are indeed implemented.

Carbon Monoxide:

The analysis indicates substantial decreases in carbon monoxide emissions for Clark and Washoe counties but it is difficult to project future impairment in air quality due to anomalies in the data base. If federal standards can reduce the existing emission levels approximately five fold for automobiles, then the carbon monoxide problems in these counties should be substantially reduced by 1990. Given the high emission levels, the crucial component of the strategy to bring these areas into attainment status will be the strict enforcement of the standards that used cars are required to meet in annual inspections. Until the carbon monoxide problem is mitigated, full emission offset requirements for stationary sources will constrain future industrial development in these areas.

Water Quality and Availability

Key Scenario-Induced Findings

- o Water quality impacts are expected to be minimal although potential local impacts due to runoff from coal pile and waste disposal sites exist.
- o Present water supplies are already allocated; new consumptive uses will require development of waste water sources.

o The scenario projections of additional electrical capacity are small and water availability does not appear to be a major issue, however, additional generating capacity in Storey County will compete directly with agriculture for scarce surface resources.

Figure 22. Potential water problem areas within Nevada Aggregated Sub-Areas (ASA)

Description

Water Quality:

A total of 296 MW gas-fired generating capacity is forecast for addition to existing facilities in Clark, Lyon and Storey Counties. These facilities are not expected to have significant water quality impacts because combustion of natural gas produces no significant solid or liquid effluents and because surface water resources within the state are scarce and are not likely to be used.

Water quality impacts of the additional coal-fired capacity scheduled for operation in Clark County are likely to be site specific in nature. Coal pile runoff and scrubber sludge treatment and disposal issues can be anticipated.

Water Availability:

Nevada's water resources are highly developed and are heavily utilized. There has always been a precarious balance between water supply and demand. The recent increase in water demand and use in the State has been predominantly caused by an expanding urban sector. The scenario allocates a relatively small increase in electric generation capacity to Nevada and there appear to be opportunities for satisfying the cooling requirements through the use of waste water. Because of recent regulatory efforts ban thermal discharges into surface water resources, there is now a trend to use evaporative cooling towers. Cooling towers will add to water availability problems although two plants currently use sewage effluent as make-up water.

The additional coal unit in Clark County (Reid-Gardner #3) is already on line and uses water from wells and treated Muddy River water. An additional 90 MW gas-stream plant for 1990 would have major difficulties in securing fresh water supplies. However, it appears that treated waste water might be available. In Lyon County, the additional unit could conceivably use agricultural return flows for cooling purposes.

Only in Storey County does it appear that the cooling requirements of the projected plant exceed the current water consumption rates in the county. The projected cooling consumption requirements are as much as 3.5 percent of the amount of water diverted from surface streams in 1969. It is unlikely that Truckee River water could be allocated for this facility, and there are no apparent waste-water resources which could meet the cooling requirements.

Ecology

Key Scenario-Induced Findings

- o SOx emissions increase about 25 percent in Clark County from 1975 to 1990. Alfalfa, a crop highly sensitive to sulfur pollution, has an annual harvest value of about \$20 million in Clark County.

Description

The ecological impacts of the expanded and continuing use of energy in Nevada are primarily related to sulfur oxide effects, acid rain and endangered species. In Clark County the SO₂ levels rise 25 percent over the 1975-1990 time period. Alfalfa, which is SO₂ sensitive, is a major crop in this county.

Potential problems due to acid rain also exist in Nevada, especially as coal use increases. The precise impacts cannot be estimated at present, but depend upon an number of factors such as local land use patterns and meteorological conditions, and better information on the response of plant and animal life to low-level chronic exposure.

Endangered species present certain problems, and Nevada, like California, has additional state legislation to aid in protection of rare and endangered species. While specific determinations of potential conflicts would have to be made on a site-by-site basis, habitat conflicts with species such as the desert tortoise have been identified in certain areas of the state.

Land Use

Key Scenario-Induced Findings

- o Because a large portion of Nevada is owned or controlled by the Federal government, decision making by Federal agencies is an extremely important component of energy policy in the state. For example, transmission line siting for projected new facilities will require approval of federal agencies.

Description

Direct land use impacts due to new energy facilities are minimal; the siting of the prescribed new facilities can avoid conflict with high-value land uses. As noted in other sections of this report, there is potential for indirect land-use impacts, most notably due to solid waste disposal and competing water uses. With regard to the latter, as pointed out in the section Water Quality and Availability, additional power plant siting and the related water requirements in several Nevada counties may compete with other water uses and such siting might require the displacement of productive agricultural land in order to provide the necessary water.

Transmission line routing has been a land use issue in Nevada, with concerns centering on direct impacts upon wilderness or potential wilderness areas, or to associated scenic resources. The new facilities proposed in the scenario appear to be expansions of existing facilities, hence new transmission line impacts might be minimal. Nevertheless, federal approvals for all or part of the transmission line corridors will be necessary.

Solid Waste

Only one new coal-burning electrical generating unit is forecast for the state by the scenario. This unit is an addition to several existing coal units in Clark County. By 1990 these plants will require 230 acres for solid waste disposal. This area may be compared with the total regional area required for disposal of industrially generated solid wastes from coal (39.7 acres) over that same period. However, even the relatively large requirement of 15.3 acres/year for the Clark County plant will represent considerably less than 1 percent of the county land area between 1975 and 1990. As noted for California, the solid waste issues are related more to the location and operation of a disposal area for scrubber sludge, bottom ash, and fly ash, all of which contain toxic materials.

Various proposals have been made for disposal of high-level radioactive waste in Nevada, either at the Nevada Test Site or elsewhere in the state. At least one existing low-level radwaste site has been operated in the state, although this was mostly for materials associated with non-energy related activities. Should the high level waste proposals receive serious consideration, the environmental impacts will require considerable attention.

Local Socioeconomic

The expansion of electrical generating facilities in Nevada is anticipated to have a moderate (less than 10 percent) impact on employment and population in-migration in two counties. Some localized impacts due to construction worker relocation for sites in rural counties can be expected, but the unit sizes of the plants are small.

Institutional and Political

Key Scenario-Induced Findings

- o Most of the new capacity additions proposed for Nevada in the scenario are natural gas fired, however, the use of gas for base-load generation is unlikely to obtain state or federal approval.

Description

Additions to electric generating capacity in Nevada between 1975 and 1990 (109 MW from coal by 1985 and 296 MW from natural gas by 1999) envisioned in the scenario are relatively minor in size. However, implementation of this scenario at the scale and with the fuel sources indicated is very highly constrained by institutional factors. As noted in the Regional Scenario Critique section, the present electric generation facilities under construction or in various stages of the planning or licensing process exceed the scenario capacity additions by a wide margin. All of these proposed additions use coal. The use of natural gas as a fuel-source for the production of baseload electricity (in contrast to peak-load) is extremely improbable. Both major in-state utility companies have indicated they have no plans for new gas-fired base load. Previous contracts for natural gas to supply about 200 MW base-load were voided by actions of the Federal Power Commission (now FERC).

While a variety of factors relative to power plant siting and energy development are similar from state to state (e.g., compliance with federal pollution laws), nearly 87 percent of Nevada is under federal pervue and 80 percent of that land is administered by the Bureau of Land Management (BLM) in the Department of Interior. Thus, unlike many states where energy related land use decisions fall to local or state entities, Nevada's decisions are frequently made by federal agencies. One of the current issues involving the federal government is the location of high-voltage transmission lines, many of which will pass over BLM land. Recently, the BLM required rerouting of an intertie to Idaho based on possible conflicts with wilderness areas.

While new energy facilities will have to comply with existing federal and state regulations, state-level constraints to energy development, per se, appear to be relatively minor. Perhaps the issue of chief concern to the state is the availability of water. Since Nevada has serious water availability problems, concern has been expressed about state attitudes toward water use for electric generating facilities in the future. For example, one utility has noted that state laws limit the interbasin transfer of water and also restrict the transfer of the beneficial use of water outside of the state. It is thus conceivable that such laws could hinder future power plant expansion for export of electrical energy to other states.

HAWAII

While state level data on energy production and use are available, no major facilities were assigned to this state in the lead lab analyses. The power plant list for Hawaii does not accurately reflect the 1975 base year.

Information on existing proposed industrial and utility facilities has been accumulated, and a limited issues assessment is presented here.

Hawaii is unique among the states in Region 9, indeed, among the other 49 states. Hawaii is almost totally dependent upon oil, which make up 92 percent of the total primary energy supply in 1975. The remaining 8 percent was from two other sources, hydroelectric generation - one percent, and bagasse-fired electrical generation - 7 percent. The Mid-Mid scenario projections alter this picture slightly, with a small amount of coal use by 1990 (less than one percent), natural gas (13 percent), and the remainder as imported crude oil or petroleum products.

The projected use of natural gas is somewhat misleading, since no sources of natural gas exist on the islands, and existing gas supplies (3 trillion BTU, or 1.5 percent) are refinery by-product gas. Hence increases in gas supply might simply lead to a greater oil requirement to produce synthetic gas. Other possible supply sources, discussed in more detail below, might be LNG imports, or production of methane from bagasse or other biomass wastes.

The scenario projects no additional electrical generating capacity over the 1975 to 1990 time period. However, disaggregation of the scenario projections to the BEA level indicates that electricity consumption declines slightly from the actual 1975 baseline. Given growth in overall energy consumption, and that utilities plan to add another 680 MW in capacity to a system with 1600 MW at present, the scenario projection appears to be inadequate.

With regard to energy end-use, the scenario projections show little change in the kinds of activities using energy. The largest energy consuming sector at present is jet-fuel for commercial aircraft. For 1990, the projection shows an overall increase in the total amount of fuel use by commercial jet aircraft. Residual fuel oil for electrical energy generation is the second largest consuming sector in 1975 and is projected to be second in 1990. Motor gasoline consumption is projected to increase, remaining third in size among the consuming sectors.

Air Quality

Key Scenario-Induced Findings

- o All of the islands are projected to remain in attainment for the primary pollutants, based on the limited data from the scenario.
- o Violations of the carbon monoxide standards in downtown Honolulu is considered a remote possibility, as gasoline consumption increases.

Description

In 1975 only particulate air quality data was collected from the network of sampling stations on the islands. Thus only measurements from mobile units can be used to infer attainment. Data from the mobile units has confirmed that the islands are in attainment for all the primary criteria pollutants, with the possible exception of particulates. Some readings

above the 75 $\mu\text{g}/\text{m}$ standard have been observed downwind of major construction sites on Oahu and Hawaii.

Localized violations of the particulates standards could occur if construction activity continues to escalate and no effort is made to limit fugitive dust emissions. However, strong tradewinds ensure that violations will only be "temporary and local" in nature.

Increased gasoline consumption, as projected by the scenario, implies increases in either automobile registrations, vehicle miles traveled, or both. This, in turn raises the possibility of increased carbon monoxide emissions. To date, vehicle miles traveled has only increased at a very moderate rate, roughly 1.5 percent per year. Until 1975, the maximum carbon monoxide reading ever recorded was only 6.5 mg/m^3 , roughly half of the current standard, 11 mg/m^3 .

Water Quality and Availability

No water quality or availability issues related to the scenario could be identified.

Ecology

Hawaii has a high concentration of endangered species, with at least 9 or 10 such species on every island in the state. While the sketchiness of the scenario does not permit any further analysis of potential impacts, clearly new industrial or energy activities in Hawaii will have to take into account the potential problem of impacts upon endangered species.

Land Use

No land use issues arising from the scenario were identified.

Local Socioeconomic

No socioeconomic issues related to the scenario were identified.

Institutional and Political

Key Scenario-Induced Findings

- o Hawaii has adopted a state policy of developing indigenous renewable energy resources to particularly replace the dependence upon oil imports. The scenario projections of increased use of oil and petroleum products (including natural gas) conflict with this policy.
- o The projected use of natural gas in the residential sector appears not to recognize that gas distribution systems currently do not exist, and that average space heating requirements are minimal or non-existent in the residential sector.

Description

Following the 1973 Oil Embargo, Hawaii set up several programs to implement policies designated to reduce state dependence upon oil. Hawaii is presently supporting programs for five renewable energy resource programs: solar (direct), biomass, geothermal, OTEC (ocean thermal energy conversion) and wind. The state policy is to move toward energy self-sufficiency, relying upon renewable, indigenous resources.

The scenario projections of greater reliance upon oil appears to directly conflict with these policies. In addition, the projections call for a significant contribution from natural gas by 1990. All present gas is refinery-byproduct, and marketed primarily in the commercial and industrial sectors.

New gas supplies would have to be imported, either as oil (for synthetic gas production) or as LNG, or as methane from bagasse or other biomass wastes. Additional oil imports would not be consistent with Hawaii's policy of reducing dependence upon oil. In addition, such gas is likely to be fairly expensive.

LNG imports are another possibility, although again these imports would be inconsistent with state policy. An LNG import facility would require approvals of a number of state agencies, including the State Department of Planning and Economic Development, which administers the state's Coastal Zone Management Program, as well as state energy programs.

Finally, space heating requirements in Hawaii are quite small, and most residences do not have central heating units. Overall residential use in Hawaii on a per capita basis is only 20 to 25 percent of the regional average. A large residential gas distribution system does not exist, and the establishment of a new system would be economically and institutionally constrained.

ARIZONA

Arizona is the fastest growing state in the region. Population increased by 23.4 percent between 1970 and 1975 and continued growth will place further demands on services, land, water, energy and food. The primary energy resource in Arizona is coal, with reserves ranking 15th among the 50 states in terms of value and tonnage. Development of this threatens the unique Hopi and Navajo cultures and the aesthetic values throughout the state. Energy projects in general are in competition with agriculture for water. The high percentage of federally owned land, water laws complicated by Indian rights, interstate compacts, case law, state legislation, and air quality/visibility regulations to protect parks and wilderness areas will play an important role in development of the state's energy resources. Arizona issues are summarized in Figure 9-23.

Figure 9-23

Local Air Quality

Key Scenario-Induced Findings

- o There are currently air quality problems from SO_x and TSP. The metropolitan areas are presently non-attainment for these pollutants and based on the scenario, no significant change is expected.
- o Control of SO_x from smelters, the major source of these emissions, may not occur before 1990.

Description

There are serious air quality problems in the six (out of fourteen) Arizona counties for which 1975 data are available. Ambient pollutant concentration levels for SO_x and Total Suspended Particulates (TSP) exceed state and National Ambient Air Quality Standards (NAAQS) in metropolitan areas; the worst violations of NAAQS are due to large SO_x emissions from seven copper smelters. It is not expected that these emissions will be controlled to meet air quality standards by 1990 because proposed state regulations to control smelter emissions have not been approved by the EPA, and Section 119 of the Clean Air Act provides a means of postponing

installation of the necessary control technology. The TSP violations in Mohave and Yuma counties are attributed to wind blown dust.

Water Quality and Availability

Key Scenario-Induced Findings

- o Coal mining activity in other Colorado basin states will adversely affect Arizona water supply.
- o Most of Arizona surface water is already appropriated. New energy activities will either compete with present fresh water users (e.g., agriculture) or will rely on waste water sources for cooling water supplies.

Description

Water Quality:

Arizona surface water quality is generally at or near levels associated with natural conditions and the state has primarily been concerned about maintenance rather than restoration. Non-point sources of pollution, such as agricultural or solid waste discharge, are considered by the state to have far more significant impacts on surface water quality than is point-source pollution such as might be connected with energy development.

New electric power generation appears to pose a minor threat to the quality of Arizona's waters. In no Aggregated Sub-Area (ASA) did projected utility siting specifically deteriorate surface water quality. In 1976 the EPA approved salinity standards designed to protect the Colorado River system as Upper and Lower Basin states develop their compact waters. These were implemented by limiting industrial and municipal effluent discharges under the National Pollution Discharge Elimination System (NPDES) permit program, resulting in essentially a policy of zero discharge. Those power plants which rely upon surface water will probably purchase most of their supply from agriculture, since virtually all of Arizona's surface waters are fully appropriate. In one respect this should act to enhance water quality by eliminating the salt loadings of water which would have occurred had the water been used by agriculture.

A potentially positive impact on both surface and ground water quality is possible if wastewater is used as a source of cooling water supply. As noted below, the Phoenix municipal sewage plant has contracted to sell 140,000 acre-ft/yr of water to Arizona Public Service Co. and the Salt River Project.

Arizona, as a Lower Basin state, inherits its most severe energy-related water quality problems. These problems are toxic substances in the form of iron (Fe), and manganese (Mn), which at sufficient levels are toxicants to fish and other instream aquatic life. The pollutants are projected by the scenario to occur at levels in violation of standards as a result of coal mine activity upstream. The northern and western counties of Coconino, Mohave, and Yuma encompass the flow of the Colorado River mainstream; however, no coal mining is projected for this area. Under the model used for RIIA, pollutants from the upper Basin are passed downstream to

concentrate to levels exceeding standards in areas of low flows. Since the model assumes the worst possible case, i.e., the lowest yearly flow of the 20-year flow record, it is possible that the impact of these pollutants on northern Arizona will be less than indicated.

Water Availability:

Steam electric power generation accounts for most of the projected water use. The Palo Verde Nuclear Station, which may eventually include five 1300 MW units, will use wastewater from sewage treatment plants in Phoenix. While additional groundwater use for energy production would appear to exacerbate such problems as falling water tables and subsidence, in fact, industry can afford to pump water from deep aquifers for which there is limited competition from existing users. Several coal-fired plants in eastern Arizona will tap groundwater from formations as deep as 1400 feet below the surface. While drawdown may have negative effects, especially reduction in aquifer yield, these impacts are considered to be relatively insignificant considering the paucity of competing users. The quantity required for energy plants represents about a 2% overall increase in total basin pumping, thus only slightly hastening the time when groundwater pumping for irrigation becomes uneconomical.

Ecology

Key Scenario-Induced Findings

- o Reclamation of strip-mined land is difficult due to Arizona's arid climate, and 65 percent of the present strip-mined land remains unreclaimed. The scenario projects increased strip-mining of existing coal fields.

Description

Land reclamation in arid Arizona is an economic and legislative problem. Of the 190,000 acres disturbed by mining as of 1977, 121,000 acres are still unreclaimed, and little has been done to revegetate disturbed areas. These regions of Arizona are in some cases critical habitat for many rare, endangered or threatened species of plants and animals. Many species are unique and once removed from Arizona, they will have been removed from the U.S. The southern portion of the state contains especially fragile ecological systems. These areas, and certain highly valued agricultural lands, may block facility siting.

SO₂ concentrations may pose a threat to critical habitat as well as to economically important crops such as cotton, wheat, orchards, vegetables and melons. Much of the usable land and water is essential to agricultural production. Conflicts can be anticipated as the agricultural industry in Arizona is threatened by unabated SO₂ concentrations and increases in population pressures.

Land Use

Key Scenario-Induced Findings

- o Arizona's rapid population expansion has had serious land use impacts, and should the trends continue, these growth induced impacts will dominate direct energy-development impacts.

Description

Less than 18% of Arizona is privately owned, with 44% of the state land area under federal ownership and 13% of the state as Navajo lands. As a result, population is clustered with 75% of all residences in Maricopa and Pima counties. Total in-migration between 1970 and 1975 was 19%, and the anticipated land use impacts due to population growth will be significant.

Energy development and agriculture compete for fresh water. Groundwater mining in Cochise County, for example, has caused a 25% decline in irrigated land, and may eliminate irrigated agriculture altogether when water tables drop below 500 feet from the surface. Thus the direct impact due to energy development appears to be smaller than those indirect impacts due to population growth and competition for available water.

Solid Waste

Arizona has no critical counties according to the scenario and only Navajo County is seriously involved in the DOE Coal Conservation Program. Navajo County totals 6.34 million acres of which 4.14 million acres are Indian reservations and 0.6 million acres are Federal lands. The projected population will require nearly 1000 acres per year of the remaining 1.6 million acres of solid waste disposal. The acreage requirement for solid waste disposal in this country is not as serious as it might be elsewhere provided that care is taken to minimize wind erosion and that water quality impacts are rigidly controlled.

Local Socioeconomic

Key Scenario-Induced Findings

- o A significant portion of the state is Indian lands, and future energy development in these areas is uncertain due to conflicts with tribal cultures and environmental impacts.

Description

None of the five Arizona counties analyzed in this study will experience population increases of 10% or more in any year. Although eight new electric generating plants and several mines are planned for development between 1978 and 1990, the large available labor force will result in minimum numbers of skilled labor migrating into the counties. While there remains the potential for shortage of skilled personnel and conflicts with tribal culture where Indian reservations are involved, no quantifiable data

has been provided in the scenario. However recent research tends to confirm that three factors will influence development on Indian reservations: 1) the tribal desire for self determination in the regulatory process; 2) tribal insistence on manpower training and Indian employment preference; 3) tribal culture that grants a lifetime assignment of a homesite to its members. The last point explains the reluctance of potential employees from relocating to centralized communities. In the absence of centralization, Indian boom towns are not generally expected to occur unless long-term labor-intensive coal-conversion facilities are developed.

The extremely large size of Arizona counties would tend to overestimate the size of the available labor force. Thus the remote location of many of the facilities projected in the scenario may in fact result in more significant impacts due to labor in-migration, which could limit energy development.

Institutional and Political

Key Scenario-Induced Findings

- o Hydroelectric expansion will be limited due to economics and environmental impacts, hence the scenario projections for additional capacity appear feasible.
- o Utility skepticism and few major federally funded demonstration programs make the projected level of solar-electric generation difficult to attain.

Description

Environmental regulations are expected to increase both capital and operating costs for power plants. The combination of federal sulfur removal requirements and the Navajo coal taxes, along with the Toxic Substance's Control Act and the Resource Conservation and Recovery Act, may significantly impact future coal steam development. Designation of non-attainment areas for future dust and PSD requirements would further restrict site availability already limited by water availability. Resource use, specifically, land for transmission corridors, can significantly impact choice of sites for electric power. The utilities are already avoiding use of Navajo lands for plant sites or for transmission corridors and are also encountering difficulty in obtaining rights-of-way across federal lands.

The conversions from oil to gas shown in the scenario appear to be feasible. The current surplus of gas should allow continued use of natural gas in both turbine and steam generation, and an Arizona moratorium on natural gas hookups has also been lifted. However, new gas steam capacity (335 MW projections for 1990) is considered unlikely because of the risk of curtailed supplies. No firm plans for hydroelectric generation exist because of environmental and economic constraints; hence none of the forecasted hydroelectric increase is expected to occur by 1985, and possibly by 1990. Designation of wilderness areas, according to several spokesmen for the utilities, has limited the number of sites available for hydroelectric development. A slowdown in electrical demand and

inadequate capital commitments have postponed the Montezuma pump storage plant.

There are virtually no institutional issues associated with the present development of Palo Verde, the 3 unit nuclear plant now under construction. In fact, the rate of progress will probably allow two units (2540 MW) to begin operation before 1985, instead of just one. (Participation of California utilities in this plant will, however, require approval of the California Public Utilities Commission.)

On the other hand economic risk may limit future expansion of nuclear power growth. Utility spokesmen foresee a possibility that the growing nationwide anti-nuclear power trend may have negative impact on the currently favorable attitudes toward nuclear development in the state.

According to the utilities, there are several deterrents to the use of solar energy for electrical power generation. Among them is the small size and number of federally-funded solar pilot plants, which will not expedite solar central power development. Second, the uncertainty associated with solar power plants make capital accumulation extremely difficult and given its relatively high capacity costs, several spokesmen for industry felt that solar electric would not expand by 1990. Finally, lead times associated with constructing a solar power plant would make it difficult, if not impossible, for solar to contribute even as little as 100 MW to Arizona's power capacity unit after 1990.

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FEDERAL REGION 10
PACIFIC NORTHWEST LABORATORY

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Project Managers	D. L. Hessel G. L. Wilfert
Siting Analysis	M. A. Beckwith P. J. Mellinger J. S. Lawson (BCL) R. W. Cobb (BCL)
Water Availability/ Water Quality	S. M. Brown G. R. Keizur
Air Quality/Visibility	W. F. Sandusky
Health and Safety	A. R. Olsen M. A. Beckwith
Solid Waste	D. C. Christensen
Ecology/Land Use	M. L. Warner
Socioeconomic	C. Cluett (HARC) M. R. Greene (HARC)
Institutional	F. A. Morris (HARC) C. W. Sawyer (HARC)
Regional Issues	G. R. Keizur M. A. Beckwith C. E. Cowan

FEDERAL REGION 10

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REGIONAL OVERVIEW - REGION 10

Region 10 is a large, non-contiguous area covering more than one-quarter of the total area of the United States and includes the states of Alaska, Idaho, Oregon, and Washington. Alaska is far larger than the other three states combined, comprising about 80% of the Region's 835,000 square miles. Figure 10-1 shows environmentally similar subregions of the states of Federal Region 10.

Physical and Social Characteristics

The climate of Region 10 is primarily influenced by the southerly and easterly drift of storms that develop over the North Pacific Ocean. Considerable moisture is gathered in cloud masses over the North Pacific and Gulf of Alaska. Much of this moisture is deposited west of the Cascade Range in Oregon and Washington, and along the coast of south-central and southeastern Alaska. Airflows over the Region are generally in a west-to-east direction. They are complex and vary seasonally. Combined with local topography, they influence local moisture gradients to cause a diverse range of microclimates, which in turn influence vegetation and wildlife distributions. In general, the climate west of the Cascade Range in Oregon and Washington is characterized by mild, wet winters and moderate summers, while east of the Cascades and in Idaho semi-arid conditions prevail with extreme seasonal and daily temperature variations. Alaska follows the same general pattern of wet moderate climates on the southeastern, south-central and southwestern coasts. The inland subregions are characterized by greater climatic extremes.

Alaska is a vast area possessing tremendous natural and energy resources, much of it largely unexplored. The Arctic region of the state consists mainly of treeless tundra underlain with permafrost and contains three major offshore and three major onshore oil fields. Development of these fields is the primary cause of Alaska's rapid population and economic growth. The state's extensive coastal and inland waters support rich commercial and sport fisheries, particularly in the southwest and south-central regions of the state and along the Aleutian Island chain. The mountainous southeast region consists of extensive island systems, bays, and fiords, and is heavily forested. Alaska's population (365,000 in 1975) is concentrated in the central and south-central regions, in and around the commercial and metropolitan centers of Fairbanks, Anchorage, and Valdez, however, much of Alaska's large Native population lives by subsistence hunting and fishing in remote villages. A major issue in the state and in the Region is the impact that exploitation of the state's vast natural resources will have on its largely unspoiled natural environment and on the social environment of the people.

The lower states of Idaho, Oregon, and Washington contain over 95% of the population of Region 10 (just under 7 million in 1975), and most of the industry and agriculture. The Coastal and Cascade Mountains of Oregon and Washington are heavily forested and supply a major share of the nation's demand for forest products as well as offer outstanding recreational opportunities. Inland, the Columbia and Snake River Plateaus of Oregon, Washington and Southern Idaho contain much rangeland, and support a strong forest products industry, although inland forests are not as

Figure 10-1. Region 10: Environmentally similar Subregions, Major Rivers and Population Centers

productive as those nearer the Pacific Ocean. The bulk of the population of Region 10 live and work in the population centers of the Puget Sound-Willamette Lowlands (Seattle and Tacoma, Washington and Portland and Eugene, Oregon). Most of Idaho's population, industry, and agriculture is concentrated along the Snake River in the Southeast corner of the state and around the state capital of Boise.

Three states in Region 10 grew at an annual rate well above the national average between 1970 and 1976. Alaska grew the fastest at a rate of 3.9%, Idaho followed at 2.5%, and Oregon grew 1.9% annually. Washington grew at the national rate of 0.9% annually. Population density in the Region approaches the national average of 60.7 persons per square mile in Washington where the value is 54.3. Oregon has 24.2 persons per square mile, Idaho 10.1, and Alaska ranks as the least densely populated state in the country with only 0.7 persons per square mile.

The average annual per capita income exceeds the national average in Alaska and Washington: the Alaskan average was \$10,178 in 1976 or 158% of the national average and \$6,772 or 105.1% was the Washington average. Oregon's per capita income was \$6,331 (98.3% of the average) in 1976 while Idaho residents earned \$5,726 per capita, or 88.9% of the average. The economy of the Region is heavily dependent on natural resource-based industries such as forest products, mining, agriculture, fishing, and fossil fuel extraction (in Alaska). The aluminum, aerospace, tourism, trade, and shipping industries are also important components of the Region's economy.

Energy

The Region is in a critical stage of energy assessment involving interrelated socio-economic and environmental impacts caused by reallocation of hydropower, increasing imports of energy sources, and major new energy developments. The disparity of energy resources among states in the Region further complicates decision-making. Physical distance between Alaska and the lower states in the Northwest has hindered energy transfers. Each area has specific environmental, social, and economic factors that must be considered separately in energy planning. Major shifts in the Region's energy use pattern are expected as the base load generation of electricity changes from hydroelectric to thermal.

Electric power has been an inexpensive source of energy in the states of Idaho, Oregon, and Washington, with hydroelectric generation supplying most electrical needs. However, forecasted load growth and the limited number of potential new hydroelectric sites will result in a heavier reliance upon thermal generation in the future. The transition from hydroelectric to thermal power generation will cause significant changes in the Northwest. The future path of electric power supply will be largely determined by demand, basic energy prices, governmental policy, public acceptance, and the environmental consequences of thermal power generation.

Reserves

Federal Region 10 contains extensive reserves of oil, natural gas, and coal. A comparison of regional and national energy reserves is given in Figure 10-2. The location of the Region's coal, oil, natural gas, and uranium fields are shown in Figure 10-3. Alaska contains all major regional reserves of oil and natural gas and most of the coal. Washington contains some coal and most of the Region's known uranium reserves. Alaska is thought to contain significant uranium resources, but exploration has not been extensive to date. All four states have one important energy resource, hydropower. Alaska has the largest share of untapped hydroelectric potential. Idaho, Oregon, and Washington have developed most of the sites having substantial hydroelectric potential (PNL 1977).

Data Source: PNL 1977

Figure 10-2. U.S. and Regional Energy Reserves in Quadrillion Btu

The Region also contains less-conventional energy sources: geothermal, wind, solar, and biomass. These sources have a large energy potential; however, to date they have not been significantly utilized.

Geothermal energy is available in each of the states. It is being used for heating in Klamath Falls, Oregon and Boise, Idaho. In addition, there is a pilot electric generation project in Idaho. Wind power has a high potential for all of the Northwest. Areas with a lower solar radiation incidence along the coastline have the highest potential for wind power generation. Solar energy potential also is high in the Region. Commercial and residential buildings are beginning to find this source feasible for passive radiation and hot-water heating.

Data Source: PNL 1977

Figure 10-3. Regional Coal, Oil, Natural Gas and Uranium Fields

The Region's forest products industry harvests large quantities of timber. Residuals from logging and milling operations along with agricultural biomass have potential for energy production.

Production

Production of adequate energy for the consumer has always been a challenge. The Northwest is rich in certain energy forms and scarce in others. Thus, with growing demand the production of energy has had to be supplemented by new sources or imports to the Region.

Natural Gas

Alaska is the only state in the Region to produce natural gas. The primary producing fields are in the Cook Inlet area, although other large gas fields have been found on the North slope. The Alaska Public Service Corporation and the Kenai Utility Service Corporation provide natural gas pipeline services within the state. Natural gas production reached approximately 165 trillion Btu in 1975, with over half of this total exported to Japan. On the other hand, Idaho, Oregon, and Washington import natural gas. Imports come principally from British Columbia and Alberta, Canada; and the American Rocky Mountain and southwest states. The three-state area is served by pipelines operated by the Northwest Pipeline Corporation. The corporation's main pipeline can carry as much as 1.45 billion cubic feet per day (PNL 1977).

Petroleum

The regional trend in petroleum production (all from Alaska) rose to nearly 84 million barrels per year in 1970, then dropped to less than 70 million barrels per year by 1975. With the addition of the Trans-Alaska Oil Pipeline, production in 1978 was about 600 million barrels per year.

Alaska, Oregon, and Washington contain the Region's ten refineries for converting crude oil into finished petroleum products (gasoline, residual and distillate oil, and asphalt). Total current capacity of these facilities is 449,000 barrels per day (PNL 1977).

Coal

Of the 4.7 million tons of coal consumed in Idaho, Oregon, and Washington during 1975, 3.7 million tons were mined near Centralia, Washington for use in a coal-fired power plant. Alaskan fields produced the bulk of the remainder for use primarily in electric generating plants.

Electric Generation

In 1975 the Region had a generating capacity of more than 25,500 MWe. Hydroelectric facilities accounted for more than 81% (20,800 MWe) of that capacity, with the rest available from coal, wood and nuclear-fueled steam plants, gas turbines, and internal combustion generators.

Washington accounts for more than 66% of the Region's total electric production. Oregon produces nearly 25%, while Idaho produces just over

7% and Alaska produces less than 2%. Most of Alaska's electricity comes from fossil fuel-fired plants, while hydropower is the leading source in the other states.

In addition to the generation facilities, there are a number of high-voltage lines used to move electricity within the Region because generating facilities are usually located far from load centers. The Bonneville Power Administration transmits most of the electricity generated in Oregon and Washington, while investor-owned utilities transmit most of Idaho's electricity (Figure 10-4). The Alaska Power Administration, a Federal agency overseeing transmission and wholesale marketing of power from Alaska's Federal dams, has transmission systems serving Anchorage and Juneau (PNL 1977).

Geothermal

At present there are 692,656 acres of known geothermal resource sites in the Northwest region, or 11.4% of the total national figure. Idaho, Oregon, and Washington have some of the nation's most promising low temperature (90, C-150, C) geothermal resources (see Figure 10-5). Alaska has both low and high temperature sites; however, development of any of the Alaska sites is not expected until after 1980.

Imports and Exports

With the exception of electricity, Idaho, Oregon, and Washington depend heavily upon imported energy sources. In 1975, for example, net imports accounted for two-thirds of the energy consumed in the Region. Petroleum, natural gas, and coal are imported.

Natural Gas

Alaska, again, is the only state in this Region capable of meeting its own natural gas requirements. Alaska exported about 90 million cubic feet (MMCF) of liquefied natural gas from its Kenai gas fields to Japan in 1978. Alaska's natural gas exports are continuing and will be expanded with construction of a natural gas pipeline connecting the Prudhoe Bay gas fields to the "lower 48" states.

Idaho, Oregon, and Washington, however, have no natural gas supplies and must import all they use. One interstate natural gas company, Northwest Pipeline Corporation, supplies all of those states' natural gas from fields in Canada and the American Rocky Mountain and Southwestern states (PNL 1977).

Petroleum

Of the four states in this Region, only Alaska produces crude oil; Washington and Oregon refineries must import crude oil supplies, while Idaho must import all finished petroleum products, since it has no refineries.

Washington and Oregon refineries supply many of the Region's finished petroleum products, although a significant portion is imported from foreign sources and by pipeline from refining centers in Montana and Utah.

Data Source: PNL 1977

Figure 10-4. Major Transmission Lines

Data Source: PNL 1977

Figure 10-5. Geothermal Resources for Region 10

Coal

Alaska and Washington are the coal-producing states in the Region; some of the Region's coal demand in 1975 was met by Utah (641,000 tons), Wyoming (370,000 tons), and the Southwest (5,000 tons).

Institutions

Various levels of government (federal, state and local) are involved in shaping energy policy. (The county names and state capitals for Region 10 are shown in Figure 10-6). Governmental agencies are involved in mining, transport and ultimate use of energy resources. Their direct participation in resource use decisions may result from: 1) outright ownership of the mineral resources or rights-of-way, 2) economic, environmental, health or safety considerations, or 3) directly related energy projects and programs.

Until recently, states in the Region have not been active in shaping energy policy. In general, planning and implementation of energy facilities and distribution systems were initiated and carried out by the private sector or by Federal agencies. The states' primary role in energy planning was limited to the regulatory power held by the various state public utility commissions. The commissioners represented the states' position on utility rates and other aspects of private utility operation; they did not have a significant role in energy planning or implementation.

In recent years the Region has been faced with several energy crises that have moved state governments toward more active roles in energy planning. The oil embargo by the OPEC nations in the fall and winter of 1973 was preceded in late 1972 through the fall of 1973 by below-average waterflow in Northwest rivers and streams which resulted in a shortage of water for hydroelectric power generation.

As a result of these energy crises, the state legislatures created state energy offices to assist the governors on energy matters and on setting up state conservation programs. However, these state energy offices are likely to differ widely in the scope and degree of their planning activities.

Besides the state energy offices and public utility commissions, state agencies have jurisdiction regarding economic development, program planning, ecology, and other areas that vary in scope, title, and authority from state to state. With this authority the states have substantial capability to influence energy planning. For example, effluent limitations can have an important impact on project locations, design, and cost (PNL 1977). A listing of the state agencies responsible for each state's conservation program, siting of energy facilities, and utility regulation is provided in Table 10-1.

THE REGIONAL SCENARIO

The national scenario was disaggregated to the county and regional level. Fuel use by industrial and electric utility facilities was allocated on a county-by-county basis. Other end-use consumption was disaggregated to the Bureau of Economic Analysis (BEA) regional level. County level power plant siting patterns are based on Federal Energy Regulatory Commission

Figure 10-6. Region 10 Counties and Election Districts by Names

Figure 10-6, continued

Table 10-1. State Agencies Responsible for Energy Conservation, Facility Siting and Utility Regulation Programs^(a)

<u>State</u>	<u>Conservation</u>	<u>Energy Facility Siting</u>	<u>Public Utility Regulation</u>
Alaska	Alaska Division of Energy and Power Development	Alaska Coastal Zone Man- agement Council Alaska Department of Natural Resources Alaska Power Authority Alaska Department of Fish and Game	Alaska Public Utilities Commission
Idaho	Idaho State Office of Energy	Idaho Public Utilities Commission	Idaho Public Utilities Commission
Oregon	Oregon Department of Energy	Oregon Department of Energy	Oregon Public Utility Commissioner
Washington	Washington State Energy Office	Washington Energy Facil- ity Site Evaluation Council	Washington Utilities and Transportation Commission

^(a) Data Source: Pacific Northwest Laboratory (1978a).

(FERC) files of existing and announced utility plans for new generation facilities. However, the FERC sites do not include siting information for unconventional energy sources. Unconventional energy facilities are sited on the basis of resource availability.

Region 10 Energy Supply and Consumption

According to the scenario, Federal Region 10 crude oil and natural gas production will increase dramatically from 569 trillion Btu in 1975 to 5185 trillion Btu in 1985 and 6429 trillion in 1990. The electric utility generation mix for Idaho, Oregon, and Washington during the 15-year period shifts from a hydroelectric generation base to a mixture of hydroelectric and thermal generation. Generation capacity is added in nuclear, geothermal, and coal technologies. The contribution that each technology currently makes to the Region's generating capacity, and the contribution from each technology called for by the scenario in 1990 is presented in Figure 10-7. As given here, the capacity of a generating facility represents its maximum instantaneous power output.

Figure 10-7. Regional Electric Generating Capacity by Technology

The facilities that comprise Region 10's 1990 scenario are identified by technology and by location in Figure 10-8. Hydroelectric generating facilities are located throughout Idaho, Oregon, and Washington. Geothermal facilities are sited in the central portion of Oregon and Washington, and in southeastern Idaho. Nuclear facilities are located along the Columbia River and in western Washington.

Region-wide, electric generation by nuclear, geothermal, and coal plants increases from 16 million megawatt hours (MWh) in 1975 to 56.6 million MWh in 1990. Hydroelectric power continues to play a dominant role in the region's electric generation, increasing from 140 million MWh in 1975 to 185 million MWh in 1990. The scenario specified energy consumption for Federal Region 10 is summarized by end use and fuel source in Table 10-2.

Location of Energy Facilities
Specified in the Scenario

Figure 10-8, continued

Table 10-2. TRENDLONG MID-MID Scenario Energy Consumption,
Federal Region 10 (trillion Btu per year)

<u>Sector/Fuel</u>	<u>1975</u>	<u>1985</u>	<u>1990</u>
Residential	287	426	451
Commercial	292	333	345
Industrial	546	791	878
Transportation	725	832	910
Total	1850	2382	2584
Electricity ^(a)	360	627	750
Oil	1034	1418	1689
Natural Gas	427	253	30
Coal	29	84	115
Total	1850	2382	2584

(a) Does not include utility fuel consumption.

The Scenario Critique

The TRENDLONG MID-MID Scenario (the midpoint in a hypothetical set of total energy supply demand levels) is only one of a series of energy scenarios used for policy analysis at the National level. Although production, supply, and demand values specified by the scenario may be appropriate at the national level, the disaggregated Region 10 scenario contains some values which are inconsistent with current Regional plans.

Table 10-3 provides an estimate of the current level of electric generation capacity within Region 10 by technology and by state, and provides scenario-specified capacities for 1985 and 1990. On a regional basis, two major discrepancies appear. First, although Region 10 currently has no plans for developing geothermal power as a significant source of electricity by 1990, the scenario specifies a total of 1000 MWe (Table 10-3). Even on the assumption that suitable geothermal resources were tapped within the year and that appropriate technology was available, institutional factors and construction time will prevent scenario goals from being reached by 1990. In both Oregon and Washington, the procedures for obtaining permits and leases necessary for development of large-scale geothermal generating facilities have yet to be fully developed. Second, the scenario specifies that the natural gas supply to Idaho, Oregon, and Washington from the eastern Rocky Mountain area will be reduced by about 93% by 1985, and that the Region's gas supply from Canada be cut off by 1990. Over the 15-year period covered by the scenario, regional natural gas supplies would be reduced by 99%. In contrast to this, the Northwest Energy policy Project (NEPP 1978) suggests that natural gas consumption will remain relatively constant through 1990 in these three states.

Table 10-3. Current Capacity and TRENDLONG MID-MID Scenario for Electric Power Generation in Region 10 (capacity in megawatts)

State	Year	Gas Peaking	Oil Peaking	Nuclear	Combined Cycle	Coal Steam	Gas Steam	Oil Steam	Hydro	Geothermal	Total
<u>Alaska^(a)</u>											
Current capacity	1978	510	416		0	54	14	0	131		1,125
Scenario	1985	0	392		0	150	0	15	0		557
	1990	0	392		0	150	0	15	0		557
<u>Idaho</u>											
Current capacity	1978	50	5						1,631	0	1,686
Scenario	1985	50	0						2,132	0	2,232
	1990	0	50						2,132	200	2,432
<u>Oregon</u>											
Current capacity	1978		392	1,216	585	0	36	85	7,445	0	9,759
Scenario	1985		718	1,130	100	500	15	175	8,654	0	11,292
	1990		718	2,390	100	500	15	175	8,809	400	13,102
<u>Washington</u>											
Current capacity	1978		130	800	0	1,330		208	13,791	0	16,559
Scenario	1985		263	5,702	510	1,200		0	19,335	0	27,330
	1990		261	6,942	510	1,200		0	19,655	400	29,268
<u>Total Region</u>											
Current capacity	1978	626	730	2,016	585	1,384	50	293	22,990	0	29,129
Scenario	1985	50	1,373	6,832	610	1,850	15	190	30,191	0	41,411
	1990	0	1,421		610	1,859	15	190	30,941	1,000	46,359

(a) Presented here for reference only

At the state level, the scenario for Alaska is especially inconsistent with current plans. The scenario specifies 557 MWe of electrical generating capacity in the state by 1990. However, this is only 50% of the generating capacity currently in operation (Table 10-3). More specifically, the scenario calls for all current gas-fired and hydroelectric generation capacity to be phased out by 1990. These technologies currently provide 45% and 12%, respectively, of all the electric generating capacity in Alaska.

The principal inconsistency between the energy system currently planned in Idaho and the scenario is the amount of geothermal generation that will be operational in 1990. If the Raft River geothermal area in southeast Idaho proves to have its currently estimated potential, and if appropriate technology can be developed, the Raft River site could contribute up to 50 MWe to the state's electric generating capacity by 1990. The Raft River site, however, is the only geothermal site being developed in Idaho for electric generation. Thus, development of geothermal resources in Idaho will not proceed at the pace called for by the scenario.

Although Oregon and Washington have geothermal resources at a number of sites (Figure 10-5), none have been investigated for their electric generating potential to the same extent as the Raft River fields. An additional constraint in the development of geothermal resources for electric generation, in contrast to Idaho, is the lack of established procedures to obtain leases and permits. Considering that geothermal resources have not been thoroughly investigated, and that site approvals and permits are needed, large scale additions of geothermal capacity will not be available to either state by 1990. This is at variance with the scenario which specifies 400 MWe of geothermal capacity for each state.

Because of the variances described above, the Trendlong Mid-Mid scenario will not be realized by Region 10.

REGIONAL ASSESSMENT

NATIONAL ISSUES WITH REGIONAL IMPACT

A number of issues cannot be limited to state or even regional boundaries. They are effectively the product of national or multi-regional developments. Issues included in this category are long-range transport of pollutants, national socio-economic impacts, inland and coastal water resources, opposition to nuclear power, and Federal environmental legislative constraints on energy development.

Long Range Transport/Visibility

Region 10 is not downwind of any major industrial areas outside of the Region; therefore, it is not a recipient of pollutants resulting from long range transport. In general, air pollutants in the Region are confined to the western valleys and air basins in which they originate. Therefore, the Region is not presently a significant emitter of pollutants that are transported eastward into other regions.

Region 10 contains a large number of federally mandated Class I areas (see Figure 10-9). The intent in classifying these areas as Class I is to preserve their pristine state. Class I areas include all national parks greater than 6000 acres and all wilderness areas over 5000 acres. Indian lands may also be classified as Class I areas under certain provisions of the Clean Air Act. New industrial sources sites in non-attainment areas must obtain offsetting reductions in emissions from existing sources. Because only low concentrations of air pollutants can be tolerated in Class I areas, long range transport of pollutants from sources outside and inside the Region were evaluated. The long range transport of pollutants can affect industrial siting in those areas where long range transport of pollutants may impact Class I areas.

Another effect of long range transport of air pollutants is the impact on visibility. Although EPA regulations will not be promulgated until August 1979, a safe assumption is that any significant decrease in visibility will not be permitted in Class I areas. In Region 10, a visibility decrease of up to 13% is projected for Class I areas in the Cascade Mountains of Washington and Northern Oregon by 1990. Because Region 10 is not a recipient of pollutants, the decrease in visibility results from industrial activities in the Puget Sound-Willamette Lowlands. As increasing sectors of the forest products industry come under compliance with air quality standards, other Class I areas in southern and eastern Oregon and in Idaho will experience increased visibility.

National Socioeconomic Effects

Implementation of the Trendlong Mid-Mid scenario will require massive amounts of capital and commitment of a large labor force of skilled construction and operating personnel. The massive capital required to implement this scenario will be in direct competition with other national demands for the financial resources of the nation. The same is true for the skilled construction and operating personnel required to implement the national scenario. At the regional level, capital and manpower requirements may be constrained because of other national needs and because of competition from energy development programs in other regions. The discussion which follows identifies the requirements of capital and labor force associated with the implementation of the Region 10 scenario. The discussion is separated into direct and indirect capital and manpower requirements.

Direct Capital and Manpower Requirements

The direct regional capital and manpower requirements of the Trendlong Mid-Mid scenario are shown in Table 10-4. These impacts are based on estimates of capital and manpower requirements for the construction and operation of energy facilities in the states of Alaska, Idaho, Oregon, and Washington. Estimates are presented for 1975 and as annual averages for the time periods 1976-80, 1981-85, and 1986-90. Annual investment in energy facilities will average about \$2.4 billion over the 1976-80 period or about 26% less than the estimated 1975 level.

Figure 10-9. Location of Mandatory Class I Areas

Table 10-4. Direct Capital and Manpower Requirements of the
the TRENDLONG MID-MID Scenario for Region 10

	<u>Baseline</u>	<u>Annual Averages</u>		
	<u>1975</u>	<u>1976-80</u>	<u>1981-85</u>	<u>1986-90</u>
Capital Costs of Regional Energy Facilities				
(millions of 1977\$)	3,219	2,369	3,935	2,588
(% Change from Previous Period)		-26.4	66.1	-18.4
Operating Costs of Regional Energy Facilities				
(millions of 1977\$)	523	589	734	927
(% Change from Previous Period)		12.6	24.6	26.3
Manpower Requirements for Constructing Energy Facilities				
(Man-Years)	17,407	13,925	21,353	15,763
(% Change from Previous Period)		-20.0	53.3	-26.2
Manpower Requirements for Operating Energy Facilities				
(Man-Years)	9,394	10,707	13,688	17,789
(% Change from Previous Period)		14.4	27.8	30.0
Total Manpower Requirements for Energy Facilities (Man-Years)	26,801	24,632	35,041	33,552
(% Change from Previous Period)		-8.1	42.3	-4.2

Average annual investment is expected to increase to about \$3.9 billion during the 1981-85 time period which is a 66% increase over the previous period. From 1986-90, average annual investment in energy facilities is expected to decline about 18.4%, to about \$2.6 billion per year. Major changes in the pattern of capital investments include a \$1 billion decline in annual investment for oil facilities from 1975 through the 1976-80 period because of the completion of the Alaskan oil pipeline. The increase in investments occurring in the period 1981-85 is due largely to the projected construction of facilities to transport natural gas from Alaska. Average annual investment in natural gas facilities is expected to increase from \$0.1 billion during 1976-80 time period to \$1.1 billion during the next five year period followed by a decline to \$0.2 billion during the 1986-90 period. In addition, regional investment in nuclear reactors is expected to increase by an annual average of \$500 million between the 1976-80 and 1981-85 periods. In contrast to the fluctuations exhibited in the level of capital investments, the operating costs of regional energy facilities are expected to climb at a fairly rapid rate over the time frame of this scenario. The annual operating costs of regional energy facilities are expected to average \$589 million from 1976-80 representing a modest increase of 12.6% over 1975 levels. Subsequently, average annual operating costs are expected to climb dramatically, rising from \$734 million per year during the 1981-85 period to \$927 million per year for the 1986-90 period. These figures represent increases of 25% and 26% respectively in average annual operating costs during these periods.

Total manpower requirements for the construction and operation of energy facilities are expected to exhibit temporal patterns that correspond closely to the levels of investment in and operating costs of regional energy facilities. Total energy related average annual manpower requirements are expected to decline by 8.1% from 1975 levels during the period 1976-80. This is due to the expected large decline in construction employment which outweighs the more moderate increases in operating employment during this period. However, both construction and operating employment increase substantially during 1981-85, causing total annual average energy related employment to increase by about 10,000 man-years. From 1986 to 1990, construction employment again declines, substantially offsetting increases in operating employment. This results in a slight decline in average employment of about 1,500 man-years from the previous period.

Construction related employment changes follow the pattern of investment in energy facilities. Construction of the Alaskan natural gas pipeline will result in a dramatic increase in employment during the 1981-85 period. The level of employment in construction of nuclear reactors is expected to increase substantially during the 1981-85 period and increase slowly thereafter. Employment in construction of hydroelectric facilities can be expected to cause local shortages in some skills and result in some labor and related population dislocations within the Region.

Operations employment increases follow the peak in construction investment. Natural gas and nuclear industry employment increases during the period 1986-90.

Indirect Capital and Manpower Requirements

In general, the indirect capital and manpower requirements of energy facility construction, which are shown in Table 10-5, are small compared to the total employment and income of the Region. Compared to 1972 regional employment and income levels the 1986-90 period indirect impacts, which are the largest for all the time periods considered, amount to an increase of less than 2%.

While manpower requirements may seem insignificant at the regional level, impacts may be quite large at the local level. For example, the Alaskan natural gas pipeline and several nuclear power plants will be sited in rural areas and will require a relatively large labor force.

Inland and Coastal Water Resources

The principal inland water resources of the Region, the Columbia and Snake River systems, have long played an important role. The huge runs of salmon and steelhead served as an important source of food and as transportation routes for the Native Americans and early settlers. Currently, the rivers provide hydroelectricity, fish and wildlife habitat, recreational opportunities, transportation routes, and water for irrigation, industrial and municipal uses. All of the desired uses of water cannot be completely and simultaneously met throughout the river system as conflicts have arisen between power production, irrigation and maintenance of flows necessary to maintain anadromous fish runs and water quality. In addition, because nearly one-fourth of the water of the Columbia River originates in Canada, water resources management is of major importance to the Region's as well as the nation's relationship with its northern neighbor.

Alaska, Oregon, and Washington have over 7000 miles of coastline, or about 57% of the U.S. total. The shoreline, tidal marshes, estuaries, and continental shelf are valuable resources. Estuaries and tidal marshes are extremely productive biologically, serving as spawning and nursery grounds for several species of migratory ocean fish and habitat for shellfish as well as wildlife and water birds. These areas also provide food and shelter for migratory waterfowl using the coastal portion of the Pacific Flyway. The Region's estuaries and shoreline are important to the Regional economy yet are fragile and have been much abused in the past. Protection of these valuable areas is of growing concern.

One of the main concerns associated with ocean transport of crude oil in the Northwest is the impact that oil spills might have on the aesthetic, recreational, and fishery resources of the Region's extensive shoreline and coastal waters. This is of particular concern in the relatively closed waters of Puget Sound and the adjacent Straits of Georgia in British Columbia. In 1977, the Canadian crude oil pipeline serving the Puget Sound refineries was shut down. This has increased tanker traffic on Puget Sound. Because of the anticipated reduction in imports of Canadian crude in Midwest refineries, several alternatives have been proposed for the transport of crude oil from Alaska to refineries in the Midwest. A pipeline from Puget Sound to service these refineries has been proposed.

Table 10-5. Indirect Socioeconomic Impacts of the Trendlong
Mid-Mid Scenario for Region 10

	Regional Total	Indirect Impacts Annual Averages		
	1972	1976-80	1981-85	1986-90
Regional Total Gross Output (millions of 1977\$)	96,023.2	1471.1	1727.9	1867.8
% Increase Over Previous Period	-	-	17.5%	8.1%
% of 1972 Baseline	-	1.5%	1.8%	1.9%
Construction Related Gross Output (millions of 1977\$)	19,576.9			
% of 1972 Construction Related Gross Output		7.5%	8.8%	9.5%
Regional Total Value Added (millions of 1977\$)	50,044.9	681.5	802.2	868.8
% Increase Over Previous Period	-	-	17.7%	8.3%
% of 1972 Related Value Added	-	1.4%	1.6%	1.7%
Construction Related Value Added (millions of 1977\$)	7,754.1			
% of 1972 Construction Related Value Added		8.8%	10.3%	11.2%
Regional Total Employment (thousands of man-years)	2,517.1	32.0	37.8	41.0
% Increase Over Previous Period	-	-	18.1%	8.5%
% of 1972 Baseline Total		1.3%	1.5%	1.6%
Construction Related Employment (thousands of man-years)	353.4			
% of 1972 Construction Related Employment		9.1%	10.7%	11.6%

Siting of energy facilities and related impacts in the coastal environment are of interest to residents of Alaska, Oregon, and Washington. Oregon and Washington have approved Coastal Zone Management (CZM) programs developed with Federal assistance through Section 306 grants of the Coastal Zone Management Act (CZMA). Alaska expects program approval in July 1979. The CZMA requires that these state programs provide "adequate consideration of national interest" (Sec. 306(6)(8)) including siting of energy facilities. In return the state may require that Federal action, including siting of energy facilities, in the coastal zone be consistent with the approved state program. One area of concern that surfaced during the CZM program development and approval is the need to provide criteria and standards by which regional and state interests and benefits may be weighted in consideration of national interests. Examples where this consideration is important are the development of Alaska's Outer Continental Shelf and the proposed transshipment port in the State of Washington. Concerns regarding the risk of oil transport in Puget Sound have resulted in amendments to the Marine Mammal Act and Coast Guard regulations limiting the size of oil tankers allowed into inner Puget Sound to 125,000 deadweight tons (dwt).

Nuclear Power

Opposition to nuclear power plants exists in some areas within the Region. In part, this opposition results from the failure of the Federal Government and the utilities, in the view of the public, to prove the safety of plant operation and to find an acceptable nuclear waste disposal method and a real need for additional power. In addition, the Federal Government has not clearly defined the role that nuclear power will play in national energy supply. If Federal policy relating to the use of nuclear power is not clearly defined and supported by the Federal Government, the role of nuclear power in meeting the Region's future energy requirements may be seriously questioned.

Federal Environmental Legislation

A conflict exists between maintaining and meeting the high environmental standards specified by Federal legislation and implementing Federal policy calling for expanded domestic energy production. A multitude of Federal environmental regulations directly affecting energy development have been promulgated in recent years. These regulations relate to the planning and construction stage and to the daily operation of energy generating facilities. Major pieces of legislation are 1) the National Environmental Policy Act, 2) the 1972 Amendments to the Federal Water Pollution Control Act, 3) the 1977 Amendments to the Clean Air Act, 4) the Safe Drinking Water Act, 5) the Toxic Substances Control Act, 6) the Resource Conservation and Recovery Act, and 7) the Rivers and Harbor Act. These pieces of Federal legislation, either alone or together, place constraints on regional energy development through their influence on the type, size and location of energy facilities that require large amounts of water or degrade the quality of the environment. In addition, the Federal Government has enacted laws that are specifically directed toward preserving and protecting the natural environment and that preclude siting of energy facilities in areas designated as wildlife refuges, wilderness areas, and areas that contain certain protected species of vegetation, fish, and

wildlife. For example, the Clean Air Act Amendments of 1977 specify that air quality in Class I areas may not be degraded by development of industrial facilities in the immediate region.

REGION-WIDE ISSUES

Many issues are unique to Region 10 but not limited to a single state. Therefore, issues common to more than one state but not to the entire nation are dealt with in this section. Discussions of regional issues in the areas of air, water, ecology, land use, solid waste, health and safety, socioeconomics, and institutions are presented.

Air

Description

Under the Clean Air Act Amendments of 1977, each state must designate all regions in the state into one of three classes:

- o Class I, which allows little or no industrial growth, as only very limited air quality deterioration may occur.
- o Class II, which allows moderate, well-controlled industrial growth
- o Class III, which allows concentrated industrial growth, as long as air quality is not degraded beyond the secondary national Ambient Air Quality Standards.

Mandatory Class I areas in Region 10 are shown in Figure 10-9. All other areas are classified as Class II. Recently, EPA classified all portions of each state as attainment or nonattainment areas. Attainment means that all national ambient air quality standards, both short- and long-term, are being met. Nonattainment areas have concentrations of one or more criteria pollutants that exceed existing standards. To protect the air quality of areas currently classified as attainment areas, the Clean Air Act Amendments specify that the air quality in these areas cannot exceed specified incremental degradation. These Prevention of Significant Deterioration (PSD) regulations have been established for SO₂ and TSP (Table 10-6), with regulations covering nitrogen oxides, hydrocarbons, carbon monoxide, and oxidants emissions forthcoming.

Table 10-6. Allowable Air Quality Increments Specified in Clean Air Act Amendments of 1977

Pollutant	Averaging Time	Allowable Increments g/m ³		
		Class I	Class II	Class III
SO ₂	Annual	2	20	40
	24-hr maximum	8	91	182
	3-hr maximum	25	512	700
TSP	Annual	5	19	37
	24-hr maximum	10	37	75

Siting of industrial and energy facilities could be restricted by the location of Class I areas, nonattainment areas, and PSD regulations for attainment areas. Siting of facilities in Class I or attainment areas require pollutant emissions to meet the PSD regulations for such areas. In nonattainment areas, emission offsets will be required before additional industrial development can occur.

In addition to ambient air quality standards, each state has developed a set of health standards under their state implementation plans (SIPs). The primary health standards for air quality are set at levels comparable to the national ambient air quality standards. As air concentrations of pollutants increase above the primary levels, the alert levels are reached. Pollutant concentrations at or above these alert levels present a significantly higher health hazard.

Air quality violations occur in every state in Region 10. Standards for four of the major pollutants (carbon monoxide, oxidants, particulates, and sulfur dioxide) were exceeded in Washington for a three-year period ending in 1976. Idaho and Oregon exceeded standards for three of the major pollutants (carbon monoxide, particulates, and sulfur dioxide in Idaho; and carbon monoxide, oxidants, and particulates in Oregon). Alaska exceeded standards for two pollutants (carbon monoxide and particulates) (EPA 1978a,b,c,d).

Region 10 has relatively few heavily populated urban centers. Only 6.5 million residents live in the four states. Where there are major urban centers, air pollution problems exist. Violations in fourteen Region 10 communities accounted for 79% of all violation-days and 74% of all alert level violation-days in the region.

Much of the air pollution in Region 10 can be attributed directly to automobile exhaust. Carbon monoxide and/or photochemical oxidants in urban areas caused 80% of the violations in Oregon, 65% in Washington, 23% in Idaho, and 50% in Alaska. In turn, 80 to 90% of these pollutants can be traced directly to automobile exhausts. Because over half of the Region's population lives in or near cities, automobile exhaust must be viewed as a significant problem in the Region. The Environmental Protection Agency (EPA) is working closely with the States of Alaska, Idaho, Oregon, and Washington to reduce both emissions from vehicles and the number of vehicle miles traveled in urban centers having high carbon monoxide pollution levels (EPA 1978a,b,c,d).

The suspended particulate problem is widespread and results from both industrial and non-industrial sources. Controls for suspended particulates have been installed on many industrial plants, and other plants are scheduled to reduce emissions in the near future. The principle non-industrial source of particulates is fugitive dust. Sources of fugitive dust include grass field burning in western Oregon and eastern Washington, wind-blown dust and dust from dirt roads. Fugitive dust is a common problem in the sparsely vegetated and dryland farming areas of the Columbia and Snake River Plateaus. Alaska also has fugitive dust problems resulting from wind erosion of mud flats exposed during low tides. Fugitive dust accounts for a significant portion of the TSP standard violations in certain areas of the region.

In communities such as Tacoma, Washington and Kellogg, Idaho, air pollution is largely attributable to the metals industry. Heavy metals, sulfur dioxide, and particulate emissions from smelters and other industries have long caused problems in these areas. Control systems are currently being installed as required by law (EPA 1978a,b,c,d.).

Background Issues

o There are several coal-fired generating plants in the Region. There is a 1330 MWe plant in western Washington, and two small plants in central Alaska. In contrast to other regions, coal-fired generation in the Northwest is very small. Therefore, effluents to the atmosphere from coal-fired generation are of little consequence on a Region-wide basis.

Scenario-Induced Changes

o Most of the electric generation capacity called for by the 1990 scenario will be met by hydroelectric and nuclear generating facilities, which are not major sources of air pollutants. Federal policy calls for increased reliance on coal. The impact of a national coal conversion policy which encourages industry and utilities to use coal as a major fuel could significantly impact air quality in the Northwest. Idaho, Oregon, and Washington contain 5.7 million acres of mandatory Class I areas in 24 national parks and wilderness areas (see Figure 10-9). Utility and industry may be restricted in the vicinity of these Class I areas, particularly when coal is used as the primary fuel.

o The proximity of the Healy plant to Mt. McKinley National Park may preclude expansion of that coal-fired power plant as specified by the scenario. Siting of additional energy and industrial facilities in Alaska is uncertain because the status of Alaska lands is as yet unsettled. Large areas may ultimately be classified as national parks and wilderness areas and, thus become mandatory Class I areas.

o Transmission corridors through forested and wooded areas results in an accumulation of slash that must be disposed of. The typical means of disposal is by open burning, which results in the emission of combustion by-products into the air. These emissions disperse quite rapidly to ambient levels and are limited to the duration of the particular right-of-way clearing program. All burning is undertaken in accordance with local, state and Federal air pollution regulations. Because burning usually takes place in relatively remote areas, air quality impacts are localized and temporary.

Water

Description

Under the Federal Water Pollution Control Act, the states established water quality standards to protect the public water supply and the quality of water for wildlife, recreation, navigation, agriculture, industry, and the propagation of fish and shellfish. The water quality standards in the states of Region 10 include parameters such as temperature, dissolved oxygen, bacteria, and turbidity in river water.

In order to provide a means of reliably measuring and comparing water quality in the Northwest, a standardized set of parameters and associated criteria has been selected. These criteria, termed "Federal water quality goals" in the following discussion, are a synthesis of the state standards, national criteria, information in the technical literature, and professional judgment (EPA 1978a,b,c,d,).

Generally, the water quality in the Region meets Federal water quality goals. Over 85% of the water quality monitoring stations in Idaho, Oregon, and Washington report water quality above the Federal water quality goals. Of the 33 principal river basins in Region 10, portions of only nine of these rivers do not meet Federal water quality goals. Of the nine rivers which do not meet Federal water quality goals, only the Spokane and Willamette Basins are not in attainment because of industrial activities (refer to Figure 10-1 for the location of the Region's major river systems). In the Spokane Basin, water quality is affected by intense mining and smelting in the Kellogg, Idaho area and municipal discharge by the city of Spokane, Washington (EPA 1978a,b,c,d,). Water quality in the Willamette River Basin is affected by municipal and industrial discharges in the Tualatin River, a tributary to the lower Willamette River. Major coastal and Puget Sound Rivers as well as the Upper Columbia, Clark Fork/ Pend Oreille and Kootenai river basins generally have relatively good water quality (EPA 1978).

The vast majority of fresh water in Alaska is considered to be of good quality, although some streams in Alaska have localized water quality deterioration near major population centers and in the more remote areas where placer mining activities are occurring (EPA 1978a). Water quality data for most areas is non-existent.

The U.S. Water Resource Council has divided the nation's drainage areas into aggregated subareas (ASA), which are a basic unit for which water policy and management decisions are made. Federal Region 10 contains all or portions of ten ASAs. These ASAs are presented in Figure 10-10.

Background Issues

- o Hydroelectric development in Region 10 has changed water conditions in rivers that were once free-flowing, often with adverse effects on river biota. Although minimum flows are typically established by government agencies, downstream water temperatures may show wide fluctuations when deep, cool waters are withdrawn from reservoirs for power generation, and when low river flows during off-peak demand periods allow for increased solar warming. Low dissolved oxygen concentrations result from withdrawal of oxygen-depleted, deep waters of eutrophic reservoirs. Gas supersaturation occurs when large volumes of water are released over spillways and plunge into deep pools downstream of the dam, resulting in higher concentrations of dissolved gases, particularly nitrogen. Fish swimming in deep waters supersaturated with nitrogen are killed by gas bubbles that form in their tissues as they later approach the surface.

- o Because the Columbia River system encompasses most of Idaho, Oregon, and Washington, interstate water relationships among the three

Figure 10-10. Water Management Aggregated Subareas (ASA) for Region 10

Source: PNL-RAP-28

states focus on the management of that system. With expanding populations and economies placing greater demands on the water resources of the Columbia and Snake River systems, interstate management problems are increasing in significance and becoming more difficult to resolve.

Scenario-Induced Changes

- o Increases in hydroelectric generation through the use of additional turbines may actually enhance water quality, especially in the case of nitrogen supersaturation. Added generating units will increase the capacity of a facility to pass water through the turbines rather than over spillways.
- o Increases in hydroelectric generation may exacerbate water quality problems of temperature fluctuations and dissolved oxygen concentrations.
- o Less than 2000 MWe of the Region's 45,000 MW of generating capacity in 1990 is to be met by coal-fired generation. Some of the coal-fired generation specified by the scenario will use coal surface-mined within the Region. The principal pollutants associated with surface mining are suspended and dissolved solids produced by runoff from piles of overburden. In addition, leaching from coal storage sites at the generating plant produces acid runoff.
- o The construction of new transmission facilities, and the operation and maintenance of the existing transmission system will result in minor water quality impacts within the region. The presence of cleared rights-of-way affects the amount, quality, and timing of water entering local streams.

Ecology

Description Region 10 encompasses an enormous variety of climate and habitat types, from arctic tundra to sagebrush and grassland. The diversity in biota found in the Region reflects this variation. However, many introduced plant species now exist interspersed with native vegetation. As a result of these introductions, a highly diverse mosaic of plant communities exists.

Historic and current land use practices of forestry, farming, grazing, fire control, and settlement have modified original ecosystems extensively in many areas. Original distributions of the Region's climax vegetation still conform to original patterns, but is now fragmented into isolated pockets associated with man's land use. The primary areas where original vegetation still remains undisturbed in Idaho, Oregon and Washington are national, state and country parks, urban parks, roadless areas of National Forests, wilderness areas, experimental forest preserves, and wildlife refuges.

Fish and wildlife populations in Alaska are largely at population levels determined by the natural environment. For Idaho, Oregon and Washington, populations are strongly influenced by the activities of man. Examples of such habitat alterations in the Region are the clearcutting of large blocks of timber in coniferous forest ecosystems, and development of agricultural lands. Populations usually decline as the habitat is destroyed,

but the habitat may be altered in such a way as to favor some wildlife species. For example, the creation of open areas containing more browse species through timber harvest may increase deer populations.

Salmon are anadromous fish, spending their adult lives in the ocean and returning to freshwater streams to spawn. The fish are very selective about the locations at which they spawn, returning only to the area where they were hatched. If the waterway to the spawning grounds is blocked, propagation from that area is lost. Historically, dam construction has resulted in diminished anadromous fish runs to historical spawning grounds (Figure 10-11). Channeling, dredging, logging, and mining in the Northwest have also destroyed some natural spawning and rearing areas by changing streambed characteristics and altering flows (DOE-RAP-28 1978).

The Region's terrestrial ecosystems are joined with the marine ecosystem at the land-water interface along the coast and in Puget Sound. This interface includes thousands of miles of coastline, bays, mudflats, sand dunes, and estuaries which support a diverse biota including several commercially valuable species. Estuarine ecosystems are extremely productive biologically but are fragile and highly susceptible to pollution. In the past, estuaries have been used as garbage dumps and have been dredged or filled, all to the detriment of the natural ecosystem.

Many areas in Region 10 are covered by SO₂ sensitive crops that could be damaged by high sulfur emissions from coal-fired facilities. The SO₂ fruit sensitive crops include berries, hay, Irish and sweet potatoes, non-citrus fruit orchards, grains such as barley, wheat and oats, soybeans, and vegetables.

Background Issues

o Over the last several decades self-maintaining runs of anadromous fish, particularly on the Columbia and Snake Rivers, have declined drastically largely because of the extensive development of hydroelectric dams on the Columbia and Snake Rivers. Although steps are now being taken to reduce fish loss resulting from dam operation it remains uncertain as to whether self maintained populations can be sustained. Further hydroelectric development will probably exacerbate the problem.

o The release of water over dam spillways increases the total dissolved gas content of the water downstream, which can have an adverse effect upon aquatic life. The installation of spillway deflectors at the dams permits some water to be spilled without serious fish mortality from nitrogen supersaturation.

o Although turbines at some Northwest dams are screened to prevent the entrance of fish, small organisms such as juvenile fish may pass through. These organisms can be killed by impact against the turbines. Both the magnitude and timing of water releases have been coordinated with fisheries agencies to reduce injury to the fish.

o Construction and operation of hydroelectric dams and its associated reservoir has destroyed original riparian (shoreline) habitat. This habitat serves as an important feeding and nesting area for many wildlife species.

Figure 10-11. Anadromous Fish Spawning Grounds Cutoff by Dams
Source: Chaney, 1978

Recently, efforts have been made to enhance habitat around some reservoirs.

Scenario-Induced Changes

- o Additional energy facilities specified by the 1990 scenario will have only minimal impact on the Regional ecology.
- o Hydropeaking can cause a number of impacts on riparian wildlife. These impacts result from, or are associated with, increased periodicity and amplitude of water level fluctuations. Adverse impacts on waterfowl can occur, but the severity has not been determined. For example, land bridges formed to river islands during low water periods may result in increased predation on waterfowl nests.
- o New hydroelectric generators will further threaten the already declining salmon populations in the Columbia and Snake Rivers. The forecasted hydroelectric expansion could further threaten fish populations in the following ways:
 - a. Direct kills by fish passing through turbines.
 - b. Destruction of spawning areas by increased variability in river flows associated with peak power generation.
 - c. Increased fish deaths during downstream migration because of increased transit time required to negotiate still-water reservoir pools. (There is a "time window" within which fish must reach salt water to permit successful physiological adaptation.)
- o The construction of a coal-fired plant in the region will result in increased SO₂ and other pollutant concentrations. Current estimates indicate that pollution levels associated with the scenario are unlikely to be high enough to cause significant vegetation damage in the Region. However, extensive acreages of SO₂-sensitive vegetation, especially crops, do occur in the proximity of the projected coal-fired power plants.
- o The scenario projects new geothermal development in Idaho, Oregon and Washington. These developments are likely to occur in relatively remote, undeveloped areas. Because of the small land areas involved and because geothermal facilities have not been sited, no specific ecological impacts can be identified.
- o Transmission corridors and pipelines generally result in alteration of habitat in the right of way. Because the probable route for transmission corridors and pipelines have not been identified in the scenario, specific ecological impacts have not been identified.

Land Use

Description

Land productivity, climate, topography, and the resulting vegetative cover determine the use of much of the Region's land. In Idaho, Oregon, and

Washington, coniferous forests are predominant in mountainous areas and sagebrush and grass are the natural cover of much of the semi-arid plateaus. Cropland is a major use of valley bottom lands; plateaus are used extensively for dry cropland, irrigated cropland, and rangeland. In Alaska, much of the land is covered by forests and tundra.

A major economic activity of the region is the forest products industry. Principal commercial species are Douglas fir and western hemlock. Commercial forests, which supply the raw material for the Region's forest products industry, produce about one-half of the national timber volume. Also, the Region is the leading plywood supplier, accounting for more than 50% of the national production. Woodpulp production amounts to about 20% of the nation's total. In addition, forest lands are important as fish and wildlife habitat and for outdoor recreation activities. Forested lands also contribute to the regional quality of life because of their outstanding natural and scenic areas, lakes, and waterways.

Agriculture ranks second to forest products in regional economic importance. If food processing, which is directly related to the Region's farm output is included, the agribusiness sector exceeds the forestry sector in cash receipts. Most of the cropland in the Region is located in Idaho, Oregon and Washington. Major crops from the valleys of the Puget Sound-Willamett Lowlands are dairy products, berries, grass seed, vegetables, pears, cherries, apples, and nuts.

East of the Cascades, the land which produces the remaining 75% of the regional farm output is far different in character. The low rainfall areas of eastern Washington and north central Idaho produce large amounts of wheat. The area is also the Region's major producer of barley, dry peas, and lentils. Other crops include apples, potatoes, sugar beets, and hops.

The Region has an estimated 58.7 million acres of nonforested rangeland. These lands are concentrated in the more arid parts of southern Idaho and southeastern Oregon, with lesser amounts in central Washington and northeastern Oregon. The majority of this land is covered with sagebrush and other arid-climate vegetation.

Background Issues

- o Forested areas in Idaho, Oregon, and Washington, and southeastern Alaska, are intensively managed for the purpose of timber production. Because some of these lands are highly valued for other uses, such as recreation and wilderness experiences, conflicts arise between potential users.
- o The uncertain status of Alaskan lands has impeded development of comprehensive land use plans.

Scenario-Induced Changes

- o The areas in arid parts of the Region particularly desirable for energy development are near water courses. Use of the land for energy facilities will compete with agricultural, urban, and industrial use of the land.
- o The scenario includes the construction of several coal and nuclear power plants, all of which have been sited or are under construction. These sites include:
 - A 1,089 acre site for nuclear plants in south central Washington.
 - A 2,170 acre site for nuclear plants in south western Washington
 - A 9,189 acre site for a nuclear plant in north central Oregon
 - A 2,170 acre site for a coal-fired plant in north central Oregon
 - There are also five geothermal facilities specified for development by the scenario in the Region. Land requirements for the facilities are presently unknown.
- o Additional impacts on land use from hydroelectric expansion would be small because the additional units would be added to existing sites and land that is already committed to hydroelectric development. However, increased use of a given hydroelectric facility for peaking purposes would alter future land use along the shoreline upstream and downstream of the dam, as well as instream uses, because of sudden fluctuations in the river level. These would also result in increased bank erosion. These changes in the land could result in a conflict with other land uses such as recreation and location of intake structures.
- o Construction of new transmission or pipeline corridors, and related facilities have a direct impact upon the current use of the land. The nature and scope of the impact vary with the land uses involved. Since the routes and capacities of energy transmission systems are not included in scenario information, the extent of the impacts on land use cannot be specified.

Solid Waste

Description

The major solid waste problem confronting Region 10 associated with energy production is the handling and storage of nuclear waste. Since most of the energy generated in the region is hydroelectric, other sources of energy-related solid waste are minimal.

Background Issues

- o The largest radioactive waste disposal site in the Region is located on the Hanford reservation in central Washington, where radioactive waste from defense programs is stored. The existing high-level storage tanks and low-level waste burial grounds that are on the Reservation will preclude use of that land until either the wastes have decayed to what are

considered "safe" levels or until the wastes are removed from the reservation and the storage sites decommissioned. In addition, some sections of the Columbia Plateau (on which the reservation is located) are under consideration for permanent isolation of both commercial and defense wastes. The presence of a repository will preclude use of land in close proximity during the period of operation and for at least the short-term following closure.

Scenario-Induced Changes

- o Waste generated from the nuclear-powered electrical generating plants called for in the scenario will be stored at the plant site pending a decision on the final disposal of such waste. Thus, in the short-term, no facilities other than those currently planned at the nuclear plant sites will need to be constructed.

- o The use of coal as a fuel for electric generation will necessitate the disposal of approximately 46,580 tons of ash per month. Potential adverse impacts from ash disposal - such as leaching of toxic materials, contamination of groundwater, or blowing dust - can be minimized by careful selection of the disposal site and proper treatment of the ash.

Health and Safety

Description

Increasing energy demands generally lead to occupational and public health impacts from fuel extraction and subsequent use. Accidental injury always accompanies major development such as coal mining, pipeline construction, and OCS activities.

Determining the impact of airborne pollutants on the health of the general population is not simple. For some pollutants, qualitative statements concerning the possible physiological effects can be based on animal experimentation or human epidemiological studies. Quantitative measurement of the magnitude of effects or dose-response relationships are more difficult and are subject to considerable uncertainty. Airborne pollutants generally exhibit three types of health impacts: irritation, direct toxicity, and carcinogenesis (DOE-RAP-21 1978). The level of health impacts depend on the type of health impact, its severity, and the susceptibility of the exposed individual.

Background Issues

- o Because hydroelectric generation facilities release no pollutants, public health and safety impacts of energy production are currently quite low. Estimates of health risk associated with fossil fuel combustion by utilities and industries indicate that Region 10 has the lowest health and safety risk in the country in this category.

- o Risk is low from effluents released by the Region's two operating nuclear plants and related nuclear fuel and waste handling. Estimates

indicate that doses of radiation to individuals in the vicinity of these sites amounts to less than the normal 10 to 15% annual fluctuations in natural background radiation levels.

Scenario - Induced Changes

- o Based on lead lab projections, total deaths from the effects of air pollution because of fossil fuel combustion are expected to increase between 1975 and 1990, but will still be lower than any other Region in the country.
- o Coal mining in region 10 is expected to be almost entirely surface mining. Occupational deaths and injuries associated with surface mining of coal are expected to increase only slightly by 1990.
- o Radiation-induced cancer deaths associated with uranium mining and milling, nuclear fuel fabrication and waste management are expected to increase by no more than one death per year by 1990.
- o Loss of life has resulted when people have touched powerlines with irrigation pipes. Expansion of the Region 10 transmission system should not exacerbate this problem.

Socioeconomic

Description

Energy development in the Northwest produces socioeconomic effects at the national, regional, state, and local levels which need to be anticipated by both government officials and citizens. Identification of effects, however, can be difficult when social and economic change is being induced by other forces in addition to energy development. Typically, socioeconomic impacts are most intensely exerted at the local level where people are least prepared to absorb and manage rapid social change.

At the local level (county and below), socioeconomic issues arise from the interaction between construction and operation of energy facilities and the capacity of the local area to absorb the construction work force. At the state and regional level these impacts are more diffuse. States and Regions are faced with problems of the equitable distribution of the social and economic costs and benefits of energy development.

A unique aspect of Region 10 is the distinctive character of Alaska compared with the other three states. The values of Alaska's Native groups are quite different from those of other segments of the Region's population. These values include preservation of traditional cultural systems and lands, and are often in conflict with the values of other segments of society.

In the Northwest, new energy development and proposed facility expansions are planned for areas with low population density. These are areas where local economies and services will be especially sensitive to the social changes caused by the development of energy facilities. Since

socioeconomic effects are generated as the combined function of facility characteristics (size, time schedule, skill requirements) and the nature of the host community (size, complexity, access to resources, experience with change), local effects are unique to each area.

Local communities in many portions of Idaho, Oregon, and Washington have hosted major hydroelectric and nuclear developments in the past. Populations in the localities near those facilities are generally favorably disposed to additional expansions. However, region-wide there is a strong sentiment in favor of the conservation of energy and renewable resources.

Background Issues

- o The construction of new generating facilities or the expansion of existing facilities typically results in the rapid influx of migrants into and around construction sites which are located in rural areas. The new-comers place a strain on the communities' existing capacity to supply adequate services. With an increase in the size of the local population, the complexity of social and political organization is likely to increase. Land values usually rise drastically. Small rural communities are typically unable to increase revenues soon enough to meet the new demands placed upon them.

- o Often the new population moving into a community adheres to values and a world view that differ from those of the local people. Strong resistance can arise in the face of development when these changes are not addressed. In Alaska and other Northwest areas there may be a substantial social and economic disparity between the newcomers and the oldtimers. This can be especially serious if the influx of new people is large and the supporting community is small. There may be animosity generated between community groups who want to incorporate lifestyle changes introduced by the newcomers and those who wish to maintain traditional community lifestyles.

- o State and regional planners cannot simply assume that the public will accept energy facility expansions without seriously questioning their costs and benefits for everyone in the Region.

Scenario-Induced Changes

- o New nuclear plants are planned for Washington and Oregon. Although this implies increased employment within the region and expanded energy resources, the potential negative impacts have resulted in widespread public debate and this has caused project delays and escalating construction costs. The people who bear most of the social costs of these developments often receive a much smaller portion of the development's economic benefits.

- o Because the construction and operation of new energy facilities requires a large work force, and because these facilities are usually sited away from densely populated urban areas, large numbers of workers and their families will migrate to and reside near the site. The influx of construction workers increases secondary employment in the local area. The net result is that sometimes four or more people come into the area

with each migrant construction worker. Future energy expansion in areas where plants are already under construction if phased correctly, could limit the impacts associated with them.

- o Hydroelectric developments are widespread throughout the region. The location of dams is dependent on the unique geographical characteristics of the region. However, dams tend to be in predominantly rural areas that are least able to absorb the increased populations and changes associated with these developments.

- o Proposed geothermal development may cause some socioeconomic impacts because they are located in very rural, isolated areas. These isolated areas may require the developer to establish and support temporary construction work camps, removed from existing communities.

Institutional

Description

Power generation in the states of Idaho, Oregon, and Washington is a regional undertaking. The Columbia River Basin drains major portions of all three states. The Federal Columbia River Power System (the dams and generating facilities of the Army Corps of Engineers and the Bureau of Reclamation, and the transmission facilities and marketing authority of the Bonneville Power Administration) accounts for nearly half of the power produced and transmitted in the three-state area (Comptroller General 1978).

The unique institutional arrangements for power generation in the Northwest date from the construction of the grand Goulee and Bonneville Dams by the Bureau of Reclamation and the Army Corps of Engineers in the 1930s. At that time, the Bonneville Project Act created the Bonneville Power Administration (BPA) to market the Federally-generated power at wholesale and provide the necessary transmission services (16 U.S.C. 832-832d). To encourage the formation of publicly-owned utilities, the Act gave public agencies first claim to BPA's hydropower in the form of the "preference clause." As a consequence, publicly owned utilities have prospered, especially in Washington.* Indeed, many have relied exclusively on BPA for power, as have direct industrial users (chiefly aluminum plants that were built before and during World War II). In addition, investor-owned and publicly owned utilities have supplemented self-generated power with that purchased from BPA. BPA's role broadened further when it was

*The varying success of publicly-owned facilities in Idaho, Oregon, and Washington probably stems from differing state laws. Idaho law does not authorize the formation of PUD's at all; publicly-owned utilities are confined to municipalities and rural electric cooperatives (Comptroller General 1978). Oregon law requires one election to establish a PUD and a second election to fund it (ORS Ch. 261). In Washington, voters can establish and fund a public utility district (PUD) in a single election (RCW Tit. 54).

authorized by Congress to transmit non-federally generated, as well as federally generated power. This action made possible a truly regional system in which a given facility might buy Federal and non-Federal power, and sell self-generated power, Federal power, and power supplied by other utilities, all through Bonneville's high-voltage transmission lines (Comptroller General 1978).

Despite this high level of integration, the system is fragmented in important ways. Each state has autonomous institutions for siting and regulating power generation and transmission within the state's borders. In Washington, the Energy Facility Site Evaluation Council must approve all non-Federal thermal power plants and power transmission facilities (RCW Ch. 80.50); the Washington Utilities and Transportation Commission regulates the rates of investor-owned utilities (RCW Chs. 80.01 to 80.04). In Idaho, the Public Utilities Commission issues certificates of convenience and necessity for the generating and transmission facilities of investor-owned utilities and regulates their rates (IC 61-101 to 61-714). In Oregon, the Energy Facilities Siting Council must approve all non-Federal power plants and power transmission facilities (ORC 469.300 to 469.580); the Public Utility Commission regulates the rates of investor-owned utilities (ORS 756.040). Each state contains a different mix of public versus private utility ownership, and residential/rural versus commercial/industrial end-use. The large number of regional power organizations and agreements, with their overlapping memberships and emissions, complicates regional decisionmaking.

Regional power organizations and agreements include: Northwest Power Pool, Pacific Northwest Coordination Agreement, Western Systems Coordinating Council, Mid-Columbia Hourly Coordination Agreements (investor-owned and publicly owned utilities, and Federal agencies); Pacific Northwest Utilities Conference Committee (investor-owned and publicly owned utilities); Columbia River Water Management Group (Federal agencies); and Intercompany Pool (investor-owned utilities).

Background Issues

Until recently, the advantages of physical integration, coupled with the availability of inexpensive hydropower from the Federal system, have overshadowed the potential difficulties posed by institutional fragmentation. To date there has been enough inexpensive federally-supplied hydropower to satisfy the needs of investor-owned and publicly owned utilities, and direct industrial users alike (at extraordinarily reasonable rates compared to those paid by customers in other parts of the United States). However, by the 1960s, few environmentally and economically acceptable dam sites with large power potential remained. In 1973, BPA stopped selling investor-owned utilities firm (guaranteed) wholesale power (Institute of Environmental Studies, n.d.). In 1976, Bonneville put the region's publicly owned utilities on notice that after 1983 they would no longer be able to satisfy projected needs from available BPA power (Institute of Environmental Studies, n.d.). At the same time, BPA announced that the direct service industries' contracts for power would not be renewed when they expired in the 1980's (Institute of Environmental Studies, n.d.).

Bonneville's wholesale customers have responded in differing ways to the prospect of insufficient supplies. Both investor-owned and publicly owned utilities have begun to build their own generation facilities, largely thermal. For the investor-owned utilities, this step has meant obtaining capital from the private market and passing the costs along to retail customers. The publicly owned utilities have adopted a more complicated course. Either separately or jointly, through the mechanisms of the Washington Public Power Supply System (WPPSS, comprised of publicly owned utilities in Washington), they are building thermal power plants and have arranged to sell the output to BPA. This power will then be blended with federally generated hydropower and the combination sold to Bonneville's customers at rates that average the two power sources. This procedure is known as net billing. The direct service industries have responded primarily by engaging in public relations and lobbying efforts aimed at changing Federal law to secure their continued access to low-cost Federal hydropower. All three sets of Bonneville's customers face the same problem, the inability of Federal hydropower to meet regional power demands. As a consequence, institutional issues have arisen. Three are of central importance: 1) allocation of existing, cheap hydropower; 2) selection of alternative sources to serve future needs, and 3) financing new power generation facilities.

The first issue concerns allocation of the finite supply of Federal hydropower; that is, who is to receive the power and at what rates. Under current arrangements, all generation could easily go to publicly owned utilities, which are preference customers under the Bonneville Project Act. Although obviously satisfactory to the publicly owned utilities, this result is plainly unacceptable to the investor-owned utilities and the direct service industries.

The second issue is how to make up the shortfall between existing hydro and thermal power generating capacity, and projected demands for the 1990s. The basic options are conservation; reliance on "soft path" technologies such as solar, biomass, and wind; and construction of new thermal power plants, or a combination. Few doubt that conservation and renewable resource technologies can make a contribution. Disagreement centers on the necessity of adding more thermal power plants beyond those already under construction or planned.

The third issue is how to finance new thermal power. One mechanism is "net billing". Under net billing, BPA promises to buy a utility's share of the electricity that is generated by a thermal power plant in whose construction the utility participates. BPA then blends this more expensive thermal power with its cheaper hydropower and sells the combination to all its customers, including the utility from which it bought the thermal power at an averaged rate. By acting as guarantor, BPA eases the utility's access to investors who may be reluctant to invest in otherwise risky power plant construction ventures.

Numerous groups have proposed policies for dealing with the three substantive issues and with the procedural question of where decision making authority should reside. Some, but not all, would involve Federal legislation to replace current arrangements under the Bonneville Project Act. Descriptions of four of these proposals follows.

The Weaver Bill:

Congressman Jim Weaver of Oregon introduced his proposal for dealing with these issues in March 1977 (H.R. 5862, 95th Cong., 1st Sess. 1977). This legislation would replace BPA with a Federally-chartered Columbia Basin Energy Corporation (CBEC). The Weaver Bill would address the allocation question by eliminating the Preference Clause. The CBEC would purchase the power generated by corporation investor-owned and publicly owned utilities, meld it with federally-generated power, and resell the power to the utilities and direct service industrial customers through three rate pools (H.R. 5862, Sections 19-20). The bill would address the question of meeting future load growth by relying heavily on conservation. The corporation could construct new generating facilities or agree to purchase power from new facilities only after determining that the technology chosen would constitute the most economical means of balancing energy supply and demand (H.R. 5862, Section 6). The Weaver Bill would address the question of financing new thermal power facilities, if necessary, by authorizing CBEC to construct the facilities itself (H.R. 5862, Section 7).

The PNUCC Bill:

The Pacific Northwest Utilities Conference Committee, a group of investor-owned and publicly owned utilities, drafted legislation introduced in Congress in September of 1977 (H.R. 9020, 95th Cong., 1st Sess. 1977). This legislation would rely heavily on an expanded role for BPA, which would acquire new powers. It would also establish the Pacific Northwest Planning and Conservation Organization (PNEPCO), a Washington corporation, to prepare load and resource forecasts, promote power conservation, study alternative energy sources, review utilities' long-range planning, provide oversight services specified in BPA power purchase contracts, and participate in plant siting studies (H.R. 9020, Section 2,17).

The PNUCC proposal would address the allocation issue by modifying the Preference Clause to allow investor-owned utilities and direct industrial users to share in cheap hydropower through three rate pools.

The PNUCC proposal addresses the question of meeting new load growth by encouraging conservation, although to a lesser extent than the Weaver Bill. PNEPCO and BPA would manage a program of conservation standards to be adopted by the states; or if they failed to do so, by BPA.

The PNUCC Bill would address the issue of financing new power plants by giving BPA the authority to buy the output of any new thermal power plant, whether constructed by an investor-owned or publicly owned utility (H.R. 9020, Sess. 5).

The Jackson Bill:

Partly in response to opposition to the PNUCC proposal by some publicly owned utilities, Senator Henry Jackson, chairman of the Senate Energy Committee, introduced his Northwest regional power bill in August 1978 (S. 3418, 95th Cong., 2nd Sess. 1978). (The identical bill has been reintroduced as S 885, 96th Cong., 1st Sess. 1979). The Jackson Bill would also expand BPA's role in regional power supply and planning.

The Jackson Bill would address the allocation issue by allocating the Federal power, now received by direct service industries, to the residential customers of the investor-owned facilities. This policy would be phased in gradually over a five-year period. Essentially, BPA would sell a pool of power at averaged rates to meet the general requirements (residential and existing industrial) of publicly owned facilities and the residential requirements of investor-owned utilities. Direct service industries would purchase from Bonneville at rates comparable to those charged industrial customers by utilities.

The Jackson Bill would address the question of meeting load growth by emphasizing conservation and renewable resource power generation. BPA would be required to meet power obligations through feasible, cost effective conservation measures such as financing residential construction, increased system efficiency, and waste energy recovery. If BPA finds conservation measures insufficient to meet power obligations, it would be authorized to acquire additional resources, giving priority to renewable resources, or to construct non-hydroelectric generating facilities using renewable resources.

The Jackson Bill would address the issue of financing new thermal generating capacity by restoring and expanding a form of net billing to include investor-owned and publicly owned utility alike (S. 3418, Section 5).

WPPSS Proposal:

As a back-up approach in the event no Federal power bill is approved, the Washington Public Power Supply System (WPPSS) has recently proposed a more limited regional electricity generation plan. Publicly owned utilities would create a power pool and assign to it their allocation of Federal hydropower, and any other power to which they have rights, such as that generated by their own thermal power plants or power plants in which they have a share (such as WPPSS nuclear plants 1 through 5) to the extent these shares are not assigned to BPA. The power pool would then sell the electricity back to the utilities and to industrial users at an averaged rate.

Other Proposals:

Various groups have made other, less comprehensive proposals. Portland Utilities Commissioner Invancie has proposed changing the Preference Clause to favor end-use allocation of Federal hydropower to residential customers. Through 1977 legislation, the Oregon Legislature has attempted to qualify the entire state of Oregon as a BPA preference customer, to be known as the Oregon Domestic and Rural Power Authority (DRPA). This "paper utility" would channel Federal hydropower to existing Oregon investor-owned and publicly owned utilities (Or. Laws, Ch. 888 1977).

The implementation of DRPA was to commence March 1, 1979; if the U.S. Congress had failed to enact a regional power bill satisfactory to the Oregon governor. A bill to delay implementation of DRPA for one year has been introduced in the Oregon Legislature. Finally, as indicated above, a Natural Resources Defense Council (NRDC) study has proposed an "alternative scenario" for meeting the region's electrical needs without constructing any additional nuclear or coal-fired power plants in the twenty

years beyond those already approved or under construction; that is, primarily through conservation (Beers and Lash, 1977). The NRDC proposal addresses the allocation issue by assuming BPA would continue to supply power to direct service industries only so long as their plants are less than 35 years old. In other words, publicly owned utilities would gradually consume all Federal hydropower (Beers and Lash, 1977). Additional information describing the Region's institutional framework as it relates to energy issues is presented in Volume III entitled, Institutional Barriers to Developing Power Generation Facilities in the Pacific Northwest.

Scenario-Induced Changes

- o No regional institutional impacts were identified resulting from the scenario. State-level impacts can, however, occur.

STATE ISSUES

This section discusses the impacts of the scenario on each of the individual states in Region 10. For each of the states an overview of energy resources, energy supplies, the environment and background issues that may constrain energy development are discussed. Finally each section focuses on particular issues that will arise from implementation of the scenario. While certain energy technologies such as transmission lines and pipelines will cause impacts in the individual states, these technologies are Regional issues because the impacts from these technologies have not yet been disaggregated to the state level. Other information about each state's climate, geography and demography is found in the Regional Overview. The information is based on physiographic subareas within Region 10.

ALASKA

Alaska leads the Region in energy reserves by a large margin. It contains all of the Region's reserves of oil and natural gas and most of the coal. The size of Alaska's 1975 fossil fuel reserves in comparison to those of the rest of the Region and the U.S. is presented in Table 10-7. A comparison of regional reserves to the U.S. total in quadrillion Btu is given in Figure 10-2. Location of Alaskan fossil fuel reserves is presented in Figure 10-3.

Table 10-7. Alaska Fossil Fuel Reserves Compared to the Rest of the Region and U.S.

	Crude Oil (Billion Barrels)	Natural Gas (Trillion Cubic Feet)	Coal (Billion Tons)
Alaska	10.1	31.9	5.8
Idaho	0	0	0
Oregon	0	0	0
Washington	0	0	1.0
Rest of U.S.	24	205	210

Source: PNL-RAP-28

Alaska's fossil fuel reserves are being tapped. Annual oil extraction is about 600 million barrels per year, gas extraction is about 200 million cubic feet per year, and coal extraction is about 1 million tons per year. Almost all of the crude oil and nearly half of the natural gas is exported.

With the availability of these fossil fuel resources, Alaska's per capita consumption of electricity is below the rest of the Region. Alaskans consumed only about 2% of the Region's 141 million MWh of electricity generated in 1975. Alaska's electrical generation capacity is heavily oriented toward the use of the fossil fuels. In contrast to the other three states in the Region where hydroelectric power facilities constitutes about 90% of the installed generating capacity, fossil fuel-fired generating facilities make up nearly 90% of Alaska's installed capacity.

The North Slope contains large amounts of natural gas. The 200 square mile Prudhoe Bay field contains an estimated 22.5 trillion cubic feet of proven natural gas reserves. A pipeline to transport gas to the lower 48 has received Federal approval, but construction of the pipeline is not expected to be completed before the mid-1980s. The State of Alaska is considering providing financial support for construction to allow the venture to proceed.

Alaska is the largest state in the nation, most of it yet unspoiled by the activities of man. The State's large reserves of fossil fuel, minerals, extensive forests, productive coastal waters, and abundant wildlife have promoted very rapid population and economic growth. In turn, this has created problems of environmental degradation in fragile ecosystems and social and political conflict between Native and immigrant populations. Alaska's northern latitude, harsh climate, unique topography and ecology combine to create special problems of waste disposal, air pollution around population centers, land use, and resource development. The uncertain status of land ownership in Alaska and Federal regulations (viewed by many Alaskans as unnecessary interference) will continue to cause uncertainty in energy and resource development.

The scenario for Alaska specifies an overall reduction in electric generation capacity by 1990. According to the scenario, all natural gas-fired generation (currently the largest contributor to existing capacity) and all hydroelectric generation will be phased out by 1990, while 100 megawatts of coal capacity and 15 MWe of oil steam capacity are to be added. Locations of Alaska's energy facilities is shown in Figure 10-8.

The scenario for Alaska is clearly unrealistic, and its implementation will undoubtedly be resisted. Phasing out of all existing hydroelectric and gas direct drive facilities will result in severe socioeconomic and institutional impacts. In fact, any attempt to reduce Alaska's generating capacity from 1125 MWe to 557 MWe will undoubtedly fail since no institution has the combination of legal authority, political power, or justifiable reason to accomplish the change. The expansion of the coal-fired facility near Mt. McKinley could be impeded due to air quality impacts in this mandatory Class I area. Although the exact route of a natural gas pipeline to the lower 48 states is not specified in the scenario, various water quality, ecological, socioeconomic, and land use impacts could occur depending on the route chosen. Industrial sitings could be restricted in some areas where

national ambient air quality standards or PSD Class I or Class II increment standards will not be met.

Air

o Figure 10-12 shows the two scenario-projected non-attainment Air Quality Control Regions for Alaska in 1990.

Figure 10-12. Alaska: Projected Nonattainment Air Quality Control Regions in 1990

o Construction and operation of a coal-fired plant expansion in central Alaska would cause air quality impacts in Mount McKinley National Park, a mandatory Class I area.

Description

Generally air quality throughout Alaska is very good. Most of the state does not contain non-natural air pollution sources (ADEC 1977a). About 165 air pollution sources currently operate under air quality control permits issued by the state. Five of these sources require variances from regulations and are on schedules to attain compliance within the next five years. These include a pulp mill, three sawmills, and a urea-ammonia plant (ADEC 1979a).

During the three-year period ending in 1976, eight of Alaska's 18 election districts recorded concentrations of pollutants that exceeded primary air quality standards. Figure 10-13 shows pollutant and number of days that standards were exceeded for each of the eight election districts. The primary air quality problems in the state are the high wintertime level of carbon monoxide (CO) occurring in Fairbanks and Anchorage. Both of these

Figure 10-13. Alaska: Election Districts Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978

cities have been designated CO non-attainment areas (ADEC 1977a). Carbon monoxide is generated almost exclusively by automobiles, and is trapped by cold-weather temperature inversions. The CO standard was exceeded in Fairbanks approximately one day in every four and in Anchorage one day in 14. Transportation control plans have been prepared for both cities; the Fairbanks plan has been adopted and the Anchorage plan is awaiting final action (Fairbanks North Star Borough 1979, Municipal Planning Department 1971).

The Valdez district has also been evaluated as a non-attainment area for sulfur dioxide (SO_2) (ADEC 1977a). This pollutant is generated by activities at the shipping terminal of the Trans-Alaska pipeline and is associated with tanker traffic (Ester et al. 1976). Projections of possible violations prior to startup of terminal operations led to a recommendation by the state to declare the area in non-attainment status (Ester et al. 1976, ADEC 1978a). Recent data indicate that emissions of sulfur oxides (SO_x) from tankers are lower than anticipated (ADEC 1979b). The associated oil companies are currently conducting further studies of tanker emissions. The current position of the state is that Valdez should be considered in attainment if tanker emission data are confirmed to be at acceptable levels (ADEC 1977a). Another potential air quality impact is the currently proposed construction in the area of a large petroleum refinery. This facility would increase the present level of emissions.

Alaska also has a suspended particulate matter problem. High particulate levels are caused by windblown dust and dust entrained by motor vehicles on unsurfaced roads (ADEC 1977a, ADEC 1975a). There are four mandatory

Class I areas in Alaska. The areas are identified in Figure 10-9. Visibility in Alaska's four Class I areas was not calculated due to incomplete data. However, visibility in Class I areas is not anticipated to decrease under the scenario.

Background Issues

- o Control of the CO problem in Fairbanks and Anchorage is the most difficult problem facing the state. Automobile emissions cannot be completely controlled, so strategies for reducing CO levels must consider ways of altering transportation patterns (ADEC 1977a). Both cities are expected to be in compliance by 1987 (ADEC 1979a).
- o A proposed regulation of the EPA required removal of 85% of the sulfur from the emissions of coal-fired power plants (EPA 1978a). Alaskan coals are known to be of very low sulfur content; coal currently produced in the state contains less than 0.25% sulfur. Removal of 85% of this quantity is amenable only to expensive control technology, and is regarded by the state as unnecessary (ADEC 1977b).
- o A second proposed regulation requires water injection to control NO_x emissions for new gas turbines (EPA 1977). Because of water availability problems in northern Alaska, the area's good air quality, and the limited anticipated development of this generating technology, this regulation is considered by the state as unnecessary (ADEC 1977b).
- o Continued development of energy-related facilities may pose air quality problems. Since most areas of this state are currently very clean, rules that prevent significant deterioration could restrict industrial development at certain locations such as the Kenai Peninsula and Valdez.

Scenario-Induced Changes

- o Lead lab analysis indicates that there will be two non-attainment air quality control regions for Alaska in 1990. Non-attainment will result from operation of oil shipment facilities and other industrial facilities projected for those areas by the Trendlong Mid-Mid scenario.
- o According to the scenario, a 150 MWe coal-fired generation facility is to become operational near Mt. McKinley National Park by 1985. The site also contains the state's only existing coal mine, as well as a 25 MWe facility that supplies electricity to Fairbanks. The capacity of the proposed new facility was reduced to 105 MWe and, early in 1979, plans for the facility were cancelled by the utility because of inflationary cost escalation and excessive emissions requirements (Anchorage Daily News, December 27, 1978). The site is located only 10 miles from Mt. McKinley National Park, a Class I area. Construction and operation of the coal plant expansion may cause air quality standards for Mt. McKinley National Park to be violated.
- o Should a natural gas pipeline be built to transport gas from the North Slope fields, air quality impacts may occur from construction, operation, and decommissioning of the system.

Water

- o Construction of the Trans-Alaska natural gas pipeline could adversely affect water quality, through both erosion of disturbed areas and through accidental discharges of pollutants. The magnitude of this impact is not known.
- o Scenario projected water quality violations for ASA 1901 in 1990 are shown in Figure 10-14. The water quality violations are not associated with energy facility development.

Figure 10-14. Alaska: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) in 1990

Description

Alaska has extensive water resources, estimated to be roughly one-third of the nation's freshwater supply. On a statewide basis, supplies of water substantially exceed demand and will continue to do so for the foreseeable future. However, because of Alaska's unique combination of geology and climate, these water resources are not always readily available (U.S. Water Resources Council 1978).

Available data indicate that the majority of rivers in Alaska are relatively unpolluted (EPA 1978a). The lower portion of the Chena River which is a tributary to the Lower Yukon River (Figure 10-1), is in an unknown status, even though in the past it has had water quality problems from its

confluence with the Little Chena River to its mouth. This river flows through the metropolitan area of Fairbanks and has been adversely affected by inadequately treated domestic sewage and urban runoff (EPA 1978a). Most of the remaining rivers can be assumed to meet Federal goals because they are located in remote, sparsely populated areas of the state.

Some violations in Federal water quality goals are expected to occur. High concentrations of heavy metals currently exist in the Susitna River. In the future, dissolved oxygen, organic toxicity, and inorganic toxicity problems can be anticipated in streams near urban centers where waste discharge and urban runoff programs have not been fully implemented. High suspended solids and turbidity are now present, but unmeasured, in streams where placer mining occurs (EPA 1978a).

Background Issues

- o Several hydro projects are being considered in Alaska. Impacts could be associated with projects such as the 1500-MWe complex proposed for the Susitna River. The considerable seismic activity characteristic of much of Alaska represents a continual danger of dam collapse, with the resulting damage caused by flooding (Alaska Division of Energy and Power Development 1977).

- o Oil terminal facilities, tanker traffic, and off-shore petroleum production create potentials for large oil spills (CEQ 1977) and generate chronic low-level oil pollution, which may be equally damaging. In 1976, the State legislature enacted legislation that includes a comprehensive oil spill prevention program. Most of the legislation, however, has been struck down in court or is still under litigation. Environmental pressures in marine areas may also increase because of expansion of both the commercial fishing industry and Outer Continental Shelf (OCS) development (EPA 1978a).

- o Alaska's wastewater treatment program for municipal and industrial discharges is well advanced, but not yet complete. Continued emphasis on this program will be necessary to maintain water quality. Untreated domestic sewage discharges have been reduced in areas such as the Chena River near Fairbanks; however, many other interior and coastal communities still have inadequate sewage treatment facilities. Most seafood processors and pulp mills are presently increasing their treatment levels. As additional industrial treatment needs are met, water quality in localized problem areas should improve (EPA 1978a).

Scenario-Induced Change

- o Construction of a Trans-Alaska natural gas pipeline could cause water quality impacts through both erosion of disturbed areas and through accidental discharges of pollutants. Construction of the Trans-Alaska oil pipeline was accompanied by over 16,000 oil spills, 50 of which were more than 1000 gallons (ADEC 1974-7).

Ecology

- o The natural gas pipeline may affect the ecology of Alaska to some extent, but specific impacts cannot be identified at this time.

Description

Alaska has an extremely diverse assemblage of habitat types and ecological regions that make generalizations about the ecology of the state difficult. For this reason, it is vital that site-specific factors be taken into account when considering the placement of energy-related facilities.

Almost one-half of Alaska is covered with tundra. The percentage of the state covered by each of the three major types of tundra are: alpine, 23%; moist, 17%; and wet, 9%. Forest covers 37% of the state: common trees are white, black, and Sitka spruce, Douglas fir, western hemlock, white birch, quaking aspen, balsam poplar, and black cottonwood (Joint Federal State Land Use Planning Commission 1973).

Many types of ecological systems are unique to Alaska, due in large part to the state's severe northern climate. Interest has been expressed in preserving some of the outstanding wildlands through the Alaska National Interest Lands Settlement. Fish and wildlife resources in Alaska are an important part of the state's economy and lifestyle of the people. Commercial fisheries are a major contributor to the economy, and commercial and recreational hunting are also important. Especially important to traditional lifestyles in Alaska is the subsistence use of fish and wildlife resources. Subsistence use of wildlife resources has been identified as a priority management objective.

Many native species are sensitive to development activities. The growing population is placing increasing pressure on fish and wildlife resources taken for subsistence, recreational, and commercial purposes. Examples of animals subject to such pressures are the caribou, moose, dall sheep, brown bear, grizzly bear, wolf, bald eagle, waterfowl, Arctic char, and Pacific salmon.

Background Issues

- o Large populations of Canada geese and other migratory birds nest in Alaska during the summer months, and migrate south for the winter. Future developments in these nesting areas may disrupt and reduce populations.
- o Caribou in Alaska migrate long distances from winter to summer habitats, and depend on the availability of vast forage ranges. Three major caribou herds exist in Arctic Alaska; their migratory routes and forage areas vary with time. Widespread petroleum development on the North Slope may threaten to disrupt populations and force them into unusual migratory patterns and ranges.
- o Logging and mining in Alaska have destroyed some natural anadromous fish spawning and rearing areas by changing streambed characteristics and altering flows (DOE-RAP-28 1978). Placer mining and gravel extraction

are also major activities with potential for introducing sediment into streams.

o The Outer Continental Shelf (OCS) of Alaska is believed to contain major undiscovered reserves of oil and natural gas. Areas of potential exploration are remote and subject to severe environmental conditions. These areas also have abundant marine life that might be damaged (Energy Northwest 1977). In 1977, the Secretary of the Interior revised the OCS leasing schedule, partly to set higher standards for environmental protection (CEQ 1977). Oil spills and chronic low-level oil pollution may threaten marine resources. Offshore petroleum extraction and onshore construction of seaport facilities could interfere with commercial fishing activities. Perhaps the most significant issue is the effect on marine mammals of proposed OCS activity in the Beaufort Sea. The Native communities are opposing development where subsistence resources are felt to be threatened (North Slope Borough 1978, ACI 1978).

Scenario-Induced Changes

o The scenario specifies that a natural gas pipeline from Alaska to the lower 48 states will be constructed by 1985, but the exact route has not been chosen. Since the ecological effects of the proposed pipeline will be route-specific, no specific impacts can be identified at this time.

Land Use

o The scenario specifies expansion of the coal-fired facility near Fairbanks. This will require commitment of an additional 105 acres of land for the facility and its associated surface coal mine (Figure 10-15).

o Requirements of land for the natural gas pipeline may conflict with current land uses, but specific problems cannot be identified.

Figure 10-15. Alaska: Scenario Projected Land Use Requirements by Election District for Thermal Power Plants in 1990

Description

Until 1959 when Alaska became the 49th state, about 99% of Alaska was federally owned. To give the new state a resource base, Congress provided in the 1958 Statehood Act that 102.5 million acres of land could be selected by the state within 25 years. As of 1977, nearly 72 million acres had been selected (Alaska Division of Energy and Power Development 1977). Land claims of Alaskan Natives resulted in a Federal Department of the Interior land "freeze" in 1968. In 1971, the Alaska Native Claims Settlement Act (ANCSA) was passed. Under ANCSA, Congress granted Native corporations \$962 million and the opportunity to select 44 million acres of land. In early 1979, the Native corporations had overselected their entitlement by about 36 million acres and had received management title from the Federal Government for approximately 5 million acres.

Under provisions of Sections 17(d)(1) and 17(d)(2) of ANCSA, the Secretary of the Interior in the early 1970s withdrew millions of acres of public land from the operation of most public land laws, including state land selection. These National Interest Lands were subsequently studied to determine the most appropriate land use classifications for Congress to assign. However, Congressional action was delayed longer than anticipated. On December 17, 1978, Section (d)(2) expired, leaving some 60 million acres withdrawn under that section still protected under the less restrictive (d)(1) classification. Some of the (d)(1) lands were left open for exploration of metalliferous minerals and selection under the Alaskan Statehood Act.

On November 16, 1978, as the unsettled land issue neared the (d)(2) expiration date, Interior Secretary Andrus temporarily withdrew some 99 million acres under Section 204(e) of the Federal Land Policy and Management Act of 1976 (FLPMA). The Department of Agriculture used Section (b)(11) of the same Act to withdraw 11.2 million acres. Soon thereafter, on December 1, President Carter designated 56 million acres as national monuments under the Antiquities Act. He also directed Interior Secretary Andrus to proceed with steps to set aside 39 million acres as national wildlife refuges under FLPMA Section 204(c).

Under the Antiquities Act, approximately 40 million acres were set aside as national parks, 14 million acres as national wildlife refuges, and 4 million acres as national forest wilderness areas. Unless overturned by Congress, national monument designation is permanent.

The enacted Section 204(3) of FLPMA allows a withdrawal period of three years while Section 204(b)(1) withdrawals are for two years. The proposed withdrawals under Section 204(c) of FLPMA would be for a twenty-year period. The Secretary of the Interior is unlikely to take final action on the proposal until after Congress has had an opportunity to resolve the land issue later this year.

The Antiquities Act withdrawals were made from land previously withdrawn under Sections 204(b)(1) and 204(e) of FLPMA. The proposed Section 204(c) withdrawals were also already protected by the FLPMA withdrawals of November, 1978. The State is pursuing litigation in the U.S. District Court to overturn the Antiquities Act withdrawals. It charges that

the President exceeded his authority granted under the Act and also that Native and state selections should be granted prior to Federal Government withdrawals.

All of the sections of FLPMA and the Antiquities Act under which land withdrawals have been enacted or proposed prohibit mineral entry and mineral leasing. This precludes new coal, uranium, gas and oil activity. However, valid existing claims can be developed if the environmental standards set forth in the respective withdrawal sections are met.

The Federal administration has assigned top priority to resolving the issue of Alaska's National Interest Lands. The President and Secretary of the Interior viewed the withdrawals as the only way to insure protection of these lands after Congress was unable to resolve the land use issue before the expiration of (d)(2).

Background Issues

- o Debate over Federal land classifications and the resultant prolonged land conveyance process will retard land selections and resource development. Investors may be unwilling to invest in projects until the land status question is resolved.

- o The subsurface rights to all Native lands are owned by Native regional corporations under the terms of ANCSA. In general, the village corporations selected lands that were traditional sites of village subsistence hunting, fishing, and gathering. Some villages may be reluctant to encourage the development of the subsurface resources. However, development of the subsurface resources is generally expected to be approved by the village corporations where such development can be accomplished without serious disruption of traditional lifestyles.

Scenario-Induced Changes

- o Scenario-specified development of Alaskan gas reserves require that a pipeline be built for gas transport. Such a pipeline would require substantial land for construction and right-of-way. Because of the uncertain ownership and management status of the lands through which the pipeline may pass, specific conflicts with other land uses cannot be identified at this time.

Solid Waste

- o No scenario-induced impacts for solid waste disposal are identified.

Description

Alaska has most of the solid waste management problems found in the other states except that no large quantities of industrial and agricultural wastes are currently generated. In addition, Alaska has many other problems that few other states have experienced. These problems are climatic (arctic deserts, permafrost, coastal rainforests), geophysical (vast regions of unsuitable soils, mountainous terrain), and demographic (lack of

surface transportation and scores of isolated villages) (EPA 1978a). For example, no planning of solid waste handling was done during construction of the Trans-Alaska oil pipeline, leaving huge quantities of material to be disposed of when the project ended.

The status of solid waste management in Alaska is difficult to describe. One method of measuring the status of progress is to determine the number of people served by approved, state-permitted disposal facilities. Approximately 67% of Alaska's population was served by sites managed in accordance with permits issued by the state at the end of 1976. This was about 24% more than in 1974 (EPA 1978a).

Background Issues

- o Most municipal waste disposal is accomplished in open dumps, which have problems including poor site selection, poor soils, permafrost, excessive rainfall, and poor management. However, much upgrading of disposal practices has been accomplished in recent years. Site selection is one critical factor, since a proper landfill competes with other uses that typically have higher priority.

- o Because of the great physical difficulties confronting solid waste disposal in Alaska, alternative methods of disposal are being investigated. Utilization of municipal and mill wood wastes as fuel is being investigated, material recycling is being accomplished on a small scale, and waste oil recovery is being evaluated. Especially needed are suitable waste disposal solutions for remote villages (ADEC 1975b).

- o Planning for disposal of wastes generated by large-scale development activities is important for solving solid waste problems. Disposal in northern Alaska has been an extremely difficult matter. Proper planning will allow systematic handling and return of waste materials and prevent the accumulation of waste at undesirable locations.

Scenario-Induced Changes

No scenario-induced solid waste impacts were identified for Alaska.

Health and Safety

- o No scenario-related health and safety impacts were identified by the lead lab analysis.

Description

Both Fairbanks and Anchorage have been designated CO non-attainment areas (Figure 10-13) primarily because of wintertime temperature inversions which prevent dispersion of this automobile-generated pollutant. Levels two to three times the primary standard have been recorded in these cities (ADEC 1977). Determining the impact of high levels of airborne pollutants on the health of the general population is subject to many variables and uncertainties.

Accidental injury always accompanies major development such as petroleum extraction, coal mining, pipeline construction, and OCS activities.

Background Issues

- o Much of Alaska's population lies beyond the reach of community water supplies and sewage treatment systems. Adequate individual water and sewage systems may be very difficult to establish. A serious health hazard may occur where septic tanks affect water supply. Many villages still melt ice for water supply and use "honey buckets" for sewage disposal.
- o In more densely populated areas of the state, such as Anchorage, Fairbanks, and Juneau, air pollution concentrations often exceed alert levels. Alert level violations represent significantly higher health risks than violations of the primary standard (EPA 1978a).
- o Many villages in Alaska are accessible only by air; emergency health care may be contingent upon this form of transportation.

Scenario-Induced Changes

- o Extraction of Alaskan natural gas reserves requires that a pipeline be constructed for gas transport. Such a pipeline would require substantial construction activity. The pipeline is still in the planning stages; therefore, health and safety impacts were not included in the scenario analysis.

Socioeconomic

- o Reduction in gas-fired and hydroelectric capacity called for by the scenario would have large socioeconomic impacts, especially when alternative means to meet demands are not provided.
- o The socioeconomic impact of the construction of the Trans-Alaska natural gas pipeline will be significant.

Description

Alaska's population, though small relative to other states (408,000 in 1976), has grown at a rapid rate, increasing by 34% from 1969 to 1970 and by 35% from 1970 to 1977. However, with completion of the oil pipeline, population fell to an estimated 403,000 by October 1978. Forecasted growth indicates an increase to 411,000 by 1980. About 50% of the population is presently living in the metropolitan area of Anchorage. About 40% of Alaska's population growth between 1970 and 1975 can be attributed to net immigration, primarily persons in the labor force between the ages of 20 and 30. Persons over age 40 have tended to outmigrate, resulting in a relatively young population. The balance of Alaska's growth is due to the excess of births over deaths, again influenced by the large portion of couples of childbearing age. Alaskan Natives represent about one-fifth of the total population, and they tend to reside in the smaller towns and villages. An estimated 4% of the Anchorage metropolitan area is Native, representing approximately 32% of the total Native population in 1977. Projections of Alaska's population size into the future under a variety of

plausible assumptions suggest that the state's population will concentrate in the Anchorage and Fairbanks area.

Alaska's economy grew quite rapidly between 1965 and 1975. Per capita income in the state grew from \$3,435 to \$5,587 (in 1967 dollars) throughout this period. The value of real output produced by the Alaskan economy grew at a substantially faster rate than that of the U.S. as a whole; a 9.9% rate of average annual growth in 1972 dollars (1965-1975) for the State of Alaska as compared to a 2.6% rate of growth for the U.S. gross national product. The agricultural, forestry, and fisheries industries grew substantially in this same period, as did the construction industry. Government, trade, and the services also account for much of the employment in the state. The average yearly personal income in the state in 1977 was \$10,586, the highest average income for any state in the U.S.

Background Issues

- o The Alaskan economy has recently experienced extremely rapid growth, spurred in part by the Trans-Alaska Oil Pipeline and other energy development activities. This growth has stimulated a rapid influx of outside influences, which offer lifestyle options that were previously unavailable to the Alaskan Natives. Many Native villages have a lifestyle based on subsistence hunting and fishing with little outside interference. Development near Native villages tends to affect, for better or worse, this lifestyle (Alaska Division of Energy and Power Development, 1977). The negative aspects of very rapid growth and sociocultural change have, in some cases, led to the opinion that outside development is something to be avoided. Also, during the construction of the oil pipeline, Natives and residents were not hired on a priority basis, partly because of lack of needed skills. This has caused some resentment.

- o Population growth rates in parts of Alaska have been very rapid in recent years, and have caused social and economic disruption at the community level. These growth rates are due to people migrating to Alaska in search of employment opportunities and high wages. A serious economic problem is caused by immigration in excess of employment opportunity. This "excess migration" contributes to the state's high level of unemployment.

- o Many villagers expressed skepticism about the merits of the development of the Beluga coal field. The presence of outsiders who have a different cultural lifestyle is viewed with suspicion and concern. Some villagers felt that outside influences have contributed to increases in alcoholism and drug abuse in Native villages (PNL 1979).

- o Alaska's skewed population distribution and dispersed population centers will have important socioeconomic consequences. Anchorage is a "young" city and its lifestyle is significantly different from the small villages of the coast and interior. Future concentration of population in one or two major metropolitan areas suggests that persons with conflicting life-styles will be able to coexist in relative isolation from one another for many years to come (Seiver 1976).

- o A survey of residents of the Fairbanks area in 1976 indicated the kinds of social and economic disruptions that can be attributed to energy development (Kruse 1976). Residents of Fairbanks felt that the oil pipeline led to increased inflation, overcrowding, and a deterioration of the natural environment. Residents of Fairbanks believed that they had to bear the social and economic costs of the pipeline disproportionately to the benefit it provided. Many perceived that they had to sacrifice values important to their family, especially being together as often as they wanted. Over the longer term, traditional Alaskan concern for the attainment of a self-reliant lifestyle seems to be giving way to a desire for high income and an exciting job experience. Conflict between economic gain and deterioration in quality of community life in Alaska is an issue that will accompany energy development in the foreseeable future.

- o Some evidence suggests that a significant portion of the wages earned on the oil pipeline project were not spent in the State of Alaska (The Alaska Economic Information and Reporting System 1977). Also, failure to reinvest capital in the local economy has serious implications for the social and economic health of the state. This issue is equally pertinent to future energy developments in Alaska.

- o Alaska's growth is being driven primarily by revenues from energy production. Determining how these revenues are used will be an important factor influencing whether future growth is relatively uniform, thereby minimizing social and economic disruptions.

Scenario-Induced Changes

- o The scenario calls for no gas-fired generating capacity for 1985 and 1990. Currently, approximately 50% of the total generation in Alaska is of this type. This elimination of capacity would have a high impact, in terms of its effect on personal income, levels of unemployment, and the health of the economy that is dependent on existing, if not growing, energy production.

- o The 1985 scenario indicates a reduction in total capacity for all technological alternatives to about one-half of current capacity. Without alternative means by which to increase capacity, local socioeconomic impacts would be very high, and economic consequences for the region could be severe.

- o Similar to the impact of the Trans-Alaska pipeline system, the socioeconomic impact of the gas pipeline would be important in terms of changes in lifestyle and economic changes that would occur. Analyses performed under the Man-in-the-Artic Program (MAP) indicates that regardless of the actual route chosen for the gas pipeline, the bulk of the impacts will occur in Anchorage, even though the routes do not pass through the city. This is the case because Anchorage is of such critical importance as a commercial center in Alaska (Kresge 1976). Another factor potentially contributing to the socioeconomic effects of the gas pipeline is the timing of the construction relative to other planned developments in the state. The longer the delay in starting the project, the greater the economic instability due to higher costs and the greater competition for scarce human and financial resources (The Alaska Economic Information and Reporting System 1977).

Institutional

o Any attempt to reduce Alaska's generating capacity from 1125 MWe to 557 MWe, as specified in the scenario will undoubtedly fail. No institution has the requisite combination of legal authority, political power, or justifiable reason to accomplish such a reduction.

Description

Energy development in Alaska is affected by three sets of institutions: the Federal Government, the State Government and the Alaska Native corporations.

The key importance of the Federal Government stems mainly from ultimate Federal ownership (when state selections are completed) of about 60% of Alaska's uplands, an artifact of Alaska's prestatehood days (Alaska Division of Energy and Power Development 1977). The availability of Alaska's federally held lands for extraction and transportation of energy resources depends on its legal status. Resource preservation lands (the National Parks Systems administered by the National Park Service of the Department of the Interior; the National Wilderness Preservation System administered by the U.S. Forest Service in the Department of Agriculture; the National Park Service for the U.S. Fish and Wildlife Service of the Department of the Interior; and the National Wildlife Refuge System administered by the U.S. Forest Service; National Resource Lands administered by the Bureau of Land Management (BLM) of the Department of the Interior) are generally open to energy development, subject to the land use planning and leasing policies of the Forest Service and BLM. Other Federal lands, such as the National Petroleum Reserve of Alaska administered by the Department of Energy, represent major energy resources not now available for development.

The Federal government also has important responsibilities in connection with the proposed Natural Gas Pipeline. The President has already chosen the route, pursuant to the Alaska Natural Gas Act of 1976 (15 USC 791-7190). The Federal Energy Regulatory Commission will be involved in setting end use and well head prices for the gas.

Finally, pursuant to the Outer Continental Shelf Land Act, 43 U.S.C. 1331-1443, BLM is responsible for granting pipeline rights-of-way and issuing oil and gas leases.

The State Government of Alaska plays a variety of important roles in energy development. Under the Statehood Act of 1958, the State is entitled to select approximately 28% of Alaska's uplands, a process that must be completed by 1984 (Alaska Division of Energy and Power Development 1977). Thus, the State itself is a land owner second only in importance to the Federal Government.

Major state institutions which influence energy development in Alaska include the Department of Environmental Conservation, which coordinates state environmental policies and sets pollution standards as well as standards for oil and gas pipeline construction and operation (AS Chapter 44.46); the Department of Transportation and Public Facilities, which

regulates tanker vessel traffic in coastal and inside coastal waters to prevent oil spills (AS 30.20.010); the Alaska Division of Energy and Power Development, which develops power, energy conservation, and energy resources (Alaska Administrative Order 21); the Alaska Public Utilities Commission, which regulates rates and issues certificates of public convenience and necessity for publicly owned, investor-owned, and cooperative electric utilities (AS 42.04.010-42.05.721); Alaska Power Authority, which constructs, acquires, finances, and operates hydroelectric and fossil fuel generating facilities (AS 44.56); the Department of Natural Resources, which administers state mining laws, leases state lands for the exploration and extraction of minerals, regulates oil, and gas drilling (AS Titles 27, 38, and 31); and the Alaska Pipeline Commission within the Department of Commerce and Economic Development, which regulates pipeline facilities and pipelines carriers (AS 42.04.010-42.06.640).

Yet a third important set of institutions are the twelve Alaska Native regional corporations established pursuant to the Alaska Native Claims Settlement Act of 1971 (ANCSA) (43 U.S.C. 1601-1628). Under the Act, Alaska is divided into twelve regions. The Native Alaskans residing in each region have become the shareholders of a corresponding for-profit corporation whose assets will include about 10% of Alaska's uplands as well as approximately \$1 million in Alaskan Native funds.

Background Issues

o The major issue is the uncertain status of federally held lands. Section 17(d)(2) of ANCSA, 43 U.S.C. 1616, directs the Secretary of the Interior to withdraw from appropriation up to 80 million acres of land in Alaska for possible designation by Congress as additions to resource preservation lands, largely closing them to Federal development. Because Congress had not acted by December 18, 1978, when the withdrawals would have terminated pursuant to ANCSA, the Carter Administration temporarily withdrew 149 million acres under the Federal Land Policy and Management Act of 1976 43 U.S.C. 1701-1782, and designated about 56 million acres as National parks, wildlife refuges, and forest wilderness lands under the Antiquities Act (16 U.S.C. 431). Three Alaska land bills are presently before Congress. The most restrictive bill, sponsored by Representatives Morris Udall and John Anderson, has the support of the Administration, as President Carter has threatened to veto less restrictive alternatives. Under the Udall-Anderson Bill, substantial portions of Federal land would be precluded from energy development. Obviously, the stakes are high. The Administration/Udall/Anderson position has aroused the opposition of logging and mining companies, Native corporations, and some Federal and state agencies. At the same time, support for tight restrictions by environmental groups and other Federal and state agencies is equally intense. The outcome is uncertain but critical; it is likely to determine the course of energy development in Alaska for years to come.

o A second issue affects energy development on native corporation lands. Because the corporations are for-profit, their management has a duty to shareholders to manage the firm's assets profitably; most likely, through the development of energy resources on corporation lands. A variety of institutional impediments are slowing such development, however. First, because of disagreements with the Federal Government

over easements and transportation corridors, much of the land has not actually been conveyed to the corporations. Lacking title, they cannot have rights to development of mineral resources. Second, Section 7(e) of ANSCA, 43 U.S.C. 1606, requires that 70% of the resources generated by mineral resources on a given corporation's land be split pro rata among all twelve native corporations; thus reducing the benefits to the corporation and energy development. Third, each corporation's constituent villages have a veto over development on their local lands.

- o A third issue stems from development of Outer Continental Shelf (OCS) oil and gas reserves. Alaska's Continental Shelf represents 65-70% of the U.S. total reserves. Current estimates place crude oil potential at between 15 and 50 billion barrels, and natural gas potential at between 71 and 295 trillion cubic feet (Alaska Division of Energy Development 1977). Areas of high potential include the Northern Gulf of Alaska, Lower Cook Inlet, and Western Gulf OCS areas on the south, the Bristol Bay area north of the Aleutian Chain, and areas around the Seward Peninsula and the Beaufort Sea of the North Slope. At present, there is uncertainty concerning jurisdiction over certain parts of those areas. In principle, the state owns the tide lands plus the three nautical mile coastal strip of the Continental Shelf; the Federal Government owns the submerged lands seaward of the State's lands to the 200 meter depth. But no agreements have been reached as to the exact boundaries. Until such an agreement is reached, development is unlikely to proceed.

- o A fourth issue concerns financing of the Alaska Highway Pipeline Project, whose route was selected by President Carter and Prime Minister Trudeau September 8, 1977 and approved by Congress on November 8, 1978. Current estimates place the project's cost at \$10-15 billion, making it the most expensive private undertaking in history. Both the President and the project sponsors have maintained that the pipeline can be financed privately without Government assistance. However, depending on the end-use and wellhead prices for the gas established by the Federal Energy Regulatory Commission pursuant to the Natural Gas Policy Act of 1978, P.L. 93-621, and other statutory authority, additional Federal guarantees may be necessary to attract the requisite investment.

Scenario-Induced Changes

- o Implementation of the Trendlong Mid-Mid Scenario which cuts electric generating capacity in Alaska to half of current capacity will produce institutional impacts.

IDAHO

Idaho does not have significant fossil fuel reserves. Nearly all (97%) of the state's electric generation capacity is hydroelectric. The state produced 7% of the 141 million MWh of electric energy produced in the Region in 1975. Hydroelectric generation will continue to dominate Idaho's electric generation in the foreseeable future. Expansion of Brownlee Dam (Figure 10-8) is currently under way. Expansion of the Dworshak, Hells Canyon, Bliss, Lower Salmon, and Oxbow projects are under consideration. In addition, a number of hydroelectric sites with smaller potential have been identified.

Several technologies for thermal power generation are under investigation. Several years ago, Idaho Power Company proposed construction of two 500 MWe coal-fired generating plants near Orchard, Idaho in Ada County. Idaho's Public Utility Commission rejected the proposed site primarily because of anticipated air quality problems. Other sites for at least one of the coal-fired plants are under consideration. In addition, the Raft River geothermal resource area in Cassia County is the site of two 5 MWe pilot electric generating plants. This reservoir has the potential to contribute up to 50 MWe to the state's power supply by 1990.

Idaho is undergoing rapid population and economic growth as the state's abundant forest and mineral resources, agricultural lands, and recreational opportunities continue to be developed. As in many fast growing areas, Idaho faces problems of unplanned residential expansion on to valuable agricultural lands, air pollution in urban centers from automobile exhaust, destruction of natural habitats, and social conflicts among groups having different values. Ever increasing and often competing demands for limited water resources may exacerbate existing water quality and availability problems, especially in southern Idaho. Demands for energy will increase, and since the investor-owned utilities serving most of the state do not have access to low-cost hydroelectric power generated by Federal water projects, Idaho is pursuing its own program of hydroelectric and other energy development to meet expanding demands.

The scenario specifies that 2,432 MWe of electric generation capacity will be operational in Idaho by 1990. System additions will be made to conventional hydroelectric and geothermal technologies. The scenario specifies that 50 MWe of natural gas capacity will be dropped and 50 MWe of oil capacity will be added. Location of Idaho's energy facilities is shown in Figure 10-8.

No major issues have been identified for Idaho that would restrict development of the facilities projected under the scenario. Almost all of the scenario specified geothermal and hydroelectric capacity additions can be made at existing facilities, resulting in limited impacts on air quality, water quality, ecology, and land use. The switch from natural gas-fired to oil-fired generation will also result in minimal impacts on air quality, water quality, ecology, and land use. Because of the remote locations of these facilities, localized socioeconomic impacts will be experienced but will not impede development of the facilities.

Industrial facility expansion projected by the scenario will be restricted in areas where the National Ambient Air Quality Standards and PSD Class I or Class II increment standards are not met.

Air

- o Additional industrial facilities sited by the scenario will cause two air quality control regions to remain in nonattainment in 1990 (Figure 10-16).
- o Visibility in mandatory Class I areas in Idaho will increase. Figure 10-17 shows the projected visual range for Class I areas in 1990.

Figure 10-16. Idaho: Scenario Projected Nonattainment Air Quality Control Regions in 1990

Description

The overall air quality of the state of Idaho has been improving in recent years (EPA 1978). Particulate matter (TSP) violations are the leading cause of air quality violations, with carbon monoxide (CO) and sulfur dioxide (SO₂) standards violations occurring in the more populated or industrialized counties. Most of Idaho's counties either do not conduct air quality monitoring or monitoring to date is insufficient to draw valid conclusions.

During the three year period ending in 1976, 11 of Idaho's 44 counties did not meet one or more air quality standards (see Figure 10-18). All of those counties in violation of air quality standards exceeded the standard for TSP. The SO₂ standard was exceeded in Shoshone County on 30% of the days in 1976, reflecting the intense mining and smelting activities in that county. Bannock County exceeded the SO₂ standard on 10% of the days, probably because of the agricultural chemical industry located there. Ada County, where the state's capital and largest city is located, was the only county monitored for CO and the standard was exceeded on about one-third of all days in 1976 (EPA 1978b).

About one-third of all instances of air quality violations in Idaho involved concentrations of pollutants at or above the "alert" level. Alert level violations represent significantly higher health risk than violations of the primary standard. Almost 80% of the more serious conditions occurred in Ada, Bannock, Caribou, Shoshone, and Twin Falls Counties where approximately one-third of Idaho's population and most of its industry is located (EPA 1978b).

Figure 10-17. Idaho: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, miles

Figure 10-18. Idaho: Counties Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978b

There are five mandatory Class I areas in Idaho. The areas are identified in Figure 10-19.

Background Issues

- o Fugitive dust is responsible for a large share of Idaho's particulate standards violations. While control of point sources of particulates is relatively easy and inexpensive, control of nonpoint sources (fugitive dust) is usually not amenable to simple solutions.
- o Areas presently not meeting the Federal SO₂ air quality standard can be traced to two point sources; the smelting and mining complex at Kellogg in Shoshone County and the agricultural chemical facilities at Pocatello in Bannock County. Application of currently available technology can (and already has) reduced the severity, frequency, and duration of violations, but localized climatic conditions may make total control of SO₂ violations difficult, especially in the Kellogg area.
- o As in other urban areas of the nation, transportation is the major source of CO in Boise (Ada County). The private automobile undoubtedly is responsible for most of this localized problem. As new automobiles with better emission controls and implementation of local programs to reduce travel in the city center and commuter corridors are phased in, a gradual reduction in CO and NO_x levels should occur (EPA 1978b).

Scenario-Induced Chagnes

- o Siting in nonattainment areas is the major standard applicable to new industrial and energy facility sitings in Idaho. Constraints are anticipated for sitings in Bannock, Caribou, Nez Perce, Shoshone, and Twin Falls Counties.
- o As with any major construction project, construction of geothermal or hydroelectric facilities may create short-term problems of fugitive dust and/or exhaust emissions from construction equipment.
- o Siting of industrial plants near Class I areas will be restricted.
- o The scenario specifies 200 MWe geothermal generating capacity in Idaho by 1990. Local air quality impacts in Cassia County will result from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of the most concern. Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron, in the form of boric acid, may also be emitted in cooling tower drift.

Water

- o Competition for the limited water resources in southern Idaho could restrict energy facility siting in that area.

- o Expansion of hydroelectric sites in the northern part of the state will alter stream flow characteristics and cause water quality impacts.

Description

Except for a few localized areas, the state of Idaho faces few water quality problems. The northern portion of the state contains numerous mountain streams and rivers, and several large, clear lakes. The south is served by only one major river system, the Snake and its tributaries. In addition, the Snake River Plains aquifer underlies an area of about 9500 square miles and is an important source of municipal and industrial, as well as irrigation water. A total of about 13.5 million acre feet of storage space in major existing reservoirs and about 2 million in smaller impoundments has been developed for irrigation, power generation, and compatible multiple uses (Pacific Northwest River Basins Commission 1979). Most of that storage capacity is in the Snake River Basin.

The most common forms of pollution in Idaho rivers and reservoirs are excessive dissolved and suspended solids, turbidity, and nutrients (Figure 10-19) (EPA 1978b). Agricultural irrigation combined with naturally high salt concentrations contribute excessive dissolved mineral salts to the Bear River system in the southeastern corner of Idaho. Excessive salt concentrations are also found in the Middle and Upper Snake River from ground water inflow and agricultural irrigation runoff.

Inorganic toxicity resulting from high concentrations of heavy metals from smelting and mining operations occur in the Coeur d'Alene River/Pend Oreille River system in the northern Idaho Panhandle, in the Boise River tributary of the Snake River in the south from industrial activities, and in Henry's Fork, a tributary of the Snake River from unknown natural sources (EPA 1978b). Organic toxicity data for Idaho rivers, reservoirs and streams is lacking although agriculture and forestry make extensive use of herbicides and pesticides throughout the state (EPA 1978b).

Background Issues

- o Perhaps the biggest issue involving water resources in Idaho is the ever increasing, often conflicting and competing demands on the limited water resources of southern Idaho by agriculture and other uses such as fish and energy production.
- o Idaho's objective of reducing its dependence on outside sources of electric energy, primarily by increasing its hydroelectric generation capacity, faces several constraints including: 1) water quality limitations based on Public Law 92-500, affecting water use for thermal plants, 2) stream and area classifications such as Wild and Scenic Rivers and National Recreation Areas which prohibit hydroelectric projects, 3) priority of the use of water in upstream areas for irrigation over power generation at the Hell's Canyon, Brownlee and Oxbow power projects on the Snake River, and 4) Federal Energy Regulatory Commission stipulations regarding minimum outflows at Hell's Canyon Dam (Pacific Northwest River Basins Commission 1979). Location of these facilities is shown in Figure 10-8.

Figure 10-19. Idaho: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

- o Maintenance of adequate instream flows required for fish wildlife habitat, recreation, and other uses. Anadromous fish have particular needs for upstream and downstream migration, spawning, and rearing. Additional research is needed to establish and confirm minimum flow requirements and the suitability of present fish passage methods in order to maximize the benefits of multiple uses of limited water resources (Pacific Northwest River Basins Commission 1979).
- o There are problems of finding adequate and acceptable sources of water for irrigation use. Competing nonconsumptive instream flow uses will continue to increase (Pacific Northwest River Basins Commission 1979).
- o Because Idaho's border with Oregon and Washington is within the Columbia and Snake River systems, the interstate water relationships between the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources of the Columbia River system, interstate problems are increasing in significance and becoming more difficult to resolve (Pacific Northwest River Basins Commission 1979).

Scenario-Induced Changes

- o The high demands placed on the limited water resources of southern Idaho may ultimately determine the course of energy development in that state. It is unlikely that any energy-related developments projected by the scenario will be allowed if they result in diminished quality or quantity of water resources already in short supply.
- o Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measureable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or surface waters, is dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature change is amplified because the optimum growth temperature often is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers need to be studied.

Ecology

- o Expansion of generation capacity at existing hydroelectric plants will further impact anadromous fish populations.
- o Construction of new hydroelectric facilities will inundate riparian habitats and impede free-flowing streams.

Description

The state of Idaho contains a diverse assemblage of habitats and ecosystems, ranging from alpine meadows and dense coniferous forests in the mountainous north to sparsely vegetated arid plateaus in the south. Elevation ranges from 730 feet to 12,600 feet. Precipitation also shows

wide variation, amounting to as little as seven inches in the south central plateaus to over 70 inches in the northern mountains. Recorded temperature extremes are -60 F and 118 F (Pacific Northwest River Basins Commission 1979).

Basically, the state consists of two distinct physiographic provinces; the northern Rocky Mountains and the Snake River Plateau. The northern Rocky Mountains area includes the rugged, mountainous Idaho Panhandle and central Idaho. The Snake River Plateau of southern Idaho is an extensive volcanic plateau ringed by mountains and consists of two subareas at different elevations and having different characteristics.

Background Issues

- o Interspersion of native plant communities with areas modified by man has induced ecological stress on native plant, fish and wildlife populations. Further changes in land use and extensive development of agriculture will undoubtedly increase the stresses and reduce the amount of habitat available.
- o In many areas, forest ecosystems are intensively managed for maximum timber production to the detriment of some components of the natural ecosystem.
- o Continued discharges of SO₂ from smelters near Kellogg in Shoshone County have denuded the surrounding hillsides. The situation is improving (EPA 1978b), but the long-term, widespread effects of SO₂ on the surrounding area is largely undetermined.
- o Expanding agriculture, especially irrigated agriculture, may have widespread effects on ground and surface water quality and aquatic ecosystems. Increased nutrients may cause increased eutrophication of receiving bodies of water.

Scenario-Induced Changes

- o The scenario envisions expanded hydroelectric generating capacity for Idaho. This additional capacity is principally accommodated at existing dams. Construction and operation of these facilities will further impact anadromous fish populations. In addition, construction of new facilities will inundate riparian habitat and impede the free-flowing character of rivers and streams.

Land Use

- o The major scenario induced impact on land will be due to construction of hydroelectric projects, which will cover some river canyons and bottom land.

Description

Land use capability is largely determined by the following physical factors: 1) character and kind of soil, 2) associated land features, and 3) climate. Most of the economy of Idaho is based upon use of the state's

natural resources, primarily forestry, mining, agriculture, and recreation/tourism. Timber production and associated milling activities, as well as mining in the Kellogg-Coeur d'Alene area of Shoshone and Kootenai Counties, make up the major share of the economy of the northern Idaho Panhandle. Livestock production and associated hay farming is important in the broad valleys separating rugged mountain ranges in east central Idaho. The Snake River plateau supports an economy based mainly on agriculture. This area is extensively irrigated and produces row crops such as potatoes, beets, beans, corn, as well as wheat and hay. Livestock production includes sheep and beef cattle. Much of the land in southern Idaho is rangeland used for livestock grazing.

The mountains of northern Idaho support extensive forests of mixed species of true firs, Douglas fir, western larch, western red cedar, and white and ponderosa pine. The river basins of the Idaho Panhandle and lower Snake contain some 20.8 million acres of forest covering about 80% of the land in these areas (Pacific Northwest River Basins Commission 1979). Forests cover 41% of Idaho's total land area, making up about 4.4% of the Nation's total forest area, and produce about 2.5% of the total timber cut (Pacific Northwest River Basins Commission 1979). The major portion of these forests are managed by the U.S. Forest Service as part of the National Forest System under multiple use concepts. Private harvest of national forests is managed and regulated to provide sustained yield. Much of this forested land is grass-covered, especially in east central Idaho, providing a significant amount of forest range for livestock.

Rangeland covers about 22.2 million acres of Idaho, making up about 43.7% of the total land area (Pacific Northwest River Basins Commission, 1979). Bunch grass and other perennial grasses, and various perennial forbs and shrubs are typical of Idaho's rangeland. Open grasslands are characteristic of higher elevations and provide good summer range for cattle and sheep, as well as wildlife such as deer and elk. Rangelands at intermediate elevation, are often interspersed with timbered areas, especially in northern Idaho. Lower elevation rangeland contains more sagebrush and shrubs and covers a large portion of southern Idaho.

On all rangeland there are areas where the original desirable vegetation has been replaced by undesirable vegetation as a result of overgrazing, natural or man-caused fires, drought and other abusive uses. Noxious and poisonous plants are common in certain localities, greatly diminishing the value and amount of rangeland for livestock grazing and wildlife (EPA 1976). A fundamental problem facing the Bureau of Land Management, which manages most of the state's rangeland, is how to maintain and improve the quality of rangeland vegetation while providing for grazing by livestock (Pacific Northwest River Basins Commission 1979).

There are about 6.0 million acres of cropland in the state of Idaho, comprising about 11.7% of its total area. Of that 6.0 million acres, almost 60% of it is irrigated, primarily on the Snake River Plateau (Pacific Northwest River Basins Commission 1979). Irrigated land has a seasonal ground cover each year, while dry cropland used to grow wheat and barley is usually cropped every other year because of the scarcity of moisture (Pacific Northwest River Basins Commission 1979).

Only about 3.5% or 1.8 million acres of Idaho is devoted to uses other than those discussed. Such uses (or nonuses) include urban and industrial areas, roads and railroads, airports, bare rock and sand, and bodies of water.

Background

- o There is currently a heated debate over the outcome and implementation of the Roadless Area Review and Evaluation (RARE II) study conducted by the U.S. Forest Service. The study seeks to identify those areas best suited for inclusion into the Federal wilderness system and those best suited for other uses such as multiple use National Forests. A large portion of the RARE II lands under study in the Northwest are located in Idaho. Mining and timber industries contend that more lands should be opened for resource development or else the state's economy will suffer considerably. Preservationists argue that many of these lands are irreplaceable and should be closed to development for the enjoyment of future generations as wilderness.
- o Urban land management problems include the effects of unplanned expansion of urban residential development into agricultural and flood hazard areas. Expansion on to agricultural land preempts valuable agricultural production.
- o Mining area problems include loss or severe alteration of the land resource base by strip mining and waste disposal, and associated environmental degradation. There exists a need to restore areas damaged by past mining activities, particularly in the South Fork Coeur d'Alene district in Kootenai County and phosphate mines of southeastern Idaho near Pocatello in Bannock County (Pacific Northwest River Basins Commission 1979).

Scenario-Induced Changes

- o Most of the hydroelectric generating capacity specified by the scenario can be met by expansion at existing facilities. If new facilities are needed, these will cover some river canyons and bottomland. Impacts will primarily be felt locally.
- o Energy development may bring population and industrial growth and associated problems of further development.

Solid Waste

- o No scenario induced impacts in the area of solid waste were identified.

Description

In 1976, 570,000 people, or about 60% of Idaho's population, was served by solid waste collection and disposal facilities approved by the state. This represents a 33% increase in five years. Some mining operations in Idaho produce large amounts of tailings which require proper management to prevent adverse environmental impacts. The forest products industries

generate large amounts of solid waste. This waste could be utilized as a resource by using it in combustion boilers to produce industrial steam or electricity. Idaho has a state-licensed hazardous waste disposal facility which uses abandoned missile silos. It is one of two hazardous waste disposal sites in the region. Resource recovery is also being implemented in the state, especially in Nez Perce County where development of a solid waste recycling program is underway (EPA 1978b).

Background Issues

- o Mine and smelter tailings near Kellogg in Shoshone County have contributed high concentrations of heavy metals to the Coeur d'Alene-Spokane River systems, adversely affecting the aquatic ecosystem (see Figure 10-19). Methods of disposal that prevent leaching of heavy metals or prevent their entry into local water courses must be further developed.

Scenario-Induced Changes

- o No major scenario induced changes are foreseen in the area of solid waste disposal. However, expanded energy supplies may promote industrial and population growth, which will generate increased volumes of solid waste.

Health and Safety

- o No scenario-induced impacts in the area of health and safety were identified.

Description

Ninety-seven percent of Idaho's electric generating capacity is met by hydroelectric power. Health effects specifically associated with operation of the hydroelectric system have not been identified, but are considered to be negligible.

Background Issues

- o Because no health and safety effects are identified relative to energy production in Idaho, no background issues have been identified.

Scenario - Induced Changes

- o Since Idaho is expected to meet its energy demands by increased hydroelectric generating capacity and some geothermal development, few impacts on human health and safety are expected, other than possible increased incidence of occupational injuries associated with construction of these projects.

Socioeconomic

- o The expansion of hydroelectric facilities in Idaho may cause local socioeconomic impacts, especially in rural communities that have little experience dealing with social and economic change.

Description

Idaho's population is predominantly rural, with 83.2% of its 857,000 residents in 1977 living in non-metropolitan area. Idaho's urban centers are located in its southeast and southwest sections. In 1977 there were 10.4 persons per square mile, placing Idaho 41st nationally in terms of population density. Population growth rates in the state jumped from 6.9% between 1960-1970, to 20.3% between 1970-1977, making it the sixth most rapidly growing state in the nation.

Although the state economy is based primarily on natural resource-dependent industries, employment is becoming increasingly concentrated in non-resource based industries, especially in the population centers of the state (Pacific Northwest River Basin Commission 1977). Unemployment rates are substantially below the national average, but may reach 15% or more in the Panhandle in winter reflecting the seasonal nature of the forest products industry (Pacific Northwest River Basin Commission 1977). Personal income in Idaho is largely dependent on the status of forestry, mining and agricultural sectors, and amounts to about 91% of the national average. Personal income is on the increase in Idaho because of continued economic growth and increased economic stability in the Snake River Basin (Pacific Northwest River Basin Commission 1977). In 1977, the yearly personal income was \$5,980 as compared to a national average of \$7,019.

Background Issues

- o Since Idaho is one of the more rapidly growing states in the country, with most of this growth occurring in nonmetropolitan portions of the state, residents are experiencing rapid social change. It is expected that conflicts may arise between newcomers and long-time residents who may not share common values with respect to further development.

- o Idaho is, in some respects, one of the last frontier states, isolated in terms of its geography and predominately rural in terms of settlement patterns. State government has recently focused on the conservation of limited resources, with a goal of a 5% reduction in projected energy use in the state by 1980 in conformity with national guidelines (Draft Idaho Energy Conversation Plan 1977). Within this context, there is likely to be conflict between pressures for economic growth and environmental preservation.

Scenario-Induced Changes

- o Three hydro sites may cause some social and economic impacts in surrounding communities. The first is in Owyhee County. The existing dam will be raised and another dam will be constructed to regulate river flow. Assuming a moderate work force requirement, the small number and size of communities adjacent to the site suggest that even moderate immigration could strain nearby town facilities and services.

- o The second hydroelectric site in Idaho that might have potential social and economic impacts is the project near the border of Elmore and Gooding Counties. It includes a new dam on the Snake River with three generating

units, located near several small, unincorporated towns. This is an earthen dam which could generate some public concern for its safety. A recent draft environmental impact statement for a rock dam site in Washington State found public concern very high for a possible collapse of that dam. It can be assumed that in Idaho, where an earthen dam has recently collapsed, such concerns would also exist. The dam site is located within commuting distance of several large cities and is close to Interstate 80, which should facilitate commuting to the site.

- o A third proposal for additional dams in Idaho which might generate social impacts is the planned series of new dams on the North and South Forks of the Payette River. While the exact locations of the dams is not known, it is possible to identify the area where they might be located. Few towns exist there, and most are unincorporated. The area is quite mountainous and rural. Boise, within a sixty mile range, is on the other side of a mountain pass from the sites, making such long distance commuting difficult. Although socioeconomic impacts depend in part on the work force requirements, this situation is likely to produce a moderate level of impact.

- o The other energy facility sites in Idaho identified in the scenario will likely produce some social impacts. Most are small additions to existing facilities, and it has been assumed that such additions require a smaller work force than a new construction project. Thus, there would be less social disruption and change.

Institutional

- o No major institutional impacts are identified for Idaho.

Description

Virtually all of Idaho's electricity is generated by hydroelectric means. In contrast to Washington, Idaho is served primarily by regulated, investor-owned utilities. These privately owned utilities service about 86% of the state. The remainder is served by municipal utilities or rural electric cooperatives (U.S. Department of Energy 1976). However, Idaho's investor-owned utilities do not build and operate all the generating capacity upon which they rely for power. In some instances, they purchase power from facilities built in whole or in part by the Idaho Board of Water Resources. In still other cases, they rely on power marketed by BPA from facilities built and operated by the Army Corps of Engineers or the Bureau of Reclamation. Thus, different institutions are involved depending on who built the facilities.

Construction of a privately owned hydroelectric generating facility in Idaho requires the approval of several state agencies. The central role is played by the Idaho Public Utilities Commission, from which the utility must obtain a certificate of convenience and necessity before construction can begin (I.C. 61-503). The utility must also obtain a separate water permit from the Department of Water Resources, the state office charged with adopting a comprehensive program for the conservation, development, and use of all unappropriated water resources (I.C. 420701-42-1759). The utility must see that its proposed facility complies with local land use

requirements. A proposed thermal or geothermal facility would also have to obtain an air quality permit from the Division of the Environment of the Department of Public Health.

In addition, the Board of Water Resources in the Department of Water Resources can build hydroelectric facilities itself, although it must market the power to investor-owned utilities or rural cooperatives.

And, of course, the U.S. Army Corps of Engineers and the Bureau of Reclamation can build dams and generating facilities whose power is marketed through the Bonneville Power Administration.

Background Issues

- o Because of the existing preference clause in the Bonneville Project Act, most or all of the power generated from new Federal facilities would go to publicly owned utilities unless new Federal legislation reallocates BPA's hydropower. Since most power in Idaho is retailed by investor-owned utilities, this would mean exporting most of the power out of Idaho. Therefore, additional Federal hydroelectric projects are not apt to be very popular in the state.

- o One current project in Idaho is motivated primarily by the desire to assure Idaho consumers continued access to relatively inexpensive hydropower. This is the proposal of the Idaho Board of Water Resources to add two new generating units to the Palisades Dam in southeast Idaho. This dam has been constructed and operated by the U.S. Bureau of Reclamation. The Board is proposing that the State finance the construction of the new units, and that the Bureau oversee construction, and when completed assume responsibility for their operation. The Board would then serve as marketing agent for the power generated. The Board's proposal would provide Idaho customers continued access to low-cost hydroelectric power by financing the construction and marketing of power from two new generating units in a Federal dam.

- o Like other northwestern states, Idaho's geothermal resources are primarily moderate temperature hot water. Although this sort of resource has obvious application as a direct heat source, technology for generating electric power from moderate temperature hot water resources has not yet been perfected. However, the R&D for this technology is being performed by DOE at Raft River, Idaho, at the urging of a local rural electric cooperative and with the participation of other regional utilities. This situation has several favorable implications. First, the two pilot plants themselves could make a small contribution—10 MWe—to Idaho's electrical generating capacity. Second, if the usable reservoir at Raft River proves to have the currently estimated potential of 50 MWe electric, and if certain institutional barriers can be overcome, Raft River could contribute perhaps 50 MWe electric to the state's power supplies by 1990. Third, the physical proximity of the technology and the present early involvement of local utilities, federal agencies, and state regulators could ease the transfer of the new technology to developers and users of the resources in other areas of Idaho over the next decade or so.

Scenario-Induced Changes

o As in other states, realization of the geothermal portion of the scenario faces severe technical and economic problems. However, Idaho is where the necessary moderate temperature power generation technology is being developed. The U.S. Department of Energy, the Idaho Water Resources Board, and various state utilities are participating. Therefore, if the technology proves commercially feasible, the institutional climate appears relatively favorable for future development.

OREGON

Oregon's base load electric generating capacity is largely based on hydroelectric power, a renewable resource. The state is actively evaluating the potential for using other renewable resources, such as geothermal, biomass, and wind, for the production of electrical power. Geothermal energy is currently being used directly for space heating in the Klamath Falls area and is under consideration as a source of heat to meet process steam needs for food processing at a site in eastern Oregon. Biomass is also being used for energy production. A Weyerhaeuser Company plant in Springfield, Oregon, is generating electricity from biomass. In addition to the use of renewable resources, Oregon is also adding thermal power capacity. A nuclear plant is presently in operation and a coal plant using coal imported from Wyoming is being constructed. Development and continued interest in Oregon's renewable resources reflect the state's desire to maintain a high environmental quality.

Oregon appears to be one of the most environmentally conscious states in the nation. The state enjoys a generally clean environment and great opportunities for outdoor recreation. Air quality problems are restricted to urban areas, agricultural areas where grass seed fields are occasionally burned, and areas where forest product mills burn their wastes. Electric generating projects utilizing forest products and municipal solid wastes are under construction or in planning. Water quality is generally good except in some rivers in the southwestern portion of the state where dams combined with land use practices such as logging and agriculture have caused problems of high temperatures during low flows, turbidity, and eutrophication. Agricultural runoff has caused the eutrophication of small lakes and streams in some areas. Since Oregon's electrical energy needs are expected to be met primarily by hydroelectric generation, further water quality impacts can be expected. In an attempt to gain access to low-cost Federal hydropower, the Oregon Legislature has created the Domestic and Rural Power Authority to qualify the entire state as a "preference" customer. Substantial public opposition to nuclear power exists in Oregon where conservation and "soft path" technologies enjoy more widespread acceptance.

The Oregon scenario specifies a 1990 level of electric generation capacity of 13,102 MWe. The generating capacity by technology is given in Table 10-3. The scenario specifies additions to generation capacity in conventional hydroelectric, pumped storage, nuclear, coal, oil direct drive, oil steam, and geothermal technologies. Combined cycle capacity is reduced from 585 MWe to 100 MWe over the period. The locations of

Oregon energy facilities are shown in Figure 10-8. Issues have been identified for Oregon that could impede development of additional generating capacity projected by the scenario. This will apply to geothermal, nuclear, and hydroelectric facility development in Oregon. Additions to existing hydroelectric facilities could further reduce the already depleted anadromous fish runs, thus jeopardizing a valuable regional resource. Also, further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fishery, agriculture, and hydroelectric power requirements. Geothermal and nuclear development will be impeded because of unresolved institutional and environmental issues. Because all of the facilities will be located in rural areas, socioeconomic impacts can be anticipated. Such impacts, however, are not expected to prevent construction of the facilities. Industrial facility sitings will be restricted in all non-attainment areas and in all areas where PSD increments will be exceeded.

Air

- o Additional industrial facilities sited by the scenario will cause one Air Quality Control Region to remain in non-attainment status in 1990 (Figure 10-20).

Figure 10-20. Oregon: Scenario Projected Nonattainment Air Quality Control Regions in 1990

- o Under the scenario, three counties will exceed PSD Class I increment standards in 1990 (Figure 10-21).
- o A visibility decrease of up to 13% is projected for Class I areas in northwestern Oregon. Other Class I areas in southern and eastern Oregon are projected to have increased visibility (Figure 10-22).

Figure 10-21. Oregon: Scenario Projected PSD Increment (TSP or SO_2) Exceeded in 1990.

Figure 10-22. Oregon: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, Miles

Description

Nine of Oregon's 36 counties (location of Oregon counties by name is shown in Figure 10-6) experienced recorded concentrations of pollutants that exceeded the allowable maximum specified by primary air quality standards during the three-year period ending in 1976 (see Figure 10-23). Particulate matter (TSP) resulting mainly from fugitive dust, is the most widespread cause of an exceeded standard. Concentrations above the primary particulate standard occurred in all of the nine counties (except Marion County), in which air quality standards are not met. The carbon monoxide standard (CO) was exceeded in Marion, Lane, Jackson, and Multnomah Counties. The standard is exceeded 15% of the days in a year in Multnomah County, and 5% of the days in Jackson County. The oxidant standard (O_3) is exceeded in Marion, Lane, Jackson, Multnomah, and Clackamas Counties. Violations occur in Jackson County on about 8% of the days in a year and in Clackamas County on about 3% of the days (EPA 1978c).

Overall, Oregon's air quality improved between 1974 and 1976. Where trends could be established, all but one county is either improving or remaining the same. Benton County faces rising levels of sulfur dioxide; while there is presently no evidence that the primary standard is being exceeded, this may become a problem in the future (EPA 1978c).

There are eleven Class I areas in Oregon. A discussion of air quality standards applied to Class I areas is given in the section on Long Range Transport/Visibility. Calculated visual range for Class I areas in Oregon are shown in Figure 10-22.

Background Issues

o While point sources of particulates can be controlled with reliable, relatively inexpensive technology, fugitive dust is responsible for a large share of Oregon's particulate problem (sources of fugitive dust are

discussed in the section on Air). Thus, even though further control of point sources will reduce the frequency and severity of violations, air quality violations will continue until area and fugitive dust sources are also controlled (EPA 1978c).

Figure 10-23. Oregon: Counties Not Currently Meeting Ambient Air Quality Standards

Source: EPA 1978c

- o Transportation is responsible for almost all of the carbon monoxide emissions in Oregon urban areas. Recently, carbon monoxide emissions have decreased partly because of Federal emission standards on motor vehicles and partly because of less burning of solid waste. A reduction of over 14% in 1976 is credited to the Portland Inspection and Maintenance Program (EPA 1978c).

- o The private automobile is responsible for more than 90% of the carbon monoxide concentration in those counties where the standard is not met.

- o Transportation related sources, solvent evaporation, and gasoline evaporation account for almost one-half of the emitted hydrocarbons in the state.

Scenario-Induced Changes

- o Additional industrial facilities cited by the scenario will cause one Air Quality Control Region to remain in nonattainment status in 1990 (Figure 10-20). This means that the projected industrial development cannot occur unless "offsets" can be obtained.

- o Under the scenario three counties (Klamath, Lane, Marion) will exceed PSD Class I increment standards in 1990 (Figure 10-21). The PSD Class I increments are given in Table 10-6). This means that the projected industrial development cannot occur unless proper pollution control technology is applied and emission levels remain below the PSD increment levels.

- o A visibility decrease up to 13% is projected for Class I areas in northwestern Oregon. Other Class I areas in southern and eastern Oregon are projected to have increased visibility (Figure 10-22). The decreased visibility in northwestern Oregon results from the industrial activity in the Air Quality Control Region to the west. Visibility is projected to increase in southern and eastern Oregon; this will occur as a result of the timber industry coming under compliance in the 1980's.

- o The scenario specifies 1200 MWe of expansion in hydroelectric capacity to be provided by increasing the number of turbines at existing hydroelectric facilities. Location of Oregon energy facilities is shown in Figure 10-8. The Brownlee and Bonneville expansions are currently underway. Other facilities under consideration for expansion include John Day, McNary, Oxbow, and Prospect No. 2. One new pump storage facility of 150 MWe capacity will need to be developed. In addition to these hydro-facilities, one nuclear, one coal, four (50 MWe) geothermal plants in Deschutes County, and four (50 MWe) geothermal plants in Lake County are to be constructed during the period. Addition of this hydroelectric and thermal generating capacity may produce localized short-term air quality impacts from fugitive dust during construction, depending on dust control practices.

- o The scenario specified 400 MWe geothermal generating capacity in Oregon by 1990. Local air quality impacts in Deschutes and Lake Counties will result from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of the most concern. Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron, in the form of boric acid, may also be emitted in cooling tower drifts.

Water

- o Industrial facilities sited by the scenario in ASA 1705 area will contribute to existing water quality violations (Figure 10-24).

Figure 10-24. Oregon: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

Description

Of the 19 rivers in Oregon, eight are partly polluted and some or all of the reaches of another seven only provisionally meet Federal water quality goals. The lower reaches of two tributaries of the Snake River in eastern Oregon, the Malheur and the Owyhee, do not meet Federal goals for water quality and are unsuitable for propagation of salmonid fish and for unrestricted recreational use (EPA 1978c). Portions of five streams (mainstream Middle Snake; Klamath in Klamath County; Bear Creek, tributary to the Rogue River; Umatilla, tributary to the Columbia River; and Tualatin, tributary to the Willamette River) have poor water quality. Other rivers, mostly located in sparsely populated areas where the predominant land use is forestry, have good water quality.

Water quality problems in the Oregon rivers include high solids concentrations, heavy metals, organic matter contributing to low dissolved oxygen concentrations, and nutrient concentrations capable of causing nuisance growths of algae. Baseline concentrations for pollutants that exceed standards are shown in Figure 10-25. These types of contamination are common to many of the rivers in the eastern, agriculturally-oriented portion of the state, as well as in the more populated areas of the Willamette River system. High temperatures mainly occur in waters of the state where intensive land use for irrigation and low summer flows are prevalent.

It appears that little significant change in water quality can be anticipated in the next three to five years (EPA 1978c). With a few exceptions, the major water quality problems of Oregon do not stem from municipal and

Figure 10-25. Oregon: Current Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type

industrial waste discharges, which in the past were the primary targets of pollution abatement programs. Water pollution in rivers and lakes in the state results from intense land and water use, reservoir conditions, and natural runoff. Waste treatment is already well advanced in Oregon; however, some water quality problems still exist, especially in the more densely populated western portion of the state where waste treatment is inadequate. Further improvement in Oregon's waste program is needed to achieve water quality standards in these areas, as well as in the coastal areas where shellfish harvesting is jeopardized by bacteriological contamination. Measures to reduce water quality impacts from runoff, stream regulation, and improper land management largely remain to be defined, although programs are presently underway to determine the magnitude and extent of these impacts.

In eastern Oregon, a major source of phosphorus appears to be from agriculture and natural occurrences. Runoff in this area contributes most of the phosphorus in the mainstream Snake River and its tributaries (EPA 1978c).

Direct industrial and municipal waste discharges do not contribute significantly to suspended solids in Oregon streams (EPA 1978c). Erosion resulting from land management practices in agriculture and forestry are the main source of suspended solids (PNL 1978). In the Willamette River, and to a lesser degree in the Santiam and Tualatin Rivers, suspended solids are due to industrial and municipal waste discharge (EPA 1978c). Most organic matter in these rivers results from runoff associated with urban and rural lands, and other nonpoint sources (EPA 1978c). However, during low flows municipal and industrial discharges account for much of the observable biochemical oxygen demand (BOD).

Coos Bay in Coos County, Tillamook Bay in Tillamook County, and Yaquina Bay in Lincoln County comprise the most important shellfish growing waters in commercial harvest of shellfish. Restrictions on shellfish harvesting result primarily from high bacterial levels caused by municipal sewage treatment plant discharges or seasonal increases in freshwater runoff from agricultural and logging areas (EPA 1978c).

Background Issues

- o Development of an extensive system of hydroelectric and water storage facilities in Oregon has changed the water temperature profile for some waterways.
- o Because Oregon's border with Idaho and Washington is within the Columbia and Snake River systems, interstate water relationships between the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources of the Columbia and Snake River systems, interstate problems are increasing in significance and becoming more difficult to resolve (Pacific Northwest River Basins Commission 1978).

Scenario-Induced Changes

o The nuclear and coal-fired facility additions specified by the scenario use man-made reservoirs for water supply; therefore, no significant water availability or water quality impacts on existing river systems will result from facility construction and operation. As thermal plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus effect water quality on the Columbia and Snake Rivers because of increased frequency and amplitude of water level fluctuations.

o Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature changes is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers also need to be studied.

o Any further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fisheries, agriculture, and hydropower requirements. Because of this competition, the availability of water to meet the scenario requirements for hydroelectric power is uncertain.

Ecology

o The scenario envisions expanding hydroelectric generating capacity in Oregon. Construction and operation of hydroelectric facilities will impact anadromous and resident fish and wildlife by altering stream flows.

o Extensive areas of SO₂ sensitive crops lie downwind of a coal-fired plant located in Morrow County.

o Continually fluctuating water levels associated with pumped storage and use of hydroelectric capacity for peaking could adversely affect aquatic ecosystems and wildlife habitat.

Description

Oregon consists of three geographical areas lying roughly parallel to each other in a north-south direction: 1) the low, wet, coastal zone on the western slopes of the Coast Range, 2) the drier system of interior valleys between the Coast and Cascade Ranges, and 3) the high, arid area east of the Cascades characterized by wide daily and seasonal temperature variations. Of both state and regional importance is the Snake River running along much of Oregon's eastern border and the Columbia River along most of the state's northern border (Pacific River Basins Commission 1979). These rivers are shown in Figure 10-1.

Figure 10-26. Oregon: Percent of County Covered by SO₂ Sensitive Crops

Oregon has highly valued fish and wildlife resources. It shares the anadromous fishery of the Columbia River with Washington and Idaho. Anadromous fish such as salmon and steelhead trout also use the streams and rivers entering the Pacific along the coastal slope. Oregon tributaries which feed the Columbia and the Snake River downstream of Hell's Canyon Dam support the spawning activity of a significant portion of the Columbia River system anadromous fishery (Pacific Northwest River Basin Commission 1979). The Columbia and some of the coastal streams support growing runs of shad and white sturgeon, and the south coastal streams support striped bass.

A wide variety of wildlife exists in Oregon. The western forests support large mammals such as elk, black bear, white-tail and black-tail deer; smaller mammals including fur-bearers such as beaver; and predatory birds such as eagles, falcons, hawks, and owls. The high arid plateau supports many rodent species, much deer, pronghorn antelope, many insect species, and birds of prey. Resident gamefish include catfish, bass, crappie, and bluegill in the lower warmer reaches of the Willamette, Rogue and Umpqua Rivers to rainbow, cutthroat, brown, and brook trout in the colder streams and lakes. Kokanee salmon are found in many lakes and reservoirs and whitefish in many upper tributary reaches (Pacific Northwest River Basins Commission 1979). Coastal waters support many different species of fish including Lingcod, red snapper, kelp greenling, rock bass, flounder, and perch. Crabbing is common along the coast and several species of clams are harvested in bays, estuaries, and along open beaches. Oysters are raised commercially. Wintering waterfowl are also found in Oregon, along with several species of upland game birds.

Demand of these fish and wildlife resources is steadily increasing as commercial and recreational fishing and hunting increase. These pressures are compounded by problems of loss of habitat or deterioration of habitat quality already facing fish and wildlife (Pacific Northwest River Basins Commission 1979). A specific problem for coastal-stream anadromous fish is seasonal low-flows and high water temperatures.

Background Issues

o Loss of spawning and rearing areas of anadromous fish has occurred because of the construction of dams on tributaries of the Willamette, Deschutes, and Middle Snake Rivers which blocked passage to previously assessible spawning areas (Figure 10-11). Fish passage does occur around many dams but mortality rates can be high. Juvenile losses from all causes have been estimated at 15 to 20% at each mainstem dam as they migrate downstream. Additional fishing pressure from an increasing number of commercial and sport fishermen also contributes to depletion of anadromous fish populations.

Scenarion-Induced Changes

o The scenario envisions expanding hydroelectric generating capacity in Oregon. Construction and operation of the hydroelectric system will negatively impact anadromous and resident fish and wildlife by altering stream flows and downstream temperature regimes, and by increasing turbine mortality.

o Increased atmospheric concentrations of sulfur dioxide are associated with the coal-fired generating plant in Morrow County projected by the scenario. Several species of native vegetation, particularly various species of grasses such as fescue, bluegrass, and bunchgrass, as well as trees such as mountain hemlock and red alder, are sensitive to this pollutant. Douglas fir and sagebrush are somewhat more resistant. Several important crops are also sensitive to SO_2 , including hay, fruit, wheat, and other grains. Such crops cover more than 30% of some counties in north central Oregon. Estimates of probable atmospheric SO_2 levels associated with the coal-fired power plant suggest that significant ecological impacts are unlikely.

o Development of thermal electric facilities will result in a shift of hydroelectric generation capacity from base load generation to peak load generation. This will result in fluctuating water levels, which can adversely impact aquatic ecosystems (section on Ecology).

Land Use

o Construction of a nuclear power plant in Gilliam County will require 9200 acres, 378 of which will be occupied by buildings. The coal-fired plant in Morrow County will require 2200 acres, 350 of which will be used for buildings. The majority of land in both cases will be covered by man-made cooling reservoirs (Figure 10-27).

Description

Almost half of the land area in the state is classified as forest. Almost 90% of that forest is classified as suitable for commercial production. Douglas fir is the dominant species in almost half of Oregon's 27 million acres of forest land. Western Oregon, with 20% of the region's commercial forest acreage, provides about 44% of the region's timber harvest; eastern Oregon, with 13% of the region's commercial forest acreage, provides about 6% of the region's timber harvest (Pacific Northwest River Basin Commission 1979).

Figure 10-27. Oregon: Projected Land Use by County for Thermal Power Plants in 1990

Rangeland occupies the second largest area of land in Oregon, totalling about 22.7 million acres. About 58% of this is federally owned. About 6.5 million acres, or 29% of the total range, is grassland. Another 5.3 million acres of land is cropland, of which 1.7 million acres is irrigated. Land classified as "other" totals about 2.3 million acres, and is increasing because of development activities. Included are urban and industrial areas, barren areas, small bodies of water, roads, and farms.

The state's vast timberlands support a diversified forest products industry of lumber, plywood, pulp and paper products, and numerous specialty products. Oregon has been the leading softwood timber producer in the United States for the past several years, largely because of a high production rate on private lands in western Oregon. The forests also supply a growing export market in logs, lumber, plywood, and wood chips. In addition to support of the forest products industry, forest lands and waters are important as fish and wildlife habitats. They provide a variety of outdoor recreation activities, and comprise major watersheds (Pacific Northwest River Basins Commission 1979).

Much of Oregon's rangeland was overgrazed in the past. This has resulted in the loss of vegetative cover, wind and water erosion, and a major decline in natural range forest productivity. In some areas, intensive rangeland development programs have improved both the vegetative and erosion conditions, but other areas still lack adequate protection or adequate rehabilitation measures (Pacific Northwest River Basins Commission 1979).

Other land areas in Oregon (urban, industrial, roads, etc.) consist of about 2.4 million acres, or 4% of Oregon's land area, and these are projected to increase to about 2.9 million acres, or 5% of the land area by the year 2000. Most of that increase is expected to be in the Willamette Valley through urbanization and industrial development that will replace present cropland. A probable consequence is the conversion of some forest and

rangeland to agricultural uses to compensate for the lost cropland (Pacific Northwest River Basins Commission 1979).

Background Issues

- o Hydroelectric projects have inundated large areas. These projects are often in sparsely populated or forested areas. The impact of this land conversion generally has been accepted.
- o An estimated 2 million acres of cropland in Oregon presently have an erosion problem. Nearly all croplands have erosion potentials.

Scenario-Induced Changes

- o The nuclear site in Gilliam County includes a man-made cooling reservoir which encompasses 9200 acres. The coal-fired site in Morrow County will cover about 2200 acres, most of it devoted to a man-made cooling reservoir. In both counties, rangeland is the predominant land use. The reservoirs are designed as multiple use reservoirs and will be a source of water for livestock and irrigated agriculture.
- o Expansion of hydroelectric power may inundate land areas now used for other purposes. For example, a pumped storage facility is projected by the scenario for Oregon. This facility has not been sited; therefore, specific land use impacts cannot be anticipated.

Solid Waste

- o The quantity of solid waste generated by the coal and nuclear facilities specified by the scenario will be small. Short-term storage of the nuclear waste and long-term disposal of the coal and will be handled onsite (Figure 10-28).

Description

About 78% of Oregon's population was served by state-approved solid waste disposal sites in 1976 (EPA 1978c). One of the two state-licensed hazardous waste disposal sites in the Northwest is located in Oregon. It is located near Arlington in Gilliam County.

In 1974, the Eugene Water and Electric Board conducted a feasibility analysis of burning municipal waste in a steam electric generating plant. They concluded that, with power revenues generated at the plant helping to defray part of the costs, this method of solid waste disposal was economically competitive with other environmentally acceptable methods. Resource recovery projects are in the planning or construction stage throughout the state.

Background Issues

- o Nuclear waste generated at the Trojan nuclear power plant is presently stored onsite pending long-term disposal. Oregon has passed a law (ORS 469.525) stating that a site for long-term disposal of nuclear waste can not be located in that state.

OREGON ASH GENERATED
FROM UTILITY COAL
COMBUSTION

Figure 10-28. Oregon: Solid Waste Residuals from Coal-Fired Energy Facilities

- o Oregon's concern for the quality of its natural environment is reflected in legislation banning "pop-top" and nonreturnable beverage containers.

Scenario-Induced Changes

- o The coal-fired generating plant under construction in Morrow County will produce about 84,000 tons of ash annually, requiring about 10 acres of land per year for disposal (Pacific Northwest Generating Company 1976). This is not expected to present any serious problems of waste management as land is presently available and is specified as a disposal site.
- o The proposed nuclear plant in Gilliam County is expected to produce about 429 tons of waste annually, some of it high-level radioactive waste. Since only one plant is expected to be operational by 1990, the amount of solid waste actually generated within the scenario time frame will be less. Pending a decision on the ultimate disposal of radioactive wastes, the waste generated at this plant will be stored on-site.

Health and Safety

No serious health and safety impacts are identified for Oregon.

Description

A health and safety concern related to energy development in Oregon is the handling and disposal of radioactive waste. Oregon has no long-term repository for storage of radioactive waste; therefore, Oregon presently sends some low-level radioactive wastes for storage to the Hanford Reservation operated by DOE near Richland, Washington.

Nine Oregon counties have experienced some air quality problems. These counties and the air pollutants are identified in the section on Description. The air concentrations of some pollutants have at times exceeded alert levels for CO, O₃, and total suspended particulates (TSP).

Background Issues

- o Oregon experiences some air quality problems, which at times exceed the alert level (Figure 10-23). At alert levels, there is some health risk.

Scenario-Induced Impacts

- o No major health and safety impacts caused by implementation of the scenario are identified for Oregon.
- o The annual radiation dose to the population surrounding the Gilliam County nuclear plant will be less than the normal fluctuation in naturally occurring radiation, barring any uncontrolled releases.
- o Health effects associated with air pollution and fuel transportation from the Morrow County coal-fired plant are expected to be minimal. Lead lab information predicts a rate of 2.8 - 45 deaths per million person-years.

Socioeconomic

- o Construction of energy facilities in rural or partially isolated areas in Oregon will cause moderate socioeconomic impacts.

Description

Oregon's population is concentrated west of the Cascades with more than 70% in the Willamette Basin. The state population nearly doubled from 1940 to 1970. The 1970 population of about 2.1 million increased by more than 2.3 million by July 1976. Most of the future growth is expected to be in the areas that are presently heavily populated (Pacific Northwest River Basins Commission 1978). Currently 59.9% of the population lives in metropolitan areas, while 40% lives in non-metropolitan areas. The rate of population growth between 1970 and 1977 was 13.6% for the state. Sixty-seven percent of this population change was due to net immigration.

In 1977, the average yearly personal income in the state was \$7,007, placing Oregon 20th among states. The U.S. average for the same year was \$7,019. The most recent figures for state poverty levels indicate that in 1975 8.9% of the state's population (or 6.7% of the households in the state) were classified as poverty level, compared to national averages of 11.4% and 9.0% respectively. Historically the lumber industry has accounted for much of the employment in the state, although this trend has been changing in recent years (Oregon DOE 1978). Other major industrial employers include food processing and paper. Trade and government services also account for much employment in the state.

Background Issues

o Agricultural areas in central Oregon and the Willamette Valley are expected to experience rapid growth in the near future, regardless of the development of proposed energy facilities. Wilderness preservation and reduced immigration from other states enjoy considerable support in Oregon. Public attitudes about the availability of energy and the economic and social costs associated with energy and industrial development will continue to raise important socioeconomic issues.

o Energy conservation is an issue that has widespread social and economic implications. Some groups feel strongly that conservation is a viable alternative to continued expansion of energy facilities. While there is a potential for conflict among supporters of conservation and people who are in favor of industrial expansion requiring increased energy use, the government must decide how strong a role to play in determining the balance between increased energy use and conservation. This represents an important socioeconomic issue that must be resolved.

Scenario-Induced Changes

o There are several energy facility sites in Oregon that will cause moderate or high levels of socioeconomic impacts. These sites are characterized as rural, partially isolated areas. These impacts are not anticipated to impede construction of the facilities.

o Geothermal facilities are likely to be sited in two areas: Lake County (near the Crump Geyser), and Deschutes County (near Bend, Oregon). Both are in eastern Oregon. In Deschutes County, a geothermal development could presumably draw from Bend (1970 population 13,710) for construction and operating workers. Other than Bend, there are few small towns in the area. These local communities will have some difficulty supporting even a limited construction and operations work force. The territory is quite mountainous and long-distance commuting, such as from western Oregon, is not very feasible. The largest town within a sixty mile radius of the Lake County (Crump Geyser) site is Lakeview (population 2,705). Thus, there may be significant problems accommodating any in-migration of population associated with the geothermal development since the county has an extra low assimilative capacity. Because of the rural, isolated nature of both sites, moderate levels of socioeconomic impacts can be expected.

o The McNary Dam is an existing dam in Umatilla County, and while the expansion is of an existing facility, it is a large construction project that could potentially generate social impacts. The uncertainty of the available labor force in the local area (thus the possibility for a large, temporary population increase) and the potential problems of an equitable distribution of impacts among several jurisdictions led to the assessment that a moderate impact would be incurred at this site.

o A second hydroelectric site, which is also identified as incurring a medium impact, is the Bonneville Dam in Multnomah County. Although this is an addition to an existing facility near a heavily populated area of Oregon, there may be social impacts because of the size of the project. Such a construction project could cause a local boom with a potential

influx, accompanying rising prices, and increased demand for local services and facilities.

- o A new hydroelectric facility is also indicated in Polk County, providing 1997 MWe of power by 1985. If such a facility were to be built, the site of the project is such that almost certainly there would be some social and economic impacts in terms of increased prices, congestion, and a strain place on housing and public facilities.

- o An addition to John Day Dam in Sherman County will add a construction work force to a relatively rural county. This could put some strain on the existing small town services and facilities, and cause a shortage of housing.

- o The proposed nuclear facility in Oregon would probably generate a high level of socioeconomic impact. The facility, Pebble Springs, is proposed to be built at Arlington (pop. 376) in Gilliam County. A large construction force peaking at 1100 to 1200 is expected for the plant. Even if only 20% of the work force lives in the area, service and facility problems can be expected. Gilliam County is identified as having a very low assimilative capacity.

- o Boardman, Oregon, in Morrow County near the Washington border, is the site of a coal-steam project that will generate moderate impacts. The construction force is expected to peak at 194 in 1978. Although some of the construction force will presumably commute long-distance from the Tri-Cities and Pendleton, the problem remains of having one county absorb most of the impact and another county (or state) most of the benefit.

Institutional

- o Institutional changes may occur as a result of implementation of the nuclear portion of the scenario, since political opposition to construction of the Pebble Springs plant is significant. Other impacts will result as lead times will have to be shortened in order to meet scenario deadlines.

Description

Institutional roles in Oregon's energy development are shared by private, federal, and state institutions. The major private role is played by the state's investor-owned utilities, which supply some 63% of the electrical load (DOE 1978). Oregon's investor-owned and publicly owned utilities alike rely heavily on hydroelectric power. Utilities purchase the bulk of their hydroelectric power at wholesale prices from BPA supplies, which are generated at Federal projects on the Columbia River and its tributaries in Washington and Idaho as well as Oregon. Because the Bonneville Project Act, 16 U.S.C. 832-832D, gives public agencies preferential access to Federal hydropower, Oregon's investor-owned utilities face difficulties in supplying their customers because Bonneville's supplies are not keeping pace with demand. As a consequence, the Oregon legislature in 1977 enacted legislation attempting to qualify the entire state of Oregon as a BPA preference customer to be known as the Oregon Domestic and Rural Power Authority (DRPA). DRPA would channel Federal hydroelectric power to existing Oregon investor-owned and publicly owned utilities. By

the terms of the legislation, DRPA powers were to commence March 1, 1979, if the U.S. Congress had failed to enact a Regional power bill satisfactory to the Oregon governor (1977 OR Laws Ch. 888). Although Governor Atiyeh has instructed the Public Utilities Commission to begin hearings to set up DRPA, he has also indicated he wishes to await the outcome of Regional energy legislation in Congress. To this end, a bill to delay implementation of DRPA for one year has been introduced in the Oregon legislature. Oregon's utilities are also proceeding with the planning and construction of their own nuclear, hydroelectric power generating facilities.

Development of non-Federal power generation facilities is subject to the jurisdiction of the Oregon Energy Facilities Siting Council (EFSC) (ORS, 469.300-469.570). Developers of power generating facilities with a nominal capacity of more than 25,000 KWe (25MW) must obtain a site certificate from EFSC. The council consists of seven public members appointed by the governor. It receives notification of intent to file an application, receives applications for site certification, sends copies to specified state agencies and affected cities and counties, studies the site application independently or with outside assistance, holds public hearings, and approves, conditionally approves, or rejects the site application.

Approval or rejection is subject to judicial review by the Oregon Supreme Court. Once the certificate of approval becomes final, it binds the state and all its political subdivisions to the approval of the site and construction and operation of the facility. Affected state agencies and political subdivisions must issue the appropriate permits, licenses, and certificates necessary for construction and operation of an approved facility (ORS 469.400). These include necessary permits (when applicable) issued by the Department of Geology and Mineral Industries, the Division of State Lands, the Department of Transportation, the Department of Environmental Quality, the Department of Fish and Wildlife, and the Oregon Department of Natural Resources.

Several state agencies also have a general impact on the construction and operation of energy facilities. The Oregon Department of Energy, created in 1975, engages in research projects related to energy, collects data on energy, informs the public, and annually provides a preliminary and final forecast of energy supply and demand that defines the state's need for power (ORS 469.030). EFSC takes need for power into account in passing on applications for site certification. The Oregon Public Utility Commission regulates the rates of investor owned-utilities (ORS 756.036). Finally, EFSC has ongoing regulatory responsibility with respect to the operation of nuclear power plants and the transportation of nuclear materials (ORS 469.530).

Background Issues

- o State leaders differ as to what new regional power arrangements should be adopted to enable Oregon utilities to gain some access to Federal hydro power and to finance new generation facilities. Until Oregon's investor-owned utilities have access to Federal hydro power through the Bonneville Power Administration or some other regional entity, long-term power planning in the state will be difficult.

- o In November 1978, Oregon voters approved Ballot Measure 9, which prohibits utilities from directly including charges for construction work in progress (CWIP) in their rate base. This measure is likely to make the financing of thermal power plants more difficult.

Scenario-Induced Changes

- o In order for the scenario to be implemented, one of the two units of the planned Pebble Springs nuclear plants would have to be completed by 1990. Although completion is currently planned for 1989, institutional constraints and political opposition are likely to delay completion beyond 1990. Political opposition to nuclear power in the state is significant, and opponents have some levers to delay or possibly halt the Pebble Springs power plant. State site certification hearings have been reopened to consider the implications of the accident at Three Mile Island. Although EFSC was previously expected to approve site certification, the outcome may change or be delayed in these circumstances.

WASHINGTON

Washington is the most populated state in the region and the most extensively developed, yet it still enjoys a high quality environment. Its air quality is generally good except in urban areas when temperature inversions occur and in the semi-arid, agricultural portions of the state east of the Cascade Range where dust problems occur. Existing water quality is good and pollution abatement programs are well developed. Conflicts between competing uses of Columbia River water will become more severe in the future, especially when destruction of the region's important anadromous fishery is considered. The state produces more hydroelectricity than any other in the region and is served primarily by public utilities with low-cost power from Federal projects.

Eighty-five percent of Washington's electrical generating capacity is provided by hydroelectric facilities. This resource base is being complemented by the addition of thermal steam generating capacity. A dual purpose Department of Energy nuclear plant began producing electrical power in 1966. Present contracts call for power from this facility to be available through 1983. High public acceptance of nuclear power in south-central Washington has encouraged nuclear power development in that part of the state. Three nuclear power plants are currently under construction in south-central Washington. These plants represent the bulk of a thermal generating base currently being developed.

The 1990 scenario for Washington specifies 29,268 MWe of electric generation capacity. Additions are made in the conventional, hydroelectric pumped storage, nuclear, oil, and geothermal technologies. Coal-fueled generation capacity is reduced from 1330 to 1200 MWe during the 1975-1990 period. Overall environmental impacts of the 1990 scenario for Washington are presented in the section on Environmental Overview of the Trendlong Mid-Mid Scenario for Alaska, Idaho, Oregon, and Washington, and are described in the following subsections.

Issues have been identified for Washington that could impede development of additional hydroelectric and geothermal generating capacity projected

by the scenario. Additions to existing hydroelectric facilities could further reduce the already depleted anadromous fish runs, thus jeopardizing that part of the regional economy. Also, further use of the Columbia River for hydroelectric production will lead to water availability conflicts between fishery, agriculture, and hydroelectric power requirements. Geothermal facilities will be impeded primarily by the lack of established procedures in obtaining permits and leases.

Air

- o Additional industrial facilities sited by the scenario will cause three Air Quality Control Regions to remain in nonattainment status in 1990. (Figure 10-29).

Figure 10-29. Washington: Scenario Projected Nonattainment Air Quality Control Regions in 1990.

- o Under the scenario, four counties will exceed PSD Class I increment standards in 1990 and two counties will exceed Class II increment standards in 1990 (Figure 10-30).
- o A visibility decrease of up to 13% is projected for Class I areas in western Washington (Figure 10-31).

Description

During the three-year period ending in 1976, data from monitoring stations showed that 17 of Washington's counties, as shown in Figure 10-32, had concentrations of pollutants that exceeded the primary air quality standard (EPA, 1978d). Particulate matter (TSP) violations were the most widespread due in large part to fugitive dust (sources of fugitive dust are discussed in the section on Air). The sulfur dioxide (SO₂) standard was exceeded in Clallam and Pierce Counties. Spokane and King Counties recorded carbon monoxide (CO) violations 28% and 24% of the time, respectively. Pierce, Yakima, and Clark Counties also recorded CO violations. Oxidant (O₃) violations occurred in King, Pierce, Clark, and Spokane Counties (EPA 1978d).

Figure 10-30. Washington: Scenario Projected PSD Increments (TSP or SO₂) Exceeded in 1990

Figure 10-31. Washington: Scenario Projected Visual Range for Mandatory Class I Areas in 1990, Miles

Figure 10-32. Washington: Counties Not Currently Meeting Ambient Air Quality Standards
Source: EPA 1978d

In approximately 17% of all instances in which air quality standards were exceeded in Washington, the concentrations were at or above the alert level. Almost half of the violations at the alert level occurred in the more populated or industrialized counties of King, Pierce, and Spokane, where about 60% of the state's population resides (EPA 1978d).

Overall, Washington's air quality improved between 1974 and 1976. Where trends could be established, 11 counties showed deteriorating air quality while 30 counties' air quality either improved or remained the same (EPA 1978d). There are eight mandatory Class I areas in Washington. A discussion of air quality standards applied to Class I areas is given in the section on Long Range Transport/Visibility, and the areas are identified in Figure 10-9. Calculated visual range for Class I areas in Washington are shown in Figure 10-20.

Background Issues

- o Sixty-one percent of all the sulfur dioxide emitted in Washington originates in Pierce County. Most of this comes from smelting and refining operations in Tacoma (EPA 1978d).
- o Sixty-five percent of the standards violations in Washington are due to carbon monoxide and/or photochemical oxidants in urban areas. The private automobile is responsible for more than 90% of the carbon monoxide emissions in those counties where the standard is not met (EPA 1978d).

Scenario-Induced Impacts

- o Additional industrial facilities sited by the scenario will cause the Air Quality Control Regions to remain in nonattainment status in 1990 (Figure 10-29). This means that the projected industrial development can not occur unless offsets can be obtained.
- o Under the scenario, four counties (Clallam, Skagit, Snohomish, and Whatcom) will exceed PSD Class I increment standards in 1990 and two counties (Clark and Cowlitz) will exceed PSD Class II increment standards in 1990. The allowable PSD increment levels are given in Table 10-6. This means that the projected industrial development cannot occur unless proper pollution control technology is applied and emissions levels remain below the PSD Class I or Class II increment levels.
- o A visibility decrease of up to 13% is projected for Class I areas in western Washington. this decrease in visibility results from the industrial activity in the Air Quality Control Regions to the west of these areas.
- o According to the scenario, electrical generating capacity increases are to come primarily from three sources: nuclear, hydroelectric, and geothermal. Air pollution impacts of the first two generation sources are mainly confined to the construction stage; for geothermal power, odors and air pollution may occur during both construction and operation phases.
- o The nuclear component of the scenario for Washington consists of five nuclear power plants, all of which are currently under construction. Aside

from air quality impacts of fugitive dust during construction, the major air quality impact is the release of small amounts of radioactive gases to the atmosphere.

- o The scenario envisions the addition of 5564 MWe of hydroelectric generation capacity by 1985. The air quality impacts of hydroelectric generation are minimal, although fugitive dust may have a local impact during construction.

- o The scenario specifies 400 MWe of geothermal generating capacity in Washington by 1990. Local air quality impacts will result in Lewis and Whatcom Counties from the construction and operation of such facilities. Most of the noncondensable gases or vapors that have been found in geothermal fluids are relatively innocuous and are normal components of the atmosphere. Some, however, normally are not significant atmospheric components. Of these, hydrogen sulfide is currently of most concern. Other emissions likely to be regulated in the future include ammonia, mercury, arsenic, and radon. Boron in the form of boric acid, may also be emitted in cooling tower drifts.

- o One hundred thirty-one MWe of oil peaking capacity and 510 MWe of combined cycle capacity are also forecast. If these facilities are built, there will be minimal releases of combustion products, which are not expected to impact local air quality.

Water

- o Any further use of the Columbia River for hydroelectric generation will lead to water availability conflicts between fishery, agriculture and hydropower requirements.

- o Two aggregated subareas (ASA 1705 and ASA 1706) will show increases in pollutant concentrations in 1990. These increases, however, are small (less than 2%), (Figure 10-33).

Description

With some exceptions, water quality in the rivers, streams, and lakes in Washington meets the goals of the Federal Water Pollution Control Act. Washington's water quality monitoring program is one of the most complete in the region, and the status of most of the principal rivers in the state is known.

Water quality tends to improve progressively from east to west (EPA 1978d). Portions of five streams east of the Cascade Mountains do not meet Federal water quality goals for propagation of native fish and unrestricted recreational use. Of the 22 streams evaluated, 15 meet Federal goals while 8 provisionally meet such goals. Eleven of these streams are located west of the Cascades and discharge directly into Puget Sound or the Pacific Ocean.

Figure 10-33. Washington: Scenario Projected Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type in 1990

Generally, rivers on the east side of the Cascades show higher concentrations of phosphorus and solids as well as higher temperatures than those on the west side (EPA 1978d). This results, in part, from intensive land use and agriculture. Five of the rivers studied not meeting water quality goals (Crab Creek, the Spokane, Walla Walla, Palouse, and Touchet Rivers) lie mainly in agricultural areas east of the Cascades. During heavy runoff periods, problems occur from soil erosion. Low summer flows and runoff from agricultural lands during the irrigation season largely account for increased temperature and nutrients and dissolved and suspended solids. The Spokane River, which flows into Washington from Idaho, contains excessive concentrations of heavy metals, bacteria, and nutrients. Sources in Idaho account for the heavy metals and part of the phosphorus; however, the major portions of nutrients and bacteria originate from the City of Spokane.

Of 19 lakes and reservoirs in Washington of at least 10 square miles surface area, one is eutrophic (high nutrient concentrations and algal productivity) and another nine are mesoeutrophic (tending toward eutrophy). These waters are all located in the eastern part of the state in either agricultural areas, or are part of the Columbia and Snake River reservoir systems. These lakes and reservoirs are sinks for natural and man-made nutrients

(EPA 1978). Nine other lakes are either oligotrophic (relatively pristine) or mesotrophic (moderate algal productivity). The two oligotrophic lakes are located at relatively high altitudes, where population is sparse and land use activity is minimal. The remaining lakes and reservoirs, classified as mesotrophic, experience moderate algal productivity.

Its vast coastal and estuarine waters make Washington one of the most active commercial and recreational areas in the country. Over the last five years, there have been significant improvements in the marine water quality of Washington as a result of waste treatment programs (EPA 1978).

During years of high runoff, much water must be spilled over dam spillways rather than passed through the generating turbines. When large volumes of water carrying along atmospheric gases plunge into deep pools behind the dams, gas supersaturation occurs when these gases dissolve at depth under pressure. Fish swimming in deep waters supersaturated with atmospheric gases, primarily nitrogen are killed by bubble formation in their tissues when they later approach the surface. In the past, nitrogen levels between mainstream Columbia River dams have reached well above critical levels for both adult and juvenile salmon and steelhead. Modifications to spillways and flow manipulations have greatly reduced the nitrogen supersaturation problem in recent years.

The drinking water coming into most homes in Washington is generally considered safe. Approximately 40% of the state's 2500 community water systems are monitoring bacteria and turbidity levels, as required by the Safe Drinking Water Act of 1974 (EPA 1978).

Background Issues

- o In the western portion of the state, the water quality effects of increased population, the need for additional treatment of municipal and industrial waste discharges, the presence of toxic substances, and increased potential for oil spills occurring in Puget Sound are all areas of concern.

- o All aggregated subareas in Washington currently exhibit concentrations of at least one heavy metal in violation of standards (Figure 10-34). In all cases the concentrations have been identified by the lead lab as being due to background sources.

- o Significant areas of land in Washington (15.5 million acres, or 35% of the state's land area) are owned by the Federal government. Under the reserved water principal, Federal reservations may reserve water for facilities developed within the reservation boundaries. The amount of water reserved is not specified, thus presenting an obstacle to sound planning for water and related resources (Pacific River Basins Commission 1978).

- o There are 22 Indian reservations totaling 2.89 million acres(6.5% of the state's local land area) for which the U.S. Supreme Court holds that an unspecified amount of water is reserved to carry out the purposes for which each reservation was created. The lack of quantification of Indian water rights in Washington, which involves primarily the Colville, Spokane, and Yakima reservations, also creates an obstacle to sound water planning.

Figure 10-34. Washington: Current Water Quality Violations for Aggregated Subareas (ASA) by Pollutant Type

- o Because Washington's entire border with Idaho and Oregon is within the Columbia River system, interstate water relationships among the three states focus on the issue of how that system is managed. With expanding populations and economies placing greater demands on the water resources of the Columbia River system, interstate problems are increasing in significance and becoming more difficult to resolve.
- o Because nearly one-fourth of the surface water available in Washington originates in Canada, water management is of major significance in the state's relationship with its northern neighbor.

Scenario-Induced Impacts

- o Any further use of Columbia River water for hydroelectric production will lead to water availability conflicts between fisheries, agriculture, and hydropower requirements. Because of this competition, the availability of water to meet the scenario requirements for hydroelectric power is uncertain.
- o Water quality impacts may result from any geothermal development carried out in the state. Geothermal waters are not normally sources of organic constituents. The pollutants of greatest concern, however, are heavy metals. Geothermal waters may contain measurable amounts of several metals. Some geothermal waters, particularly those with high salinity, contain metals in concentrations hazardous to humans, animals, and/or plant life. Waste heat in spent geothermal waters, if allowed to enter surface waters, is potentially dangerous to aquatic life. Sensitivity of most desirable aquatic organisms to temperature changes is amplified because the optimum growth temperature is within only a few degrees of the destructive temperature. Land subsidence and the potential for altering existing aquifers needs to be studied.
- o As thermal plants are added to the regional electric system, the hydroelectric plants will be used more and more to produce peaking power. The use of hydroelectric facilities for load following and peaking power will increase the rate of bank erosion and thus affect water quality on the Columbia and Snake Rivers.

Ecology

- o The scenario envisions expanding hydroelectric generating capacity in Washington. Construction and operation of hydroelectric facilities will further impact anadromous and resident fish and wildlife by altering stream flows, particularly on the Columbia River.
- o Extensive areas of SO₂ sensitive crop and vegetation lie downwind of a scenario-identified coal-fired plant located in north-central Oregon (Figure 10-35).
- o Continually fluctuating water levels associated with pumped storage and use of hydroelectric capacity for peaking could adversely affect aquatic ecosystems and wildlife habitat.

Figure 10-35. Washington: Percent of County Covered by SO₂ Sensitive Crops

Description

The Cascade Mountains divide the state into two distinct physiographic regions. The area west of the mountains has a temperate maritime climate with dry, moderately warm summers and wet, mild winters. The eastern section has an arid to semi-arid climate with much greater extremes in temperature during summer and winter than western Washington.

The coastal area of Washington lies in the humid coniferous forest zone (Pacific Northwest River Basins Commission 1978). Variations in species composition occur according to precipitation and elevation differences. Shrubs and Sitka spruce near the shoreline merge into forests of Douglas fir and western hemlock, with fir and cedar also present. Subalpine forests occur in the Olympic Mountains.

Vegetation in the Puget Sound-Willamette lowlands has been modified extensively by human activity. Cities, farmlands, and other developments dominate the landscape and, even where natural vegetation remains, it has been largely altered by clearing, logging and grazing activities. Eastward to the Cascades there are stands of Douglas fir, western hemlock, western white pine, Englemann spruce, and silver fir.

Vegetation consists of shrub-steppe species throughout the Columbia Plateau, with the exception of areas that have been farmed. Sagebrush and wheatgrass are common plants. In the eastern part of the state, extensive ponderosa and lodgepole pine forests are found.

Two areas of the state have an unusually large number of rare and potentially endangered plant species; one, the Wenatchee Mountain Range, where distinctive climatic and soil conditions provide a refuge for several endemic species; the other, the Columbia River Gorge, which forms a unique low-land "bridge" between the flora of the east and west sides of the Cascade Range. The unusual soil, moisture and wind conditions in the Gorge have allowed species and varieties found nowhere else in the world to evolve and survive (Pacific Northwest River Basins Commission 1978).

The many different landforms and water resource areas of the state provide habitat for a great variety of fish and wildlife species which contribute to the environmental quality and support some segments of the economy.

Anadromous fish use nearly all rivers and streams emptying into the Pacific Ocean and Puget Sound. These waters are inhabited by adults and/or juveniles of one or more anadromous fish species during certain times of the year. Resident fish inhabit all state waters with the distribution of each species determined by habitat conditions. Rainbow trout are the most widely distributed and the most abundant. Most low-elevation water bodies support warmwater game fish including catfish, bass, sunfish, perch, and walleye. Many marine fish inhabit coastal waters including tuna, herring, halibut, and lingcod. Important shellfish include shrimp, crab, clams, and oysters (Pacific Northwest River Basins Commission 1978).

The state has very significant wildlife resources. Many species have large populations, their numbers being defined primarily by the availability of suitable habitat. Water supply is not generally the limiting factor in habitat availability except in the arid areas of eastern Washington.

Among big game animals within the state, deer, elk, and black bear are the most numerous, and present on both sides of the Cascades. Extensive logging in western Washington has had both positive and negative effects on the habitat for these species (Pacific Northwest River Basins Commission 1978).

Washington state is the route of a major flyway for migratory birds, extending in a northeast-southwest direction across the state above the Columbia Basin area and along the Pacific Ocean and Puget Sound. The wildfowl flyway probably has shifted westward as a result of changes in the availability of food, shelter, and water (Pacific Northwest River Basins Commission 1978).

Background Issues

o Dams constructed on the Columbia and Snake Rivers have impounded most of the free-flowing sections of these rivers, resulting in diminished anadromous fish populations. Construction of dams has blocked passage to previously accessible spawning and rearing grounds (Figure 10-11). Additional fishing pressure from an increasing number of commercial and sport fishermen also contributes to depletion of anadromous fish populations. Fish passage does occur around many dams but mortality rates can be high. Generally, the higher the river flow, the poorer the passage conditions. Juvenile losses from all causes have been estimated at 15 to 20% at each mainstream dam as they come downstream.

Scenario-Induced Impacts

o The impacts of increased hydro development in Washington are considered to be high. In the Northwest, the most serious water related impact is to anadromous fish, which are impeded by the dam in both upstream and downstream movement. It has been stated (NEPP 1977) that, "If new hydroelectric dams that would adversely affect anadromous fish are developed, upriver races of fish probably would be lost."

- o Development of thermal electric facilities for production of base load power will result in a shift of use of hydroelectric facilities to produce peak power. This will result in fluctuating water levels which can adversely impact aquatic ecosystems.
- o Impacts may occur from development of pumped storage sites, oil direct drive, and combined cycle facilities. Additional power generation from pumped storage in the near term will occur as expansions to existing sites. Oil direct drive and combined cycle facilities will be developed as additions to or modifications of existing facilities. The ecological impacts of these facilities is not expected to be significant.
- o Increased concentration of sulfur dioxide in south-central Washington is associated with the coal-fired generating plant in north-central Oregon currently under construction. Several species of native vegetation, particularly various species of grasses such as fescuse, bluegrass, and bunchgrass, as well as trees such as mountain hemlock and red alder, are sensitive to this pollutant. Douglas fir and sagebrush are somewhat more resistant. Several important crops are also sensitive to SO₂, including hay, fruit, wheat, and other grains. Such crops cover more than 30% of some counties in south-central Washington.

Land Use

- o Figure 10-36 shows projected land use. Up to 7000 acres of land will be disturbed by surface mining of coal in Washington.
- o 2600 acres of land will be required for the five nuclear power plant sites in Washington.

Figure 10-36. Washington: Projected Land Use Requirements by County for Mining and Thermal Power Plants in 1990

Description

Forestry, farming, and rangeland are the three economic activities that most land is devoted to in Washington. Of the total state area, 54% is predominately forest land, 20% rangeland, 19% cropland, and the remaining 7% include barren land, urban, industrial and commercial development, farmsteads, roads, railroads, airports, and bodies of water.

The state's vast timberlands support a diversified forest products industry of lumber, plywood, pulp and paper products, and numerous specialty products. They also supply a growing export market in logs, lumber, plywood and wood chips. In addition to support of the forest products industry, forest lands and waters are important as fish and wildlife habitats, offer a variety of outdoor recreation activities, and comprise major watersheds (Pacific Northwest River Basins Commission 1978).

Croplands and rangelands produce a wide range of agricultural products. Wheat farming accounts for a large percentage of agricultural land primarily in eastern Washington; milk and beef cattle production are also major land users. Fertile river valleys and lowlands are farmed in western Washington.

In northeastern Washington exploration for uranium has been intense during the past few years. The energy-producing material is being mined on the Spokane Indian Reservation, and a second large mine was due to start production in 1978 (Pacific Northwest River Basins Commission 1978).

Coal is found in Washington, with about half the reserves being located in Lewis and Thurston Counties. The total amount of demonstrated coal reserves available is 1954 million tons; almost all of this coal is expected to be surface mined.

Background Issues

- o Debates on the Roadless Area Review and Evaluation (RARE II) study continue, and are representative of the differences of opinion that exist on the issue of how much land should be set aside as wilderness in the state.
- o Washington does not have comprehensive land use legislation, though a concern about residential and commercial development encroaching on valuable agricultural, forest, and range lands has caused several bills to be considered by the legislature (DOE-RAP-21 1978).

Scenario-Induced Changes

- o Land use impacts are expected from surface mining of the state's coal reserves. The scenario projects that approximately 7000 acres will be disturbed by surface mines by 1990. In comparison, development of subsurface mines will affect only 45 acres of surface land. Sixty to seventy percent of the land area in the counties where coal development is projected to occur is occupied by commercial forests.
- o Increases in other energy technologies may also affect present land uses. Expansion of hydropower and pumped storage, for example, may inundate land area now used for other purposes. Raising the existing Ross Dam on the Skagit River to increase the hydroelectric generating capacity is constrained by the fact that the additional land flooded would include acreage in Canada (an increase of 125 feet in height would flood 5000 acres in Canada) (Pacific Northwest River Basins Commission 1978).
- o Construction of five major nuclear plants in Washington will require commitment of 3,600 acres of land. Land use conflicts are not likely to

result from this nuclear power plant development because all plants have been sited and are under construction.

Solid Waste

- o Nuclear reactors will be the major source of energy-related solid waste, some of which will be highly radioactive.
- o Solid waste generated from coal combustion in Washington is expected to amount to 400,000 tons in 1990 (Figure 10-37).

Figure 10-37. Washington: Solid Waste Residuals From Coal-Fired Energy Facilities

Description

In 1976, some 1.1 million people or 32% of Washington's population was being served by state-approved solid waste disposal sites. This is an increase of 100% in the past five years (EPA 1978d).

The recovery of energy and other resources from waste is being considered and developed as problems and costs of other acceptable disposal systems have increased. One of the largest such projects is in Seattle, where a "fuel from refuse" facility is planned.

The most controversial aspect of solid waste disposal in Washington is the disposal of waste generated by the nuclear power plant. Wastes generated by the U.S. defense program are stored at the Hanford Reservation in the

south-central Washington. These wastes are grouped as "high-level" or intensely radioactive materials and those of "low-level" or weak radioactivity (National Academy of Sciences 1978). Research is being conducted at the Hanford Reservation to determine safe methods for long term disposal of nuclear wastes.

Background Issues

- o Leaks from 20 high-level waste tanks have been detected through 1976, releasing a total of about 1700 cubic meters (450,000 gallons) of high-level waste to the ground. In addition to the 20 confirmed leaking tanks, another 14 have been removed from service because their integrity was suspect. Although none of these leaks has posed a serious hazard (National Academy of Sciences 1978), a more secure method of disposal of Hanford wastes is being sought, possibly by deep geological isolation.

Scenario-Induced Changes

- o The only major scenario-induced change with respect to solid waste will be disposal of radioactive wastes generated by nuclear power plants. In addition, the Hanford reservation operated by DOE in south-central Washington may receive wastes from reactors throughout the region as well as the nation.
- o Operation of the coal-fired plant in southwest Washington is expected to generate 400,000 tons of solid waste in the year 1990.

Health and Safety

- o No serious health and safety impacts are expected in Washington.

Description

A major area of concern in the health and safety aspects of energy development in Washington is the handling and disposal of radioactive waste. The radioactive constituents of wastes offer two kinds of potential radiation hazard: whole-body exposure from gamma-rays, and localized irradiation of specific body tissues from beta- and alpha-emitting ingested radionuclides.

As a basis for comparing hazard: (a) the measured natural background radiation of the Hanford area from cosmic rays and radioactive elements in rocks and soils ranges from 75 to 92 millirems per year (mrem/year) for an individual; (b) natural radioactive materials within the body, acquired from ingestion and inhalation, and another 25 mrem/yr; and (c) the average exposure from medical and dental procedures to an individual in the United States is about 70 mrem/yr (National Academy of Sciences 1978).

The external radiation hazard from wastes stored in Washington is very small, to either operating personnel or the public, because the wastes are shielded and confined. The added average per capita annual dose rate for the population within 80 kilometers (50 miles) of the area is 0.1 mrem; for a person standing for an entire year directly over a tank containing high-level waste; the radiation dose would be about 350 mrem, less than five

times the dose from natural background radiation. The dose rates at ground level above cribs into which low-level wastes have been percolated are much less, averaging 7×10 mrem per year (National Academy of Sciences 1978).

A series of statistical studies have been and are being made to investigate the health of workers at nuclear facilities, including Hanford, as related to external radiation levels and other factors. The AEC/ERDA Health and Mortality study, begun in 1964, has reported the year and cause of death and radiation exposure history for the work force at the area since 1944. The first analysis of this data suggested a radiation-induced effect for certain malignant diseases. Two subsequent studies, however, have found no convincing evidence of an excess of cancer among exposed Hanford workers. Studies are still continuing, and other data from other disposal sites and other statistical analyses of the data will be required to resolve these different interpretations of the same body of data (National Academy of Sciences 1978).

Background Issues

- o The external radiation hazard from waste stored in Washington is very small to either operating personnel or the public, because the wastes are shielded or confined.

Scenario-Induced Changes

- o The only major coal mine operating in Washington is a surface mine supplying a coal-fired generating plant in Lewis County. Lead lab information suggests there will be 0.15-0.51 deaths and 8.1-30 injuries associated with surface coal mining in the year 1990. Underground mining is expected to cause 0.16-0.60 deaths and 18-68 injuries for the same year. Up to 5 cases of chronic respiratory diseases and 0-0.4 deaths are also expected to occur among coal workers in 1990. Since underground mining is not expected to be of great importance in coal extraction in the state (DOE-RAP 21 1978) and lead-lab projections are based on national statistics, the predictions of death and injury and occupational hazards in coal miners are probably not realistic for the state of Washington.

- o In 1990, lead lab information predicts nuclear fuel fabrication will cause 1.1 radiation-induced cancer deaths among workers; .0014 such deaths in Washington State's general public, and 0.000004 to 0.0022 such deaths in the public as the result of an accident.

- o Nuclear waste management is expected to cause .081 occupationally induced cancer deaths in 1990.

- o Lead-lab information predicts a death rate of 3.8 to 61 per 10^6 person-year, or 15-230 total deaths in the state due to utility and industrial use of coal as fuel in 1990.

Socioeconomic

- o Socioeconomic impacts are projected whenever large construction projects occur in conjunction with areas of low assimilative capacity.

Impacts may occur in previously undeveloped areas in realizing the geothermal portion of the scenario.

Description

Washington State has a population of 3.7 million (1977 estimates), representing an increase of approximately 28% since 1960. Much of this population growth has been concentrated in urban areas where 71.4% of the state's population lives. The average density of 54.9 persons per square mile ranks this state 22nd in the nation for population concentration. However, The western third of the state is much more densely populated; the 18 counties west of the Cascade Mountain Range contain 74.8% of the state's population and have a density of 116.0 persons per square mile, more than twice the state average. Washington's rate of growth has declined from 1.8% per year in the 1960's to 1.0% per year in 1970's, compared to rates for the U.S. of 1.3% and 0.9%.

Aerospace, forest products, and machinery industries dominate the manufacturing sector of the state's economy. Agriculture and other resource industries are also important; and because of the geographic location of the state, military/defense activities are also an important sector in the state economy.

From 1967 to 1976, the employment of the working age population increased 4.8%, from 69.8 to 74.6%. Average weekly earnings for the state exceeded national averages by \$41 in 1977, with a state average wage of \$268.00 per week. Personal income from all sources was \$7,528 in 1977, ranking 13th nationally. The most recent figures for state poverty levels indicate that, in 1975, 8.5% of the state's population (or 6.6% of the households in the state) were classified as below the poverty level compared to national averages of 11.4% and 9.0%, respectively.

Background Issues

- o The proposed hydroelectric facilities are primarily additions to existing dams. If the site is in a rural, sparsely populated area, even a moderately sized construction force can cause social and economic impacts in the form of changing community character and strains put on existing facilities and services. The problem is compounded if, when the construction force leaves, overcapacity exists in community services.
- o Some Washington residents place a high value on the conservation of scarce and costly energy resources. Policies which advocate extensive energy development without concern for conservation will encounter opposition from a significant portion of the state's energy consumers.
- o Most citizens of Washington desire moderate economic growth in their state with more balance between urban and rural areas. Since energy policy tends to concentrate rapid development in predominately rural areas, with most of the economic benefits accruing to urban areas, the desired balance is rarely achieved. Public concerns of this type may affect energy development.

- o Public concern for preservation of natural environment is often in conflict with the need to expand energy production. Raising hydroelectric dams threatens vast expanses of forest lands and alters the natural ecology of river systems. Issues in ecology, land use, and water quality easily become social and economic issues and matters of intense public debate, the outcome of which can have a major bearing on a state's energy future.
- o Washington relies primarily on hydroelectric energy and, relative to the national average, pays substantially less for this energy. It will be difficult to expand hydro facilities much further, and, as the state begins to rely more heavily on alternative sources such as nuclear, the costs to the consumer will rise dramatically in the coming years. Public attention will focus more intensely on energy policy as the number of energy consumers continues to rise in the face of uncertain supplies and increasing prices.
- o Washington state presently hosts a major nuclear waste disposal site and may in the future absorb the waste products of other states' nuclear energy projects. While populations living near these facilities tend to value the economic benefits associated with nuclear energy, other residents in the state object to their state becoming the country's nuclear dumping ground. Both local and national concern with this issue could affect the course of nuclear energy development in this state.

Scenario-Induced Changes

- o One of the nuclear sites is in Benton County, where construction of three plants is ongoing. The lead lab has projected that the primary work force will peak at 7,153 in 1984, implying a total job-induced population immigration of 35,799. This represents 48.6% of the total county population. Such a population increase, if it occurred, would put a tremendous strain on local government services in the Tri-Cities area during the construction period. This implies a high level of impact on social services, although a segment of the area's population views the increased employment opportunities as beneficial. A sudden decline from the large construction work force to a permanent operating work force of 500 people could produce severe social adjustment problems.
- o The other nuclear site is in Grays Harbor County in the south-western corner of the state. The lead lab has projected a peak labor force of 1,186 in 1987. This implies a peak construction-related increase in population of 3,766, which represents 5.8% of the baseline population. This is viewed as causing moderate impact, and impact payments between the utility and some of the local governments have already been negotiated.
- o One of the proposed geothermal facilities would be located in the eastern third of Lewis County. This is a mountainous, very sparsely populated area of the state. Presumably, the labor force for a geothermal facility would be moderate in size; however, given the location, much of the work force might in-migrate to the area. This could put a strain on the few existing towns. Prices might be inflated, housing could be hard to find, and services and facilities could be strained. The other proposed geothermal site in Washington is in the Mt. Baker area in Whatcom County, where a situation similar to Lewis County exists. Possibly, much of the work force might have to live near the site in presently unincorporated

towns, putting a strain on county services and facilities. However, if a work camp is created and supported by the builder/contractors, social impacts on surrounding communities may be low.

- o There are three hydro sites in Washington that might have moderate social impacts associated with their development. The first is a rock-fill dam in Skagit County. While the work force is expected to be small, a recent draft environmental impact statement on the dam indicated that the following socioeconomic impacts would be significant: widespread local public concern that the rock-fill dam would be unsafe and pose a threat to the lives and property of downstream residents, land use and development in the Skagit River valley would be intensified by the construction labor force, and construction of the dam along with a proposed nuclear project not currently identified by the scenario would create a housing shortage in the Skagit River valley.

- o the raising of a dam in Whatcom County north of the Copper Creek site may also cause moderate social impacts. There are only a few very small towns in the vicinity. The site is isolated enough to preclude commuting, except possibly from a small town an hour or so in driving time to the west. Thus even a small work force moving temporarily into the area (particularly with additional household members) could put a significant strain on the few communities there.

- o The third hydro site in Washington that may cause moderate impacts is the Grand Coulee Dam in Grant County. There are plans to add 2400 megawatts to the existing dam, which would entail a large construction effort in a very rural, sparsely populated area of the state. There are only small towns in the area, and substantial in-migration, even on a temporary basis, could prove a hardship for some of the small towns that have part-time governments, services, facilities geared to a rural lifestyle unlike that of the more urban construction worker.

- o The combined cycle site in Lewis County also may generate moderate impacts. While surrounding towns can likely supply the requisite labor force, a new plant generating 510 megawatts will currently have an economic effect on the area, both during construction and into the operation phase. Certain strains may be placed on the local economy if demand exceeds the capacity of facilities and services during a boom construction period. Changes in community lifestyle may also occur if there is much in-migration of the construction force and secondary population.

- o A proposed new hydro facility in Clark County may also generate moderate impacts. This facility has not been identified by any Northwest official or utility representative. However, if such a facility were to be constructed, it would likely, because of its size, generate some social and economic impacts. The labor force would probably be drawn from the Vancouver-Portland area, and some changes might be expected in the local area's economy during the temporary construction phase. Overcrowding may cause changes in the style of life in the communities adjacent to the dam site.

- o An addition of 446 MWe to a hydro facility in Benton County has also been proposed in the scenario. If a hydro facility in Benton County were to be expanded it is possible that significant social impacts could result. This would be primarily because there is a boom already occurring in the county caused by the development of other energy facilities, particularly the nuclear plants. Another large construction project would further exacerbate the boom problems of spiraling prices and overloading of services and facilities in the county.

Institutional

- o Political and legal opposition to High Ross Dam and Copper Creek could stop or slow construction.

Description

In comparison to other northwestern states, federal and state institutions in Washington play a larger role in power development than private institutions. This is because in Washington investor-owned utilities supply only 23% of the electrical power to end-users. Fully 77% of the market is occupied by publicly owned utilities, primarily public utility districts and large municipal-owned utilities such as Seattle City Light and Tacoma City Light (U.S. Department of Energy 1978). The Bonneville Power Administration supplies most of the public utilities' needs and a significant fraction of the investor-owned utilities' needs with hydroelectric power generated by the Federal Columbia River Power System.

Because federal hydroelectric power is not expanding fast enough to meet anticipated demand in the 1980s, both investor-owned and publicly owned utilities in Washington have been constructing their own new power plants, mostly thermal. The state's publicly owned utilities are building five nuclear power plants through the Washington Public Power Supply System (WPPSS). WPPSS was established in 1957 as a municipal corporation and joint operating agency of the State of Washington. Its members consist of 19 public utility districts and 3 municipal utilities in the state (WPPSS Quarterly Report, September 30, 1978). Essentially, WPPSS is a vehicle for the joint construction and operation of thermal power plants by its member utilities, which are thereby able to aggregate their capability to issue low-interest municipal bonds.

In constructing new generating facilities, both publicly owned utilities (whether through WPPSS or independently) and investor-owned utilities are subject to extensive state regulation. The state licensing process centers on the Energy Facility Site Evaluation Council (EFSEC) created by RCW Chapter 80.50, which must approve all thermal (but not hydroelectric or geothermal) power plants. Represented on the council are the state agencies and political subdivisions whose approval would otherwise have to be individually obtained for siting of the facility. Instead of approving the facility separately, however, the Council's members review the application for compliance with relevant state laws, hold hearings, and collectively pass on the application. If the Council's decision is favorable, it recommends certification (subject to any condition) by the Governor, with whom the final decision rests. Among other things, EFSEC is responsible for ensuring the equivalent of compliance with the Washington State

Environmental Policy Act, (RCW Chapter 43.21C), through environmental analysis by an independent consultant (RCS 80.50.071). EFSC's authority supersedes the authority of all state agencies and political subdivisions that might otherwise impose requirements on the construction of the facility. Agencies represented on the Council who also play significant state energy roles in their own right, include the Department of Ecology (administers state air pollution, water pollution, and many SEPA regulations) and the Department of Natural Resources (manages state-owned lands). Other state agencies involved in state energy policy are the State Energy Office, which essentially provides information and advice, and the Washington Utilities and Transportation Commission, which regulates rates of investor-owned utilities.

Background Issues

- o WPPSS has recently come under criticism for its management of the construction of the five nuclear plants. A recent study of three of the WPPSS projects, performed for BPA by Theodore Barry and Associates, attributes cost escalations of roughly 275% in part to inadequacies in the management of WPPSS. In addition, the study concludes that WPPSS lacks effective checks and balances from either external or internal sources. The Barry report recommends a strengthened role for BPA in overseeing construction of the WPPSS facilities. Senator Ted Bottinger, Chairman of the Senate Energy and Utility Committee in the Washington Legislature has proposed creation of a joint legislative committee to monitor the projects on a continuing basis. A similar measure has also been proposed in the state's House of Representatives. As a result of this cost escalation, BPA, which through "net billing" is purchasing all of the output of two of the plants and 70% of the output of the third on long-term contract, has announced a wholesale rate increase of 40% for November, 1979. Additional projected increases are 28% in 1981, 24% in 1983, and 15% in 1985. This situation has led to concern about future federal underwriting of thermal power plant construction, since the cost increases from the WPPSS facilities will be borne by all consumers whose utilities purchase wholesale power from BPA. Some believe restoration of this practice for the construction of thermal generating facilities by publicly-owned utilities, and its extension to investor-owned utilities as well, could result in unacceptably high power rates because of inadequate incentives for the builders of net-billed plants to hold down costs.

- o Presently, it is unclear whether EFSEC's authority overrides city, county, or regional zoning codes. By statutes, EFSEC is required to hold hearings on compliance of a proposed facility with land use plans rezoning ordinances. However, a recent Attorney General's opinion states that the Council may go ahead and approve sites even after determining that their use is inconsistent with local land use laws. This issue is now being litigated and will be resolved either by the Washington Supreme Court or by legislation. State legislators have recently introduced several bills that would require compliance with local zoning as of the date of application to EFSEC.

- o Considerable uncertainty surrounds the status of the Washington State Energy Office. The office has been criticized by a GAO audit, a state audit, the state legislature, and the Governor as suffering from weak management

and unclear objectives. New legislation may reconstitute the office, perhaps by transferring its functions to the State Utilities and Transportation Commission. Although the office does not have a major role in energy development, it does administer federal funds, such as those provided for conservation. Until the status of the office is clarified, these functions are apt to remain unperformed.

Scenario-Induced Changes

- o The nuclear facilities included in the scenario are under construction. State siting permits and NRC construction permits have been granted. Political opponents of nuclear power in the state such as the Crabshell Alliance have few legal levers left. Although cost escalation and charges of poor management may lead the Washington Legislature to restructure the Washington Public Power Supply System, builder of the facilities, such a move is unlikely to delay completion of the facilities beyond 1990. New NRC regulatory requirements imposed in the wake of Three-Mile Island could also slow completion, but probably not beyond 1990.

- o Most of the additions to Washington's hydroelectric capacity are also sufficiently well advanced that they are likely to be in place by 1990. However, some 20% of the hydroelectric capacity is still in the very early planning stages. Of these, some federal projects may not receive necessary Congressional approval. Two projects of Seattle City Light, the raising of High Ross Dam and the construction of a dam on Copper Creek, also face political and legal opposition that could stop or slow them.

- o Technical and economic considerations tend to foreclose the development of significant geothermal electrical generating capacity in Washington by 1990. Institutional considerations only enhance the difficulties: the state has not developed statutory norms for leasing geothermal resources on state lands, the state has not developed procedures for the required drilling permits on private or state lands, and federal procedures for leasing federal land are slow.

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APPENDIX I

APPENDIX

This section contains summary matrices which rank environmental, socio-economic and health and safety impacts of implementation of the DOE Mid-Range Projection Series C Scenario in each State. Impacts are ranked according to the criteria defined in Table AP-1. The State matrices are presented in alphabetical order.

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DEFINITION OF CRITERIA FOR RATING OF IMPACTS

IMPACT CATEGORY	HIGH IMPACT	MEDIUM IMPACT	LOW IMPACT
AIR QUALITY	<p>MAJOR FACILITIES IN PROPOSED SITING SCENARIO COULD BE CONSTRAINED BY ONE OR ALL OF THE FOLLOWING ISSUES.</p> <p>A) PERSISTENT AND CONTINUED VIOLATIONS OF PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARDS.</p> <p>B) INABILITY TO ATTAIN ACCEPTABLE PSD INCREMENT LIMITATIONS.</p> <p>C) LIMITED PROBABILITY THAT IMPROVED EMISSION CONTROL EFFICIENCIES OR OFFSETS WOULD RESULT IN NAAQS ATTAINMENT.</p>	<p>SOME MAJOR FACILITIES IN PROPOSED SITING SCENARIO COULD BE CONSTRAINED BY HIGH IMPACT ISSUES.</p> <p>VIOLATIONS OCCUR BUT ARE AMENABLE TO EXTENSIVE CONTROL TECHNOLOGY, FUEL (COAL AND OIL) PURCHASING POLICY, AND/OR OFFSET.</p>	<p>AIR QUALITY AND EMISSION LEVEL ARE WITHIN ACCEPTABLE STANDARDS. NO MAJOR ADJUSTMENTS TO SITING OF PLANTS BECAUSE OF AIR QUALITY ISSUES.</p>
VISIBILITY	<p>THERE IS A SIGNIFICANT DECREASE IN CALCULATED VISUAL RANGE IN CLASS 1 AREAS.</p>	<p>THERE IS A MODERATE DECREASE IN VISUAL RANGE BUT THE REDUCTION IS AMENABLE TO MITIGATION MEASURES.</p>	<p>NO DECREASE IN VISUAL RANGE OR NEW SITING IMPACTS AMENABLE TO MITIGATION MEASURES. NO MAJOR ADJUSTMENT IN SITING.</p>
WATER QUALITY	<p>SIGNIFICANT ECONOMIC BURDEN TO MEET WPCA REQUIREMENTS.</p>	<p>TREATED EFFLUENTS MEET EFFLUENT STANDARDS BUT OCCASIONAL LOCALIZED STREAM STANDARD VIOLATIONS WILL OCCUR IN RECEIVING WATER BODY.</p>	<p>RECEIVING BODY CAPABLE OF HANDLING ALL PROJECTED EFFLUENT ADDITIONS. FEW OR NO VIOLATIONS OF STREAM STANDARDS ANTICIPATED.</p>
WATER AVAILABILITY	<p>NO WATER AVAILABLE WITHOUT MAJOR SHIFTS IN CURRENT WATER USES, E. G., EITHER ENERGY DEVELOPMENT OF AGRICULTURE, EVEN WITH LOW-FLOW AUGMENTATION, OR WATER AVAILABLE THROUGH MAJOR STRUCTURAL AND NON-STRUCTURAL ALTERNATIVES, E. G., STRUCTURAL-CONSTRUCTION OF DAMS AND RESERVOIRS.</p> <p>GROUND WATER MINING WITH NO RECHARGE POTENTIAL.</p>	<p>WATER AVAILABLE AT MODERATE ECONOMIC COST TO THE REGION.</p> <p>GROUND WATER MINING WITH RECHARGE POTENTIAL AVAILABLE OR POSSIBLE.</p>	<p>NO CONFLICTS EXCEPT FOR RECREATIONAL USES.</p> <p>GROUND WATER WITHDRAWAL WHERE ANNUAL RECHARGING OCCURS.</p>
SOLID WASTE	<p>SEVERE POTENTIAL CONTAMINATION PROBLEMS LIKELY TO REQUIRE COMPLETE CONTAINMENT OF WASTES.</p>	<p>MINIMAL ENVIRONMENTAL IMPACTS WITH PROPER CONTROL TECHNOLOGY. INDICATION THAT MANY AREAS MAY EXPERIENCE PROBLEMS AND IN SOME OF THESE AREAS SUITABLE OPTIONS MAY NOT BE AVAILABLE.</p>	<p>MINIMAL ENVIRONMENTAL IMPACTS WITH PROPER CONTROL TECHNOLOGIES. SOME POTENTIAL PROBLEMS BUT GENERALLY AMENABLE TO CURRENT TECHNOLOGY OPTIONS AT ADDITIONAL COST.</p>
ECOLOGY	<p>CRITICAL NATURAL HABITATS WILL BE DISTURBED.</p>	<p>CRITICAL NATURAL HABITAT OR LARGE ACRES OF CROPLAND MAY BE DISTURBED.</p>	<p>LOCALIZED IMPACTS WHICH MAY BE READILY MITIGATED BY STRUCTURAL OR SITING ALTERNATIVES.</p>
LAND USE	<p>CONFLICT WITH HIGH VALUE LAND USE, SUCH AS LOSS OF HABITAT, PARKLAND, SEISMIC RISKS, SCENIC RESOURCES, INDIAN LANDS, AGRICULTURAL LAND.</p>	<p>SIMILAR CONFLICTS, WITH ALTERNATIVE SITES OR MITIGATION MEASURES COSTLY BUT AVAILABLE.</p>	<p>FEW CONFLICTS; OR A RANGE OF ALTERNATIVES AVAILABLE.</p>
PUBLIC HEALTH	<p>SIGNIFICANT INCREASES IN MORBIDITY AND MORTALITY RATE DUE TO EXPOSURE TO ENERGY RELATED POLLUTANTS.</p>	<p>MODERATE INCREASES IN MORBIDITY AND MORTALITY RATE DUE TO EXPOSURE TO ENERGY RELATED POLLUTANTS.</p>	<p>NO SIGNIFICANT IMPACT. ALL IMPACTS SUBJECT TO MITIGATION.</p>
OCCUPATIONAL HEALTH AND SAFETY	<p>SIGNIFICANT INCREASES IN OCCUPATIONALLY RELATED DEATHS, INJURIES, AND DISEASE DUE TO INCREASED ENERGY DEVELOPMENT.</p>	<p>POTENTIAL SIGNIFICANT INCREASES IN RESPIRATORY AND OTHER DISEASES BUT IMPROVEMENTS IN OSHA, NRC AND EPA REGULATIONS AND WORK-PLACE CONDITIONS EXPECTED TO ALLEVIATE MUCH OF THE PROBLEM.</p>	<p>NO SIGNIFICANT INCREASES IN OCCUPATIONALLY RELATED DEATHS, INJURIES, AND DISEASE DUE TO INCREASED ENERGY DEVELOPMENT.</p>
LOCAL SOCIOLOGICAL FACTORS	<p>IMPLEMENTATION DELAYED OR POSSIBLY BLOCKED DUE TO POTENTIALLY SEVERE CHANGES IN A COMMUNITY'S QUALITY OF LIFE; HEAVY DEMANDS PLACED ON PHYSICAL INFRASTRUCTURE INCLUDING SERVICES, FACILITIES, HOUSING; CONFLICT IN VALUES AND LIFESTYLE BETWEEN IMMIGRANTS AND LONG-TIME RESIDENTS; IMMIGRANTS REPRESENT A STATISTICALLY SIGNIFICANT PORTION OF THE BASELINE POPULATION; EXTENDED NEGOTIATIONS LIKELY BETWEEN DEVELOPER AND AFFECTED COMMUNITIES; AFFECTED COMMUNITIES WILL HAVE GREAT DIFFICULTY ABSORBING HIGH SOCIAL AND ECONOMIC COSTS OF PROJECT WITHOUT OUTSIDE ASSISTANCE.</p>	<p>POTENTIAL DELAYS DUE TO COMMUNITY AND LOCAL GOVERNMENT RESISTANCE TO FACILITY; POTENTIAL INCREASED COSTS TO LOCAL GOVERNMENT; SOME COMMUNITY FEARS FOR CHANGES IN THE QUALITY OF LIFE ACCOMPANYING INFLUX OF POPULATION; MITIGATION STRATEGIES AVAILABLE, BUT USUALLY COSTLY; MODERATE CAPACITY OF AFFECTED COMMUNITIES TO ABSORB THESE IMPACTS.</p>	<p>MINOR CHANGES IN LOCAL GOVERNMENT'S INFRASTRUCTURE; FEW IMMIGRANTS OR FEW CULTURAL AND LIFESTYLE CLASHES EXPECTED; MITIGATION COSTS EASILY ABSORBED BY AFFECTED COMMUNITIES.</p>
LOCAL ECONOMICS	<p>IMPLEMENTATION BLOCKED DUE TO UNACCEPTABLE ECONOMIC DEMANDS ON LOCAL INFRASTRUCTURE.</p>	<p>POTENTIAL DELAYS DUE TO LACK OF SKILLED PERSONNEL, FINANCIAL IMPACTS ON LOCAL GOVERNMENT.</p>	<p>INFRASTRUCTURE IMPACTS MINOR. ADAPTABILITY OF COMMUNITY GOVERNMENT HIGH.</p>
REGIONAL ECONOMICS	<p>CAUSES ADVERSE CAPITAL OR EMPLOYMENT IMPACTS ON REGION. DECREASES COMPETITIVE POSITION COMPARED TO OTHER REGIONS.</p>	<p>POTENTIAL EMPLOYMENT, CAPITAL OR COMPETITIVE IMPACTS, BUT MITIGATION STRATEGY POSSIBLE.</p>	<p>NO SIGNIFICANT IMPACTS.</p>
INSTITUTIONAL AND LEGISLATIVE	<p>PROHIBITION OF IMPLEMENTATION BASED ON AVAILABLE STRONG LEGAL CONSTRAINTS. ANTICIPATED LEGISLATIVE PROHIBITION. ABSENCE OF EFFECTIVE ORGANIZATIONAL RESPONSIBILITIES, STATUTES, ETC.</p>	<p>DELAY POSSIBLE DUE TO LEGAL OR POLITICAL CONSTRAINTS. LOW TO MODERATE PUBLIC OR PRIVATE INTEREST IN ENFORCEMENT.</p>	<p>NO SIGNIFICANT OPPOSITION, LEGAL CONSTRAINTS, OR ORGANIZATIONAL PROBLEMS.</p>

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Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Alabama

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	H	L	L	M	L	H	L	L	L	M
Oil	L					L	L	L	L	L
Gas	L					L	L	L	L	L
Nuclear							M	M	M	H
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	H	L					M	M	M	M
Industry	L	L			L		M	L	L	M
Mining		M		M			M	M	M	M

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Alaska

Energy Source	Air Quality	Water		Ecology	Land		Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use	Solid Waste		Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction									
Coal	L	L	-	M	M	-	-	L	L
Oil	L	L	-	L	L	-	-	L	L
Gas	L	L	-	L	-	-	-	L	L
Geothermal									
Transport of Energy									
Oil tankers	-	L	-	-	L	-	-	L	L
Pipelines	M	M	L	M	M	-	-	H	M
Transmission lines	-	L	-	M	M	-	-	L	L
Conversion									
Refineries									
Electric Generation									
Hydro									
Conventional	-	-	-	-	-	-	-	H	H
Hydro Pumped Storage									
Coal	M	L	L	L	L	L	L	L	L
Nuclear									
Gas Direct Drive	-	-	-	-	-	-	-	H	H
Gas Steam									
Oil Direct Drive	L	-	-	-	-	-	-	L	L
Oil Steam	L	L	L	L	L	-	-	L	L
Combined Cycle									
Geothermal									

High (H), Medium (M), Low (L)

(-) No Impact

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

Environmental Impacts of the
MID-MID Scenario on Arizona *

	Air	Water		Land		Health & Safety	Social and Economic			
Energy Source	Quality	Quality	Availability	Ecology/Land Use	Solid Waste	Occupational & Other	Local Socio-logic Factor	Local Economics	National Economics	Legislative/Institutional
Extraction (production)										
Coal	-	L	H	M	M	M	L	L	L	-
Oil	-	-	-	-	-	-	-	-	-	-
Gas	-	-	-	-	-	-	-	-	-	-
Transportation of fuels										
Oil imports (ports, tankers)	-	-	-	-	-	-	-	-	-	-
Gas imports (ports, tankers)	-	-	-	-	-	-	-	-	-	-
Transmission lines	-	-	-	-	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-	-	-	-	-
Conversion										
Refineries	-	-	-	-	-	-	-	-	-	-
Gasification facilities	-	-	-	-	-	-	-	-	-	-
Electric Generation	M	L	L	M	M	L	M	L	L	-
Nuclear	-	L	L	M	M	L	L	L	L	L
Coal	M	L	M	M	M	L	L	L	L	L
Oil	-	-	-	-	-	-	-	-	-	-
Gas	L	L	L	-	L	L	L	L	L	H
Solar	-	-	-	-	L	L	-	-	-	H
Geothermal	-	-	-	-	-	-	-	-	-	-
Hydroelectric	-	-	-	-	-	-	-	-	-	H
End Use										
Industrial										
Coal										
Oil	L	-	-	L	M	L	-	-	-	-
Gas										
Residential/Commercial	-	-	-	-	-	-	-	-	-	-
Transportation Sector	-	-	-	-	-	-	-	-	-	-
TOTAL SCENARIO										

* Based on LASL profile matrix

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Arkansas

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	L	M	M			H for combustion	L	L	L	L
Oil	L						L	L	L	L
Gas	L						L	L	L	L
Nuclear	L					L	M	M	M	H
Conservation										
Energy efficiency Improvements							L	L	L	M
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility		M					L	L	L	M
Industry		L					L	L	L	L
Mining		L					L	L	L	M

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts of the
MID-MID Scenario on California

	Air	Water		Land			Health & Safety	Social and Economic			
Energy Source	Quality	Quality	Availability	Ecology	Land Use	Solid Waste	Occupational & Other	Local Socio-Logic Factors	Local Economics	National Economic	Legislative/Institutional
Extraction (production)											
Coal	-	-	-	-	-	-		-	-	-	-
Oil	-	L	-	-	M	-		-	L	L	L
Gas	-	L	-	-	M	-		-	L	L	L
Transportation of Fuels											
Oil imports (ports, tankers)	M	-	-	-	M	-		-	L	L	M
Gas imports (ports, tankers)	L	-	-	-	H	-		-	M	L	M
Transmission Lines	-	-	-	-	M	-		-	M	L	L
Pipelines	-	-	-	-	L	-		-	L	L	L
Conversion											
Refineries	M	M	-	-	H	M		-	L	L	-
Gasification facilities	-	-	-	-	-	-		-	-	-	-
Electric Generation											
Nuclear	L	L	L	L	L	L		-	L	L	M
Coal	-	-	-	-	-	-		-	-	-	-
Oil	M	M	M	M	L	L		M	L	L	L
Gas	-	L	M	L	L	L		L	L	L	L
Solar	-	L	L	L	L	L		-	L	L	L
Geothermal	M	H	H	M	H	L		H	M	L	M
Hydroelectric	-	M	-	M	H	-		M	L	L	L
End Use											
Industrial											
Coal	L	M	-	M	-	M		-	-	-	L
Oil	L	M	-	L	-	L		-	-	-	L
Gas	L	L	-	L	-	L		-	-	-	L
Residential/Commercial	-	-	-	-	-	-		-	-	-	M
Transportation Sector	H	-	-	-	M	-		-	-	-	M
TOTAL SCENARIO										L	

ENVIRONMENTAL IMPACTS¹ OF THE EIA TRENDLONG MID-MID SCENARIO ON COLORADO

Energy Source	Air		Water		Land		Health & Safety ³	Social and Economic			
	Quality	Visibility	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
COAL -Electric	H	H	L	L	H	M	L	H	H	H	L
OIL	L	L		L	M	L	L	L	L	L	L
GAS	L	L		L	L	L	L	L	L	L	L
NUCLEAR	L			L	M	M	L	L	L	L	L
CONSERVATION -Energy Efficiency Improvements					L	L	L	L	L	L	
-Urban Waste					L	L	L	L	L	L	
-Cogeneration					L	L	L	L	L	L	
SOLAR											
GENERAL -Utility	H	H	L	L	M	M	L	H	H	H	M
-Industry	M	H	L	L	M	M	L	L	L	L	
-Mining	L	L	M	H	M	M	M	H	H	H	

¹Criteria for ranking impacts found in Table AP-1.

²Includes groundwater.

³Includes health effects not covered by air quality.

Summary of State Level Environmental Impacts: Connecticut

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	-	-	-	L	-	-	-	-	M
Oil	-	-	-	-	-	-	-	-	-	-
Nuclear		L	L	L	F	L	L	L	L	M
Supply										
Gas	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	-
Urban Waste	M	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

SUMMARY OF STATE LEVEL ENVIRONMENTAL IMPACTS: DELAWARE

Energy Source	Air	Water		Land		Health & Safety ³	Social and Economic			
	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	L	L	L	L	L	M
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	-	-	-	-	-	-	-	-	-
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	-	-	-	-	L	L	-	-	-
End Use										
Industry	H	-	-	-	L	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Environmental Impacts^a of the
EIA trending Mid-Mid Scenario
at the regional or state level - Florida

Energy source	Air	Water		Land		Health safety ^b	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	M	H	H	M		L	L	L	L	M
Oil	L					M	L	L	L	M
Gas	L					M	L	L	L	L
Nuclear						L	M	M	M	H
Conservation										
Energy efficiency Improvements							L	L	L	L
Urban waste Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	M	M					H	M	M	M
Industry	L	M					M	L	L	M
Mining		L		L			M	L	L	M

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Georgia

Energy source	Air	Water		Land		Health safety ^b	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	M	L	L	L		M	L	L	L	L
Oil	M					M	L	L	L	L
Gas	L					M	L	L	L	L
Nuclear	L					L	M	M	M	M
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar										
General										
Utility	M	L					M	L	L	M
Industry	L	L					L	L	L	L
Mining		L		L			L	L	L	L

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Idaho

Energy Source	Air Quality	Water		Ecology	Land		Solid Waste	Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use				Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction										
Coal										
Oil										
Gas										
Geothermal	*	*	*	L	L		-	-	L	M
Transport of Energy										
Oil tankers										
Pipelines	-	L	-	L	L		-	-	M	M
Transmission lines	-	L	-	M	M		-	-	-	-
Conversion										
Refineries										
Electric Generation										
Hydro										
Conventional	L	L	L	H	L		-	-	M	L
Hydro Pumped Storage										
Coal										
Nuclear										
Gas Direct Drive										
Gas Steam										
Oil Direct Drive	L	-	-	-	-		-	-	L	L
Oil Steam										
Combined Cycle										
Geothermal	*	*	*	L	L		-	-	L	M

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - ILLINOIS¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	L	L					L	L	M	
-Oil	M ⁴						L	L	M	
-Gas	L						L			
-Nuclear	L						L	L	M	
-Combined Cycle	L								M	
-Solar	L									
-Hydro										
General:										
-Utility	M	L	H	L	L	L	L	L	M	M
-Industry	H					L		L		
-Mining	L			M	M		M		L	L

¹Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

²Includes ground water.

³The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴Fuel switching to premium quality fuel may be required.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - INDIANA¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	L	M	M				L	M	H	
-Oil	M ⁴						L	M	M	
-Gas							L	L		
-Nuclear	L						L	L	H	
-Combined Cycle										
-Solar										
-Hydro										
General										
-Utility	L		M	L	L	L	L	M	H	H
-Industry	M					M				
-Mining	L	M		M	M		L		M	H

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to a premium quality fuel may be required.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - IOWA¹

	Air	Water		Land			Health and Safety		Local Socioeconomic ³	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	H					L	L	L		
-Oil	M ⁴						L	L		
-Gas	L						L			
-Nuclear	L		H				L	L		
-Combined Cycle										
-Solar										
-Hydro										
General:										
-Utility	M		H	M	L		L	L	L	L
-Industry	H		L	M		L		L		
-Mining	L		L	L	L		L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to premium quality fuel may be required.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - KANSAS¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	H						L	L	H	
-Oil	M ⁴						L	L		
-Gas							L			
-Nuclear			H				L	L	M	
-Combined Cycle										
-Solar										
-Hydro										
General:										
-Utility	H		H	M	L	L	L	L	H	H
-Industry	H		L	M		L		L		
-Mining	L		L	L	L		L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to premium quality fuel may be required.

Environmental Impacts^a of the
EIA trondlong Mid-Mid Scenario
at the regional or state level - Kentucky

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	H	M	M	H		H	L	H	H	M
Oil	L					L	L	L	L	L
Gas	L					L	L	L	L	L
Nuclear	L					L	L	L	L	L
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	H	M					L	M	M	M
Industry	L	L					L	L	L	M
Mining		M		H			L	M	M	M

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Louisiana

Energy source	Air	Water		Land		Health safety ^b	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal		M	M	M						
Electric	L					H	L	L	L	M
Oil	L					H	L	L	L	H
Gas	L					H	L	L	L	H
Nuclear						L	M	M	M	H
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	L	M					M	M	M	H
Industry	L	L					M	M	M	H
Mining		L		None			L	L	L	H

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Summary of State Level Environmental Impacts: Maine

Energy Source	Air	Water		Land		Health & Safety ³	Social and Economic			
	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	L	L	L	L	L	L	L	L	M
Oil	-	-	-	-	-	-	-	-	-	-
Nuclear	-	L	L	L	H	L	L	L	L	M
Supply										
Gas	-	-	-	-	-	-	-	-	-	-
Oil	-	M	-	M	-	-	-	-	-	M
Urban Waste	-	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

SUMMARY OF STATE LEVEL ENVIRONMENTAL IMPACTS: MARYLAND

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	L	L	L	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	L	L	L	M
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	L	L	L	L	L	L	L	L	L
End Use										
Industry	M	-	-	-	L	L	L	L	L	L

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¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Summary of State Level Environmental Impacts: Massachusetts

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	-	-	-	M	-	-	-	-	M
Oil	-	-	-	-	-	-	-	-	-	-
Nuclear	-	L	M	L	H	L	L	L	L	H
Hydropower	-	L	-	M	-	-	-	-	-	-
Supply										
Gas	-	M	-	M	-	-	-	M	M	H
Oil	-	M	-	M	-	-	-	M	M	H
Urban Waste	-	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹ Criteria For Ranking Impacts Found In Table

² Includes Ground Water

³ Includes Health Effects Not Covered By Air Quality

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - MICHIGAN¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	H			L			L	L		
-Oil	L			L			L	L		
-Gas	L			L			L			
-Nuclear	L			L			L	L		
-Combined Cycle	M									
-Solar										
-Hydro										
General:										
-Utility	M	M		M	M	L	L	L	L	L
-Industry	H			M		M		L		
-Mining	L									

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - MINNESOTA¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:							L	L		
-Coal	L						L	L		
-Oil	L						L			
-Gas	L						L	L		
-Nuclear										
-Combined Cycle										
-Solar										
-Hydro										
General:										
-Utility	L			L	M	L	L	L	L	L
-Industry	L					L		L		
-Mining	L						L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

Environmental Impacts^a of the
EIA trending Mid-Mid Scenario
at the regional or state level - Mississippi

Energy source	Air	Water		Land		Health safety ^b	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	L	L	L	L		L	L	M	M	M
Oil	L					M	L	L	L	L
Gas	L					M	L	L	L	L
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	L	L	L		L		M	M	M	M
Industry	L	L			L		L	L	L	L
Mining		L		L			L	L	L	L

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

**Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - MISSOURI¹**

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	H						L	L	M	
-Oil	L						L	L		
-Gas	L						L			
-Nuclear	L						L	L		
-Combined Cycle	M									
-Solar										
-Hydro										
General:										
-Utility	M	L	L	L	L	L	L	L	M	M
-Industry	H	L	L			L		L		
-Mining	L	L	L	M	M		L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

ENVIRONMENTAL IMPACTS¹ OF THE EIA TRENDLONG MID-MID SCENARIO ON MONTANA

Energy Source	Air		Water		Land		Health & Safety ³	Social and Economic			
	Quality	Visibility	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
COAL -Electric	N	L	L	L	H	M	L	H	H	H	L
OIL	L	L		L	M	L	L	L	L	L	
GAS		L									
NUCLEAR											
CONSERVATION -Energy Efficiency Improvements					L	L	L	L	L	L	
-Urban Waste					L	L	L	L	L	L	
-Cogeneration					L	L	L	L	L	L	
SOLAR											
GENERAL -Utility	M	L	L	L	M	M	L	H	H	H	M
-Industry	L	L	L	L	L	L	L	L	L	L	
-Mining	L	L	M	L	M	M	M	H	H	H	

¹Criteria for ranking impacts found in Table AP-1.

²Includes groundwater.

³Includes health effects not covered by air quality.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - NEBRASKA¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	M						L	L	M	
-Oil	M ⁴						L	L		
-Gas							L			
-Nuclear	L						L	L	M	
-Combined Cycle										
-Solar										
-Hydro										
General:										
-Utility	M	L	H	M	L	L	L	L	M	M
-Industry	H	L	L	M		L		L		
-Mining	L	L	L				L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to premium quality fuel may be required.

Environmental Impacts of the
MID-MID Scenario on Nevada

	Air	Water		Land			Health & Safety	Social and Economic			
Energy Source	Quality	Quality	Availability	Ecology	Land Use	Solid Waste	Occupational & Other	Local Socio-logic Factor	Local Economics	National Economics	Legislative/Institutional
Extraction (production)											
Coal	-	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	L	-
Gas	-	-	-	-	-	-	-	-	-	L	-
Transportation of Fuels											
Oil Imports (ports, tankers)	-	-	-	-	-	-	-	-	-	-	-
Gas Imports (ports, tankers)	-	-	-	-	M	-	-	-	L	L	M
Pipelines	-	-	-	-	L	-	-	-	L	L	L
Conversion											
Refineries	-	-	-	-	-	-	-	-	-	-	-
Gasification facilities	-	-	-	-	-	-	-	-	-	-	-
Electric generation											
Nuclear	-	-	-	-	-	-	-	-	-	-	-
Coal	M	M	M	M	L	M	-	L	L	L	L
Oil	-	-	-	L	L	L	-	L	L	L	-
Gas	L	L	H	L	L	L	-	L	M	L	H
Solar	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	-	-	-	-	-	-	-	-
Hydroelectric	-	-	-	-	-	-	-	-	-	-	-
End Use											
Industrial											
Coal	L	-	-	M	-	L	-	-	-	-	-
Oil	-	-	-	L	-	L	-	-	-	-	-
Gas	-	-	-	L	-	L	-	-	-	-	-
Residential/Commercial	-	-	-	-	-	-	-	-	-	-	-
Transportation Sector	H	-	-	-	L	-	-	-	-	-	-
TOTAL SCENARIO							L			L	H

Summary of State Level Environmental Impacts: New Hampshire

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	-
Nuclear	-	H	M	M	L	L	L	L	L	H
Supply										
Gas	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	-
Urban Waste	-	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹ Criteria For Ranking Impacts Found In Table

² Includes Ground Water

³ Includes Health Effects Not Covered By Air Quality

Summary of State Level Environmental Impacts: New Jersey

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	M	L	L	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	M	L	L	H
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	-	-	-	-	L	-	-	-	-
End Use										
Industry	M	-	-	-	L	L	L	L	L	M

¹Criteria For Ranking Impacts Found In Table 2.

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - New Mexico

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	H	L	L	H	H	H	L	L	L	M
Oil	L	L	L	M	L	L	L	L	L	H
Gas	L	L	L	L	L	L	L	L	L	H
Nuclear		L	L	M	M	L				H
Conservation										
Energy efficiency										
Improvements			L	L	L	L				H
Urban waste			L	L	L	L				L
Cogeneration			L	L	L	L				L
Solar			L	L	L	L				H
General										
Utility	H	L	L	L	M	L				
Industry	L			L	M	L				
Mining		M	H	M	M	M	M	M	L	

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Summary of State Level Environmental Impacts: New York

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	M	L	M	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	M	L	L	M
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	-	-	-	-	-	L	L	-	-	-
End Use										
Industry	M	-	-	-	M	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table 2.

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - North Carolina

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	M	M	M	M	L	H	L	L	L	M
Oil	L					M	L	L	L	L
Gas	L					L	L	L	L	M
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	M	L			L		M	M	M	M
Industry	L	L			L		L	L	L	L
Mining		L		L			L	L	L	M

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - OHIO¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	M						L	M		
-Oil	M ⁴						L	M		
-Gas							L	L		
-Nuclear	L						L	L		
-Combined Cycle	H									
-Solar										
-Hydro										
General:										
-Utility	M	M		L	L	L	L	M	L	L
-Industry	H	M				M		M		
-Mining	L	M		M	M		M		M	

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to a premium quality fuel may be required.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Oklahoma

	Air	Water		Land		Health safety ^b	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	L	M	M	L		M	L	L	L	M
Oil	L					L	L	L	L	H
Gas	L					M	L	L	L	H
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	L	M					M	M	M	H
Industry	L	L					M	M	M	H
Mining		L		L			L	L	L	H

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Oregon

Energy Source	Air Quality	Water		Ecology	Land		Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use	Solid Waste		Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction									
Coal									
Oil									
Gas									
Geothermal	*	*	*	L	L	-	-	L	H
Transport of									
Energy									
Oil tankers									
Pipelines									
Transmission lines	-	L	-	M	M	-	-	-	-
Conversion									
Refineries									
Electric									
Generation									
Hydro									
Conventional	L	L	M	L	L	-	-	M-H	H
Hydro Pumped									
Storage	L	L	L	L	L	-	-	L	H
Coal	L	L	L	L	L	L	L	M	M
Nuclear	L	L	L	L	L	L	L	H	H
Gas Direct									
Drive									
Gas Steam									
Oil Direct									
Drive	-	-	-	-	-	-	-	L	L
Oil Steam	L	-	-	L	L	-	-	L	H
Combined									
Cycle	L	-	-	L	L	-	-	-	-
Geothermal	*	*	*	L	L	-	-	M	M

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

SUMMARY OF STATE LEVEL ENVIRONMENTAL IMPACTS: PENNSYLVANIA

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	L	M	L	L	L	L	L
Oil	M	M	M	L	-	L	L	L	L	L
Nuclear	-	M	M	M	H	M	L	L	L	H
Supply										
Gas	L	L	L	L	L	L	L	L	L	L
Oil	L	L	L	L	L	L	L	L	L	L
Urban Waste	L	L	L	L	L	L	L	L	L	L
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	L	H	L	H	L	M	M	M	L	H
End Use										
Industry	M	-	-	-	L	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table 2

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Summary of State Level Environmental Impacts: Rhode Island

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	*	-	-	-	-	-	-	-	-	-
Oil	*	-	-	-	-	-	-	-	-	-
Nuclear	-	M	-	-	-	L	L	L	L	M
Supply										
Gas	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	-
Urban Waste	-	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

NOTE

* Energy related air quality impacts due mainly to emissions outside of Rhode Island. No major coal or oil electric utility facilities are hypothesized in MID-MID scenario for Rhode Island.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - South Carolina

	Air	Water		Land		Health ^b safety	Social and economic			
Energy source	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	L	L	L	M		L	L	L	L	L
Oil	L					M	L	L	L	L
Gas	L					L	L	L	L	M
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	L	L					M	M	M	M
Industry	L	L					L	L	L	L
Mining		L		L			L	L	L	L

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Tennessee

Energy source	Air	Water		Land		Health ^b safety	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	H	L	L	H		H	L	L	L	L
Oil						L	L	L	L	L
Gas						L	L	L	L	L
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency										
Improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar							L	L	L	L
General										
Utility	H	L					M	M	M	M
Industry	L	L					L	L	L	L
Mining		L		M			L	L	L	M

^a Criteria for ranking impacts found in table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

Environmental Impacts^a of the
EIA trendlong Mid-Mid Scenario
at the regional or state level - Texas

Energy source	Air	Water		Land		Health safety ^b	Social and economic			
	Quality	Quality	Availability ^c	Ecology/ land use	Solid waste	Occupational and other	Local socio- logic factors	Local Economics	Regional Economics	Legislative/ Institutional
Coal										
Electric	M	H	H	M		H	L	M	M	M
Oil	L					L	L	L	L	H
Gas	L					H	L	L	L	H
Nuclear						L	M	M	M	M
Conservation										
Energy efficiency improvements							L	L	L	L
Urban waste							L	L	L	L
Cogeneration							L	L	L	L
Solar										
General										
Utility	M		H				M	M	M	H
Industry	L	L					M	M	M	H
Mining		L		H			L	L	L	H

^a Criteria for ranking impacts found in Table

^b Includes health effects not covered by air quality.

^c Includes groundwater.

ENVIRONMENTAL IMPACTS¹ OF THE EIA TRENDLONG MID-MID SCENARIO ON UTAH

Energy Source	Air		Water		Land		Health & Safety ³	Social and Economic			
	Quality	Visibility	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
COAL -Electric	H	L	L	L	H	M	L	H	H	H	L
OIL	L	L		L	M	L	L	L	L	L	
GAS	L	L		L	L	L	L	L	L	L	
NUCLEAR											
CONSERVATION -Energy Efficiency Improvements					L	L	L	L	L	L	
-Urban Waste					L	L	L	L	L	L	
-Cogeneration					L	L	L	L	L	L	
SOLAR											
GENERAL -Utility	H	L	L	L	M	M	L	H	H	H	L
-Industry	M	L	L	L	L	L	L	L	L	L	
-Mining	L	L	M	L	L	L	M	H	H	H	

¹Criteria for ranking impacts found in Table AP-1.

²Includes groundwater.

³Includes health effects not covered by air quality.

Summary of State Level Impacts: Vermont

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- Logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	*	-	-	-	-	-	-	-	-	-
Oil	*	-	-	-	-	-	-	-	-	-
Nuclear	-	-	-	-	-	-	-	-	-	M
Hydro	-	-	-	-	-	-	-	-	-	M
Supply										
Gas	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	-
Urban Waste	-	-	-	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	-	-	-	-	-	-	-
End Use										
Industry	-	-	-	-	-	-	-	-	-	-

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

NOTES

- * Energy related air quality issues due to sources outside Vermont. No major electric utility facilities are hypothesized in MID-MID scenario for Vermont.

SUMMARY OF STATE LEVEL ENVIRONMENTAL IMPACTS: VIRGINIA

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	-	-	-	-	-	-	-	-	-
Oil	M	M	M	L	L	L	L	L	L	L
Nuclear	-	M	M	M	H	M	L	L	L	M
Supply										
Gas	L	M	L	M	L	L	L	L	L	M
Oil	L	M	L	M	L	L	L	L	L	M
Urban Waste	L	L	L	L	L	L	L	L	L	M
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	L	H	L	H	L	M	L	M	L	H
End Use										
Industry	M	-	-	-	L	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Environmental Impacts of the State Level Mid-Mid Scenario Energy Technologies in Washington

Energy Source	Air Quality	Water		Ecology	Land		Solid Waste	Health/Safety Occupational and Others	Social and Economic	
		Quality	Availability		Land Use				Regional/Local Economic and Sociologic Factors	Institutional and Legislative
Extraction										
Coal	L	L	-	L	L		L	-	L	-
Oil										
Gas										
Geothermal	*	*	*	L	L		-	-	L	M
Transport of Energy										
Oil tankers	-	L	-	*	-		-	-	-	-
Pipelines	-	L	-	L	L		-	-	M	M
Transmission lines	-	L	-	M	M		-	-	-	-
Conversion										
Refineries	L	L	L	L	L		-	-	-	-
Electric Generation										
Hydro										
Conventional	L	L	M	M	L		-	-	M	L
Hydro Pumps										
Storage	L	L	L	L	L		-	-	L	-
Coal	L	L	L	M	M		L	L	-	-
Nuclear	L	L	L	L	L		L	L	H	M
Gas Direct										
Drive										
Gas Steam										
Oil Direct										
Drive	L	-	-	L	L		-	-	L	L
Oil Steam	L	-	-	L	L		-	-	L	H
Combined										
Cycle	L	-	-	L	L		-	-	-	-
Geothermal	*	*	*	L	L		-	-	M	H

High (H), Medium (M), Low (L)

(-) No Impact^(a)

(*) Data is not sufficient to assess impacts.

(a) No impact indicates that once the technology is in place, there is no impact in the state. A blank indicates the energy technology was not specified by the scenario.

SUMMARY OF STATE LEVEL ENVIRONMENTAL IMPACTS: WEST VIRGINIA

	Air	Water		Land		Health & Safety ³	Social and Economic			
Energy Source	Quality	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
Electric Sector										
Coal	M	M	M	M	M	L	L	L	L	L
Oil	-	-	-	-	-	-	-	-	-	-
Nuclear	-	-	-	-	-	-	-	-	-	-
Supply										
Gas	L	L	L	L	L	L	L	L	L	L
Oil	L	L	L	L	L	L	L	L	L	L
Urban Waste	L	L	L	L	L	L	L	L	L	L
Solar	L	L	L	L	L	L	L	L	L	L
Coal Mining	L	H	L	H	L	M	L	M	L	H
End Use										
Industry	M	-	-	-	L	L	L	L	L	L

¹Criteria For Ranking Impacts Found In Table

²Includes Ground Water

³Includes Health Effects Not Covered By Air Quality

Environmental Impacts of the EIA Trendlong MID-MID
Scenario at the State Level - WISCONSIN¹

	Air	Water		Land			Health and Safety		Local ³ Socioeconomic	
Energy Source	Quality	Quality	Availability ²	Ecology	Land Use	Solid Waste	Occupational Safety	Public Health	Economics	Sociological Factors
Utility:										
-Coal	H						L	L		
-Oil	M ⁴						L	L		
-Gas	L						L			
-Nuclear	L						L	L	M	
-Combined Cycle	H									
-Solar	L									
-Hydro										
General:										
-Utility	M	M	L	L	M	L	L	L	M	M
-Industry	M					L		L		
-Mining	L						L			

¹ Criteria for ranking impacts found in Table 3. Blank entries indicate either no impact or impact not addressed. Refer to the individual state text.

² Includes ground water.

³ The socioeconomic entries only reflect growth in counties with a projected immigration, (for energy facility developments) in excess of 10% of the baseline population in any one period. Because actual impacts are extremely localized and thus vary significantly by county, the utility of the aggregated state impact index presented in the matrix is limited.

⁴ Fuel switching to a premium quality fuel may be required.

ENVIRONMENTAL IMPACTS¹ OF THE EIA TRENDLONG MID-MID SCENARIO ON WYOMING

Energy Source	Air		Water		Land		Health & Safety ³	Social and Economic			
	Quality	Visibility	Quality	Availability ²	Ecology/ Land Use	Solid Waste	Occupational And Other	Local Socio- logic Factors	Local Economics	Regional Economics	Legislative/ Institutional
COAL											
-Electric	M	M	L	L	H	M	L	H	H	H	L
OIL	L	L		L	M	L	L	L	L	L	
GAS	L	L		L	L	L	L	L	L	L	
NUCLEAR											
CONSERVATION											
-Energy Efficiency Improvements					L	L	L	L	L	L	
-Urban Waste					L	L	L	L	L	L	
-Cogeneration					L	L	L	L	L	L	
SOLAR											
GENERAL											
-Utility	M	M	L	L	M	M	L	H	H	H	L
-Industry	L	L	L		M	L	L	L	L	L	
-Mining	L	L	M	H	M	L	M	H	H	H	

¹Criteria for ranking impacts found in Table AP-1.

²Includes groundwater.

³Includes health effects not covered by air quality.

APPENDIX II

The major technology assumptions used in this report are shown in Table II-1. In addition to those listed, other, more specific technology assumptions were made in some of the regional assessments for areas or states where energy production and distribution differed significantly from national trends. Most of these exceptions are discussed in this appendix; a few others are specifically identified in the text of the report.

Region 5

Combined cycle facilities were assumed to use coal as their primary fuel. Solar and "other" technologies contributed only a small amount to the total increases in generating capacity projected for the region, and were assumed to be small decentralized facilities.

Region 7

The 1300 MW of increased generating capacity from pumped storage facilities are projected to use existing reservoirs.

Region 8

1. Zero utility discharge. In 1976, EPA-approved salinity standards for the Colorado Basin states were put into effect by eliminating industrial discharge except under specified conditions. EPA guidelines concerning thermal discharge and difficulties in obtaining NPDES construction permits have predicated a policy of zero discharge for utility plants. All plants proposed through 1990 contain a zero discharge provision.
2. Fifty percent reduction in coal mining residual rates to account for projected impacts of the application of BAT (Best Available Technology) standards.
3. Reduced flow rates for selected Aggregated Subareas (ASA) to project low flow conditions more accurately.

Region 9

1. Coal mining activity in Region 9 occurs in only one state, Arizona where coal is strip mined. According to the BNL file, future coal production will also be strip mined from the same coal deposit with the same operational characteristics such as average seam thickness, overburden ratio, and heat content.
2. Oil and natural gas production activities are primarily located in California, with most production off-shore. No detailed assumptions have been made except to note that many of these off-shore operations are in frontier areas and that oil spill potentials (production residuals) will remain the same as for present, less risky off-shore operations.

Table II-1
CONTROL TECHNOLOGY ASSUMPTIONS

	UTILITY	INDUSTRY	MINING																														
AIR	<p>EMISSIONS AND LOCAL AIR QUALITY:</p> <p><u>COAL</u></p> <ul style="list-style-type: none">EXISTING PLANTS - UNCONTROLLED EMISSIONS BASED ON FPC COAL CHARACTERISTICS FOR ASH, HEAT AND SULFUR (1976)PLANTS WITH STARTUP DATES PRIOR TO 1983 - SIPs OR NSPS REQUIREMENTSPLANTS WITH STARTUP DATES AFTER 1983 - BACT, 85% AND 90% CONTROL OR REMOVAL OF SO₂ CONSIDERED <p><u>OIL</u></p> <ul style="list-style-type: none">SIPs REQUIREMENTS <p><u>GAS AND METALLURGICAL COAL</u></p> <ul style="list-style-type: none">UNCONTROLLED	<p>EMISSIONS AND LOCAL AIR QUALITY:</p> <p><u>COAL</u></p> <table><tr><td><ul style="list-style-type: none">NEW LARGE SOURCES (250 X 10⁶ BTU/HR)NEW SMALL SOURCES (100-250 X 10⁶ BTU/HR)NEW NON-MFB PLANTS (100 : 10⁶ BTU/HR)EXISTING LARGE SOURCES (250 : 10⁶ BTU)EXISTING SMALL SOURCES (100-250 X 10⁶ BTU/HR)EXISTING NON-MFB PLANTS (100 X 10⁶ BTU/HR)</td><td><p>SO₂</p><p>BACT, 80% RE-MOVAL 1.5 LB/10⁶ BTU</p><p>SIPs WITH PHYSICAL CLEANING SIPs FOR MFBs</p><p>SIPs FOR MFBs</p><p>SIPs USING LOCALLY AVAILABLE COAL</p></td><td><p>PARTICULATES</p><p>BACT, 90% RE-MOVAL 0.05 LB/10⁶ BTU</p><p>SIPs, CYCLONES SIPs FOR MFBs</p><p>SIPs FOR MFBs</p><p>SIPs USING SETTLING CHAMBER/EXPANDED CHIMNEY & CYCLONES</p></td></tr></table> <p><u>OIL AND GAS</u></p> <ul style="list-style-type: none">SIPs LIMITATIONS ON SULFUR CONTENT OF FUEL, AS A WEIGHT FRACTION.EMISSIONS FACTORS IN USEPA "COMPILED OF AIR POLLUTANT FACTORS".	<ul style="list-style-type: none">NEW LARGE SOURCES (250 X 10⁶ BTU/HR)NEW SMALL SOURCES (100-250 X 10⁶ BTU/HR)NEW NON-MFB PLANTS (100 : 10⁶ BTU/HR)EXISTING LARGE SOURCES (250 : 10⁶ BTU)EXISTING SMALL SOURCES (100-250 X 10⁶ BTU/HR)EXISTING NON-MFB PLANTS (100 X 10⁶ BTU/HR)	<p>SO₂</p> <p>BACT, 80% RE-MOVAL 1.5 LB/10⁶ BTU</p> <p>SIPs WITH PHYSICAL CLEANING SIPs FOR MFBs</p> <p>SIPs FOR MFBs</p> <p>SIPs USING LOCALLY AVAILABLE COAL</p>	<p>PARTICULATES</p> <p>BACT, 90% RE-MOVAL 0.05 LB/10⁶ BTU</p> <p>SIPs, CYCLONES SIPs FOR MFBs</p> <p>SIPs FOR MFBs</p> <p>SIPs USING SETTLING CHAMBER/EXPANDED CHIMNEY & CYCLONES</p>	<p>NO ASSUMPTIONS MADE. AIR POLLUTANTS FROM MINING ACTIVITIES NOT CONSIDERED.</p>																											
<ul style="list-style-type: none">NEW LARGE SOURCES (250 X 10⁶ BTU/HR)NEW SMALL SOURCES (100-250 X 10⁶ BTU/HR)NEW NON-MFB PLANTS (100 : 10⁶ BTU/HR)EXISTING LARGE SOURCES (250 : 10⁶ BTU)EXISTING SMALL SOURCES (100-250 X 10⁶ BTU/HR)EXISTING NON-MFB PLANTS (100 X 10⁶ BTU/HR)	<p>SO₂</p> <p>BACT, 80% RE-MOVAL 1.5 LB/10⁶ BTU</p> <p>SIPs WITH PHYSICAL CLEANING SIPs FOR MFBs</p> <p>SIPs FOR MFBs</p> <p>SIPs USING LOCALLY AVAILABLE COAL</p>	<p>PARTICULATES</p> <p>BACT, 90% RE-MOVAL 0.05 LB/10⁶ BTU</p> <p>SIPs, CYCLONES SIPs FOR MFBs</p> <p>SIPs FOR MFBs</p> <p>SIPs USING SETTLING CHAMBER/EXPANDED CHIMNEY & CYCLONES</p>																															
WATER QUALITY	<p>BPCT, EFFECTIVE JULY 1977 BACTEA, EFFECTIVE JULY 1984 NSPS, EFFECTIVE JULY 1977</p> <p>UTILITY GENERATING LOAD FACTOR - 55%</p>	<p>BPCT, EFFECTIVE JULY 1977 BACTEA, EFFECTIVE JULY 1984 NSPS, EFFECTIVE JULY 1977</p>	<p>MINE DRAINAGE: "COAL SUPPLY REGION" (CSRI DRAINAGE DATABASE - COMPLIANCE WITH EFFLUENT LIMITATIONS ASSUMED.</p> <p>COAL WASHING: ASSUME 50% OF COAL IS CLEANED, 96% OF THAT BY WET METHODS. ALL FACILITIES HAVE ZERO DISCHARGE IN CSRs 7 - 10, 60% OF FACILITIES HAVE ZERO DISCHARGE IN CSRs 1 - 6, CSR 11 AND CSR 12. 40% OF FACILITIES IN THOSE CSRs PRODUCE 2,150 LITERS/METRIC TON OF COAL WASHED.</p> <p>COAL REUSE FILL: 40% OF ANNUAL PRECIPITATION IN EACH CSR RESULTS IN EFFLUENT RUNOFF: 7.08 X 10⁹ HECTARES/METRIC TON OF COAL CLEANED ARE EXPOSED TO RAIN FOR ONE YEAR.</p> <p>RECLAMATION: SEDIMENTATION CAN ACHIEVE 80% CONTROL EFFICIENCY. OTHER RUNOFF RATES ARE FROM EPA NATIONAL ASSESSMENT OF NON-POINT SOURCE POLLUTION.</p>																														
WATER AVAILABILITY	<table><tr><td>COOLING OPTION:</td><td colspan="2">NUCLEAR (1000 MW)</td><td colspan="2">FOSSIL (1000 MW)</td></tr><tr><td></td><td>WITH-DRAWAL (MGD)</td><td>CONSUMPTION (MGD)</td><td>WITH-DRAWAL (MGD)</td><td>CONSUMPTION (MGD)</td></tr><tr><td>ONCE THROUGH</td><td>1410</td><td>4</td><td>830</td><td>3</td></tr><tr><td>POND OR CANAL</td><td>42</td><td>26</td><td>25</td><td>15</td></tr><tr><td>WET COOLING TOWER</td><td>28</td><td>17</td><td>17</td><td>10</td></tr><tr><td>DRY COOLING TOWER</td><td>0.3</td><td>0</td><td>0.2</td><td>0</td></tr></table>	COOLING OPTION:	NUCLEAR (1000 MW)		FOSSIL (1000 MW)			WITH-DRAWAL (MGD)	CONSUMPTION (MGD)	WITH-DRAWAL (MGD)	CONSUMPTION (MGD)	ONCE THROUGH	1410	4	830	3	POND OR CANAL	42	26	25	15	WET COOLING TOWER	28	17	17	10	DRY COOLING TOWER	0.3	0	0.2	0	<p>DATA BASE:</p> <ul style="list-style-type: none">WATER CONSUMPTION DATA DEVELOPED FOR THE WATER RESOURCES COUNCIL.	<p>WATER REQUIREMENTS FOR COAL EXTRACTION AND WASHING, DUST CONTROL AND REVEGETATION ARE ASSUMED TO BE NEGLIGIBLE.</p>
COOLING OPTION:	NUCLEAR (1000 MW)		FOSSIL (1000 MW)																														
	WITH-DRAWAL (MGD)	CONSUMPTION (MGD)	WITH-DRAWAL (MGD)	CONSUMPTION (MGD)																													
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WET COOLING TOWER	28	17	17	10																													
DRY COOLING TOWER	0.3	0	0.2	0																													
SOLID WASTE	<ul style="list-style-type: none">COAL CHARACTERISTICS IN 1985 AND 1980 ARE THE SAME AS IN 1976. DATA FROM FPC TAPES.USE OF ELECTROSTATIC PRECIPITATORS AND FLUE GAS DESULFURIZATION WITH LIME/LIMESTONE SLURRIES ASSUMED FOR 1985 AND 1980.	<ul style="list-style-type: none">NSPS AND SIPs REQUIREMENTS USED TO DETERMINE ASH AND FGD SLUDGE PRODUCTION AND LAND REQUIREMENTS.	<ul style="list-style-type: none">CONVERSION FACTORS FOR COAL MINING RANGED FROM 0.0818 ACRES/1000 TONS (COAL MINED) IN DEEP MINING IN EASTERN KENTUCKY TO 0.235 ACRES/1000 TONS IN STRIP MINING IN ARKANSAS.PAST BUREAU OF MINES DATA AND MINRES PROGRAM WERE USED TO DETERMINE MINING RESIDUALS.																														

ABBREVIATIONS:

BACTEA	BEST AVAILABLE CONTROL TECHNOLOGY ECONOMICALLY ACHIEVABLE
BEA	BUREAU OF ECONOMIC ACTIVITY AREA
BPCT	BEST PRACTICABLE CONTROL TECHNOLOGY
BTU	BRITISH THERMAL UNIT
FGD	FLUE GAS DESULFURIZATION
FPC	FEDERAL POWER COMMISSION
MFB	MAJOR FUEL BURNING INSTALLATIONS
MGD	MILLION GALLONS PER DAY
MW	MEGAWATTS
NSPS	NEW SOURCE PERFORMANCE STANDARDS
SIPs	STATE IMPLEMENTATION PLANS

3. Fuel or Energy Transport Technologies. No changes in present technologies were assumed. Oil tanker sizes are not expected to increase much above the present ~150,000 dwt class, primarily because harbor sizes and depths are limited. Emission rates from tankers, both air pollution and operational discharges to water, are assumed to remain unchanged from the present.

The qualitative assessment of transmission line impacts is based on present day technologies--essentially 500 kVAC lines.

Electrical Generation. For all thermal steam-cycle generation, calculations of cooling water requirements were based upon mechanical draft evaporative towers. Solar-derived electric technology characteristics were assumed to be a mix of solar central receiver ("power tower"), 160 MW; wind turbine generators, 50 MW; and biomass fuel for use in a thermal steam-cycle generating plant, 90 MW.

5. Geothermal energy production in the dry steam fields of Northern California is based upon present technologies (including mechanical draft cooling). Emissions of H_2S are assumed to be controlled by retrofit of NaOH injectors on existing facilities to meet the 1979 California H_2S standard of 200 gms H_2S per MWh and the 1990 standard of 170 gms H_2S per MWh. New facilities will be equipped with Stretford scrubbers to meet these standards. For the brine-dominated geothermal fields in Southern California, no precise technology assumptions were made, except that Stretford scrubbers would be employed to maintain H_2S emission at the state standards noted above.

6. No detailed assumptions regarding technical characteristics of refineries were made. New or expanded refinery operations would have lower emission rates than existing operations (for which no retrofits were assumed). Based on discussions with the California Air Resources Board, emission factors for these new or expanded refineries are: organic gases 0.46R; NO_x 0.934R; SO_x 0.67R; particulates 0.71R; CO 0.74R; where R is the present emission rate (in amount per barrel) for existing refineries.

7. For general fuel burning in the industrial sector, lead lab assumptions were used. For process sources, new facilities have the same fractional decrease in emission factors as do refineries noted above.

8. Emissions from energy use in the transportation sector are based on two main technology assumptions. First, automobiles for each model year are assumed to meet the DOT sales weighted mileage standard. The 1985 standard of 27.5 miles per gallon (mpg) is assumed to apply to 1990 as well. An EPA scrappage rate formula is applied to each model year as it "ages". The resulting fleet mix for 1985 has an average fuel efficiency of 21.4 mpg, and for 1990, 25.2 mpg.

Second, the technology for each model year will meet the Federal emission standards, or in the case of California, the more stringent state standards. Emission factors for a given model year deteriorate through the automobile lifetime, according to emissions estimates derived by the California Air Resources Board. This analysis does not assume any significant penetration of diesel engines into the automotive fleet by 1990.

Region 10

1. A major part of the hydroelectric generation capacity to be added in the Northwest will be provided by adding generators to existing facilities. As thermal base generation capacity is increased, the Region's hydroelectric capacity will be used more and more to meet peak load demand.

2. A large number of candidate pumped storage sites exist in Idaho, Oregon, and Washington. However, the assumption is made that pumped storage will develop slowly in the Northwest because additional peaking power can be produced at less cost and without the energy loss inherent in pumped storage by additions at existing hydroelectric plants.

Pumped storage can be classified as either on-stream or off-stream. In an on-stream project, reversible units are included in a conventional hydroelectric installation and some of the stream flow is pumped back into the project's reservoir to provide greater capacity during peak-load periods. In an off-stream project, water is pumped from a lower reservoir located in a stream to an off-stream reservoir for release during peak-load periods. It is assumed that additions to pumped storage capacity in the Northwest will be met by off-stream facilities.

3. A majority of the geothermal resources in the region are hot water rather than steam, and will require a vapor-turbine cycle facility. This type of facility requires hot water to be pumped to the surface and kept above saturation pressure. The water gives up its heat through a heat exchanger to a volatile liquid, such as isobutane or freon. The secondary loop then drives a turbine which in turn drives electric generators. The working fluid is cooled and recycled. Primary loop well water can be disposed of by reinjection into a nearby well, carrying most dissolved gases and solids with it. Non-condensable gases are vented.

Geothermal plants can be designed to require very little outside water. Thus, water availability is not considered a major constraint in the development of Northwest geothermal resources.