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REGIONAL ISSUE IDENTIFICATION
AND ASSESSMENT (RIIA):
AN ANALYSIS OF THE MID-RANGE PROJECTION
SERIES C SCENARIO

Bob Honea
Ed Hillsman

MASTER

Executive Summary for Federal Region VI

(Arkansas, Louisiana, Texas, Oklahoma, and New Mexico)

**ORNL
REGIONAL
STUDIES
PROGRAM**

OAK RIDGE NATIONAL LABORATORY
OPERATED BY UNION CARBIDE CORPORATION · FOR THE DEPARTMENT OF ENERGY

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ENERGY DIVISION
ENVIRONMENTAL SCIENCES DIVISION
HEALTH AND SAFETY RESEARCH DIVISION

REGIONAL ISSUE IDENTIFICATION AND ASSESSMENT (RIIA):
AN ANALYSIS OF THE MID-RANGE PROJECTION
SERIES C SCENARIO

Executive Summary for Federal Region VI
(Arkansas, Louisiana, Texas, Oklahoma, and New Mexico)

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<i>The Maryland Power Plant Siting Project: An Application of the ORNL Land Use Screening Procedure</i>	J. E. Dobson	ORNL/NUREG/TM-79	1977
<i>A Cell-Based Land Use Screening Procedure for Regional Siting Analysis</i>	J. S. Jalbert J. E. Dobson	ORNL/NUREG/TM-80	1977
<i>Power Plant Siting: An Application of the Nominal Group Process Technique</i>	A. H. Voelker	ORNL/NUREG/TM-81	1977
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<i>National Coal Utilization Assessment: A Preliminary Assessment of Coal Utilization in the South</i>	R. M. Davis et al.	ORNL/TM-6122	1978
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<i>A Special Analysis Method of Assessing Water Supply and Demand Applied to Energy Development in the Ohio River Basin</i>	A. D. Shepherd	ORNL/TM-6375	1979
<i>Water Availability Problems for Energy Development to 1990</i>	J. E. Dobson A. D. Shepherd	ORNL/TM-6777	1979
<i>The Effect of Florida's Water Law Modifications on Power Plant Siting</i>	C. S. Rosemarin	ORNL/TM-6811	1979
<i>Oak Ridge Siting Analysis: A Base-Line Assessment Focusing on the National Energy Plan</i>	R. B. Honea, E. L. Hillman, R. F. Mader	ORNL/TM-6816	1979
<i>Regional Issue Identification and Assessment (RIIA): An Analysis of Mid-Range Projection Series C Scenario. Executive Summary for Federal Region IV (Southeastern)</i>	R. B. Honea, E. L. Hillman et al.	ORNL/TM-6942	1979

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ABSTRACT

The Department of Energy (DOE) has hypothesized a number of alternate energy futures as part of its energy planning and analysis programs. In this report, which is part of DOE's Regional Issue Identification and Assessment (RIIA) Program, Oak Ridge National Laboratory examines how a proposed energy future called the Mid-Range Projection Series C Scenario would affect Federal Region VI (Arkansas, Louisiana, Oklahoma, Texas, and New Mexico).

This scenario, to be called the Series C Scenario, assumes a medium supply and a medium demand for fuel through 1990, and it incorporates the fuel switching provisions of the Energy Supply and Environmental Coordination Act.

The report portrays the major regional environmental, human health and safety, socioeconomic, and institutional effects that might result from the realization of the Series C Scenario. This discussion should serve as a basis for further assessments, as it identifies some issues of major concern for Region VI that must be addressed in more depth.

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KEY FINDINGS FOR FEDERAL REGION VI

The majority of issues identified in Region VI are long-standing and would exist within any energy future. However, a few of the issues, particularly those related to the coal fuel cycle, would probably be aggravated by the Series C Scenario because of its postulated heavy dependence on the use of coal in the future.

- 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 VI, particularly Texas and Oklahoma.
- Texas will be particularly hard hit by impacts resulting from this scenario (2300 MWe in 1975 vs 23,000 MWe in 1990 for coal fired electric) not only the economic burdens of switching to coal, but also by the environmental costs associated with increased air emissions, the socioeconomic burdens on rural counties selected for major energy developments, and the potential impacts on water quantity and quality.
- Solid waste sludge (approximately one million tons per year) generated as a result of burning coal, and the land displaced by increased lignite mining (approximately 9500 acres per year in 1990) are not expected to create serious problems in Region VI except for the possibility of local groundwater contamination. If the Environmental Protection Agency should designate scrubber sludge a hazardous waste, the technical problems will be eased, but public opposition may increase.
- 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. Almost 80% of New Mexico's residents have doubts about nuclear waste disposal in the state.

Six of the DOE national laboratories — Argonne (ANL), Brookhaven (BNL), Lawrence Berkeley (LBL), Los Alamos (LASL), Oak Ridge (ORNL), and Pacific Northwest (PNL) — assumed various lead assignments in analyzing the impact of these county level patterns on the air, water, and land resources of the country and on the socioeconomic and health and safety aspects of the nation's welfare. In this report, ORNL has utilized the data provided through these analyses, but does not necessarily endorse its accuracy.

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CONCLUSIONS

The Regional Issue

Region VI supplies 55% of the nation's oil and natural gas and produces over 44% of the gasoline consumed in the United States. Obviously, the political and economic forces of the region will be greatly concerned about any federal policy that might adversely redistribute its energy resources internally and to the rest of the nation. There is opposition to the idea of being required to sell energy resources to other regions (such as the Northeast) 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 oil and gas resources (such as California). Over the past three decades, numerous industries have been attracted to the region because of abundant, inexpensive 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 Projection Series C 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 VI. Many believe that the prevention of significant deterioration (PSD) and nonattainment provisions of the amendments could seriously stifle much future economic growth in sections of Region VI that already have high pollution levels. In another example, the scenario reflects the provisions of the Energy Supply and Environmental Coordination Act of 1976* as well as earlier regulations issued for Texas by the Texas Railroad Commission. These provisions call for a 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 VI, major capital and infrastructure investments are 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 raises the cost of operating business in the region. This increased cost 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 its energy

* This preceded the Power Plant and Industrial Fuel Use Act of 1978.

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. For example, many states in the region doubt that the present transportation system can handle the increased volumes of coal (nearly double by 1990 compared with 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 region's urban areas will become worse, particularly in the eastern-most states. Other major issues identified in each state are summarized below.

- Arkansas is expected to be moderately impacted by fuel use switching (principally to coal) found in the scenario. The most significant environmental impact areas are to 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 the Red and Sulphur rivers and the Lower Arkansas River). Health impacts from increased coal use also are expected to be significant (increasing from 20-310 to 35-560 deaths per year by 1990), and seven counties will receive moderate socioeconomic impacts from proposed energy-related developments.
- Louisiana, like Texas and Oklahoma, is concerned with the deregulation of natural gas and the resulting effects on 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 worsen with the increased coal burning proposed in the scenario. Water availability does not appear to be a problem for the state, although water quality could be affected in southern and western Louisiana.
- 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 reclamation and potential damage to the ecosystem.
- 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 occurring in the scenario.
- 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 total suspended

particulates (TSP) levels by 1990], water quality and availability, and groundwater and terrestrial ecology. As many as ten counties may experience significant socioeconomic impacts from the construction of new energy facilities or expanded mining activity. The financial infrastructure of most utilities will be weakened 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.

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The Regional Issue Identification and Assessment for Federal Region VI was conducted through a cooperative effort involving personnel from the Energy, Health and Safety Research, Environmental Sciences, and Computer Sciences Divisions at Oak Ridge National Laboratory (ORNL). Input to the assessment was provided by each national laboratory participating in the Regional Studies Program of the Office of Technology Impacts in the Department of Energy.

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1. INTRODUCTION

1.1 RIIA Study Description

This study, the Regional Issue Identification and Assessment (RIIA), is an evaluation of the regional environmental impacts of future energy development. The study was conducted for the Regional Assessments Division, Office of Technology Impacts, Office of the Assistant Secretary for Environment, Department of Energy (DOE). The impacts described for 1985 and 1990 are based on a national energy projection (scenario) that assumes medium energy demand and medium fuel supply through 1990 but does not incorporate the policies of the National Energy Act (NEA). The scenario, known as the Mid-Range Projection Series C or simply the Series C, is one of six possible energy futures produced by the Energy Information Administration of the Department of Energy for the Department's 1977 Annual Report to Congress. It was chosen as representative of the official DOE national energy projections when this project was initiated, prior to the passage of the NEA. Because the RIIA program is part of an ongoing review of the regional impact of energy policies, the next phase will examine the NEA and initiatives suggested by the President's second National Energy Plan. However, because coal utilization increases generally under the NEA, impacts identified in the Series C Scenario should provide a framework for the discussion of impacts by NEA.

The environmental impacts discussed in this volume are for Federal Region VI. There are nine companion volumes — one for each federal region in the nation (shown in Fig. 1.1). This set of reports represents a comprehensive, consistent portrayal of the regional environmental impacts and implications of the future national energy development reflected in the scenario. A detailed description of the methodologies used at each level of this study and a summary of the data developed in the RIIA process for each state are available in Volume II of the national report.

1.2 RIIA Methodology and Control Technology Assumptions

1.2.1 Overall program methodology

In developing the national energy scenarios, the Energy Information Administration balances projections of supply and demand at the federal region level. The RIIA studies used the predicted fuel mixes by federal regions derived from the Mid-Term Projection Series C Scenario as a starting point for their analyses. County level patterns for utility, industry, and mining activities for 1985 and 1990 were then developed from these federal region totals. Energy sources addressed were coal, nuclear, oil, oil shale, gas, geothermal, hydroelectric, and solar.

DEPARTMENT OF ENERGY FEDERAL REGIONS

Fig. 1.1. Federal regions assigned to each national laboratory.

Six of the DOE national laboratories — Argonne (ANL), Brookhaven (BNL), Lawrence Berkeley (LBL), Los Alamos (LASL), Oak Ridge (ORNL), and Pacific Northwest (PNL) — assumed various lead assignments in analyzing the impact of these county level patterns on the air, water, and land resources of the country and on the socioeconomic and health and safety aspects of the nation's welfare. In this report, ORNL has utilized the data provided through these analyses, but does not necessarily endorse its accuracy. When these tasks were completed, each laboratory focused on an assessment of the products of all the lead laboratory analyses from the particular perspective of the states and regions for which they were responsible (Fig. 1.1).

1.2.2 Technology assumptions

The major control technology assumptions used in the lead analyses of technologies addressed in the scenario concerned control techniques. These are shown in Table 1.1. In addition to those listed, other more specific technology assumptions were made in some of the regional assessments of areas or states when energy production and distribution differed significantly from national trends. These exceptions are specifically identified in the text when appropriate.

1.2.3 Criteria for ranking of impacts

The discussion of each region and each state within the region includes a summary matrix displaying the severity of specific environmental, health, social, and economic impacts of energy and energy technologies imposed by the scenario. The severity is rated as high, medium, or low according to criteria described in Table 1.2. Because of the inappropriateness of some impact criteria to the South Central region, ORNL chose to modify the severity ratings in selected categories.

Water quality. The suggested criterion for "high" impact — "significant economic burden to meet Clean Water Act (CWA) requirements" — calls for an assessment of the economic impacts of the CWA regulations; the suggested "medium" and "low" criteria describe the levels of actual water quality impacts projected for the scenario levels of development. To avoid inconsistencies that might arise from using a purely economic criterion for only one level of one type of impacts, we have expanded the definition of "high" impact. In our analysis, "high" impact indicates river basins where new, widespread violations of water quality standards attributable to energy facilities have been predicted at scenario levels of development.

In some areas, flows (and thus the assimilation and dilution capacities) are so low that the national model assumed no discharges of utility and industrial effluents. These areas have been given a "high, flow-related" (HF) classification. It is in these areas that the suggested criterion of economic burden is most likely to apply. In river basins where energy facilities will add to existing water quality violations but cause no new ones, a "medium" rating has been used.

Table 1.1. Control technology assumptions^a

Utility		Industry			Mining
Air	Emissions and local air quality	Emissions and local air quality			No assumptions made.
	Coal	Coal	SO ₂	Particulates	Air pollutants from mining activities not considered.
	<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 requirements Plants with startup dates after 1983 — BACT. 85 and 90% control or removal of SO₂ considered 	<ul style="list-style-type: none"> New large sources (>250 × 10⁶ Btu/hr) New small sources (100–250 × 10⁶ Btu/hr) New non-MFBI plants (>100 × 10⁶ Btu/hr) Existing large sources (>250 × 10⁶ Btu) Existing small sources (100–250 × 10⁶ Btu/hr) Existing non-MFBI plants (>100 × 10⁶ Btu/hr) 	<ul style="list-style-type: none"> BACTEA, 80% removal (1.5 lb/10⁶ Btu) SIPs with physical cleaning SIPs for MFBI's SIPs for MFBI's SIPs using locally available coal 	<ul style="list-style-type: none"> BACTEA, 99% removal (0.05 lb/10⁶ Btu) SIPs, cyclones SIPs for MFBI's SIPs for MFBI's SIPs using settling chamber, expanded chimney, and cyclones 	
	Oil				
	<ul style="list-style-type: none"> SIPs requirements 				
	Gas and metallurgical coal				
	<ul style="list-style-type: none"> Uncontrolled 				
		Oil and gas			
		<ul style="list-style-type: none"> SIPs limitations on sulfur content of fuel, as a weight fraction Emissions factors in EPA "Compilations of Air Pollutant Factors." 			
		BPCT, effective July 1977			
		BACTEA, effective July 1984			
		NSPS, effective July 1977			
Water quality	BPCT, effective July 1977				Mine drainings: CSR drainage data base. Compliance with effluent limitations assumed.
	BACTEA, effective July 1984				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 2150 liters per metric ton of coal washed.
	NSPS, effective July 1977				Coal refuse pile: 40% of annual precipitation in each CSR results in effluent runoff: 7.08 × 10 ⁶ hectares per metric ton of coal cleaned are exposed to rain for one year.
	Utility generating load factor — 55%				Reclamation: Sedimentation can achieve 80% control efficiency. Other runoff rates are from EPA National Assessment of Non-Point Source Pollution.
Water availability	Cooling option	Nuclear (1000 MW), Mgd		Fossil (1000 MW), Mgd	
		Withdrawal	Consumption	Withdrawal	Consumption
	Once-through	1400.0	4	830.0	3
	Pond or canal	42.0	26	25.0	15
	Wet cooling tower	28.0	17	17.0	10
	Dry cooling tower	0.3	0	0.2	0
				Data base	
				<ul style="list-style-type: none"> Water consumption data developed for the Water Resources Council. 	
Solid waste					Water requirements for coal extraction and washing, dust control, and revegetation are assumed to be negligible.
	<ul style="list-style-type: none"> Coal characteristics in 1985 and 1990 the same as in 1976. Data from FPC tapes. Use of electrostatic precipitators and flue gas desulfurization with lime/limestone slurries 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. 	<p>Conversion factors for coal mining ranged from 0.0818 acres per 1000 tons of coal mined in deep mining in Eastern Kentucky to 0.235 acres per 1000 tons in strip mining in Arkansas.</p> <p>Past Bureau of Mines data and MINERS program were used to determine mining residuals.</p>

^aAbbreviations: BACTEA, Best Available Control Technology Economically Achievable; BPCT, Best Practicable Control Technology; Btu, British Thermal Unit; CSR, Coal Supply Region; EPA, Environmental Protection Agency; 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.

Table 1.2. Definitions of criteria for rating of impacts^a

Impact category	High impact	Medium impact	Low impact
Air quality	Major facilities in proposed siting scenario possibly constrained by one or all of the following issues: <ul style="list-style-type: none"> • Persistent and continued violations of primary NAAQS • Inability to attain acceptable PSD increment limitations • Limited probability that improved emission control efficiencies or offsets would result in NAAQS attainment 	Some major facilities in proposed siting scenario possibly constrained by high impact issues Violations occurring, but amenable to extensive control technology, fuel (coal and oil) purchasing policy, and/or offset	Air quality and emission levels within acceptable standards No major adjustments to plant siting
Visibility ^b	Significant decrease in calculated visual range in Class I areas	Moderate decrease in visual range, but amenable to mitigation measures	No decrease in visual range; new siting impacts amenable to mitigation measures No major adjustment in plant siting
Water Quality ^b	Significant economic burden to meet requirements of Clean Water Act	Treated effluents meeting effluent standards, but occasional localized stream standard violations to occur in receiving water body	Receiving body capable of handling all projected effluent additions Few or no violations of stream standards anticipated
Water availability ^b	No water available without major shifts in current water uses (e.g., either energy development or agriculture, even with low-flow augmentation) Water available through major structural and nonstructural alternatives (e.g., construction of dams and reservoirs) Groundwater mining with no recharge potential	Water available at moderate economic cost to the region Groundwater mining with recharge potential available or possible	No conflicts, except for recreational uses Groundwater withdrawal where annual recharge occurs
Solid waste	Severe potential contamination problems likely to require complete containment of wastes	Minimal environmental impacts with proper control technology. Indication that many areas may experience problems, but suitable options available in some of these areas	Minimal environmental impacts with proper control technologies Some potential problems, but generally amenable to current technology options at additional cost
Ecology ^b	Disturbance of critical natural habitats	Disturbance of critical natural habitat or large acreages of cropland	Localized impacts which may be readily mitigated by structural or siting alternatives
Land use ^b	Conflict with high value land use, such as loss of habitat, parkland, scenic resources, Indian lands, agricultural land	Similar conflicts, with alternative sites or mitigation measures costly but available	Few conflicts; or a range of alternatives available
Public health ^b	Significant increases in morbidity and mortality rate due to exposure to energy-related pollutants	Moderate increases in morbidity and mortality rate due to exposure to energy-related pollutants	No significant impact All impacts subject to mitigation
Occupational health and safety ^b	Significant increases in occupationally related deaths, injuries, and disease due to increased energy development	Potential significant increases in respiratory and other diseases, but improvements in OSHA, NRC and EPA regulations and workplace conditions expected to alleviate much of the problem	No significant increases in occupationally related deaths, injuries, and disease due to increased energy development
Local sociological factors	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 10% or more of 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	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	Minor changes in local government's infrastructure Few immigrants, or few cultural and lifestyle clashes expected Mitigation costs easily absorbed by affected communities
Local economics	Implementation blocked due to unacceptable economic demands on local infrastructure	Potential delays due to lack of skilled personnel and financial impacts, but mitigation strategy possible	Infrastructure impacts minor Adaptability of community government high
Regional economics	Adverse capital or employment impacts on region Competitive position with other regions threatened	Potential employment, capital or competitive impacts, but mitigation strategy possible	No significant impacts
Institutional and legislative	Prohibition of implementation based on available strong legal constraints Anticipated legislative prohibition Absence of effective organizational responsibilities, statutes, etc.	Delay possible due to legal or political constraints Low to moderate public or private interest in enforcement	No significant opposition, legal constraints, or organizational problems

^aAbbreviations: EPA, Environmental Protection Agency; NAAQS, National Ambient Air Quality Standards; NRC, Nuclear Regulatory Commission; OSHA, Occupational Safety and Health Act; PSD, Prevention of Significant Deterioration.

^bThese criteria were established by the Department of Energy, Division of Regional Assessments; variations from these definitions unique to this Federal Region are explained in the text.

Ecology/land use. For Region VI, ORNL chose to use the rating criteria specified in the first draft of the RIIA report. These ratings are:

- High — conflict with high value land use, such as loss of wetlands, cash crops, endangered species habitats, park land, waterfronts, etc. Limited and costly mitigation options.
- Medium — medium conflict with high value land use. Sites or mitigation measures readily available.
- Low — conflict with high value land use. Mitigation or alternative siting strategies costly but available.

Health/safety. ORNL has substituted for the criteria stated in Table 1.2 a method for ranking high, medium, and low health impacts that incorporates a risk philosophy developed by Starr.¹ The reference levels established range from the annual death risk due to natural events such as flood, lightning, snake bites, etc. (approximately 1 per 10^6 persons/year) to the normal U.S. disease death rate (approximately 1 per 10^2 persons/year). Starr considers a risk high if it approaches that of disease death, moderate if the risk falls between 1 and 2 orders of magnitude below that of disease death, and low if it approaches the hazard level of natural events. For purposes of the present analysis, these designations have been given the numerical values of 5×10^{-3} /year, 1×10^{-4} /year, and 5×10^{-6} /year, respectively.² This procedure was used to develop a ranking of public health risk from exposure to fossil fuel combustion products in the region and accidental mortality risk among coal miners.

Visibility. Visibility impacts for the Southeast have been estimated by examining two criteria: projected changes in regional haze conditions and plume blight from specific power generating plants. Plume blight occurs when plumes from one or more power generating plants are visually identifiable with their sources. The regional haze conditions were estimated by calculating the total light extinction for Class I areas as designated by the EPA, which is the sum of (1) light scattering due to gas molecules (Rayleigh scattering), (2) extinction due to the sources and light scattering aerosols accounted for in the interregional air quality analyses, and (3) the remaining light extinction due to the sources and light scattering aerosols not accounted for in the interregional air quality analyses. From these calculations, a total light extinction coefficient due to emissions from all sources and the calculated extinction coefficients for SO_2 and primary particulates due to utility and industrial emissions are calculated. The visual range in the Class I area is determined from this total light extinction coefficient. The percent change in this visual range for 1985 and 1990 from the calculated visual range for 1975 is compared. Class I areas that have significant impairment in visual air quality are identified. The EPA has yet to determine standards for each Class I area: consequently, ORNL has followed LASL's criteria for ranking the severity of impacts.

For regional haze, a low impact is less than a 10% decrease in the calculated visual range in a Class I area in the relevant time period; a moderate impact is a 10 to 20% decrease; and a high impact is a greater than 20% decrease.

For plume blight impact estimations, a low impact means that oil- or coal-fired power plants with less than 500 MWe capacity or gas-fired power plants of less than 1250 MWe capacity are sited in or adjacent to a county having a Class I area; a moderate impact means 500 to 1000 MWe of coal- or oil-fired capacity or 1250 to 2500 MWe of gas-fired capacity are so sited; and a high impact is more than 1000 MWe of coal- or oil-fired capacity or more than 2500 MWe of gas are so sited. (These criteria vary between fuel sources because emissions from gas plants are less conducive to visible haze formation.)

REFERENCES FOR SECTION 1

1. C. Starr, *Science* 165, 1232-38 (1969).
2. C. Starr, R. Rudman, and P. Whipple, "Philosophical Basis for Risk Analysis," pp. 629-62 in *Annual Review of Energy*, vol. 1, ed. by J. M. Hollander and M. K. Simmons, Annual Reviews, Inc., Palo Alto, Calif., 1976.

2. REGIONAL OVERVIEW

Region VI (the South Central region) 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 for energy and the 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 drier 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. The eastern portion is culturally part of the South. New Mexico and western Texas and Oklahoma are culturally part of the West. 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 includes a higher percentage of mobile and single-family homes than 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, and it processes a substantial portion of the nation's imported oil. 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 people in the region are 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 it 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 may 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 agencies 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.

3. THE MID-RANGE PROJECTION SERIES C SCENARIO

3.1 National Scenario

The Series C Scenario represents a mid-term, that is, 1985 to 1990, projection of energy development based on the assumption of medium supply, medium demand, and constant world oil prices. It projects the future on the basis of the continuation of policies prior to the implementation of the NEA. These are the assumptions for the scenario:

- slight increase of domestic oil production due to Alaskan oil field and outer continental shelf development;
- continued decline of natural gas production in the lower 48 states;
- dramatic increase in coal production, particularly in the western states, due to an increasing demand coupled with rising domestic oil and gas prices;
- decrease in the growth rate of electricity sales from the historic 7% to 4.8% per year, representing saturation of air conditioning and major appliances that penetrated the market during the 1960s. The projected growth is consistent with 5% growth from 1970 to 1976 and 4.2% growth from 1976 to 1977; and
- shift in the industrial sector from gas to oil, and, to a lesser extent, to electricity, as indicated by fuel shares in the industrial sector.

Figures 3.1, 3.2, and 3.3 show the average annual change in population, employment, and energy use, respectively, between 1975 and 1990 by U.S. Bureau of Economic Analysis (BEA) region. These growth rates were based upon the assumptions embedded in the scenario and use of ORNL's MULTI-REGION and REBS models.^{1,2} Table 3.1 shows the overall scenario projections for energy supply and demand for 1975, 1985, and 1990. Total energy use is projected to increase from 72.6 quadrillion Btu's (quads) in 1975 to 96 quads in 1985 and 110.9 quads in 1990. The total electricity distribution in 1975 was 2036 billion kWhr. The scenario projects it will reach 3045 billion kWhr in 1985 and 3692 billion kWhr in 1990. Electrical generation by federal region is presented in Tables 3.2 and 3.3 for 1985 and 1990, respectively. These values are based on the scenario.

3.2 Regional Scenario

3.2.1 Disaggregated scenario

The energy supply and demand scenario for Federal Region VI is summarized in Table 3.4. These projections were the basis for the county level

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

ORNL-DWG 79-14610

Fig. 3.1. Average annual growth in population between 1975 and 1990 by BEA region. These growth rates are based upon the Mid-Range Projection Series C Scenario, using ORNL's MULTIREGION model, a regional economic forecasting model.

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

ORNL-DWG 79-14608

Fig. 3.2. Average annual growth in total employment between 1975 and 1990 by BEA region. These growth rates are based upon the Mid-Range Projection Series C Scenario, using ORNL's MULTIREGION model, a regional economic forecasting model.

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

ORNL-DWG 79-14609

Fig. 3.3. Average annual growth in total energy use between 1975 and 1990 by BEA region. These growth rates are based upon the Mid-Range Projection Series C Scenario, using ORNL's Regional Energy Balance System [REBS], an energy use forecasting model.

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Table 3.1. National energy supply/demand balance
for 1975, 1985, and 1990
(10¹⁵ Btu/year)

Projection series ^a	1975	1985	1990
Domestic production			
Crude oil	17.9	19.0	18.0
NGL and butane	2.6	2.0	1.8
Shale oil	0.0	0.1	0.3
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	59.1	71.8	79.6
Imports			
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	13.5	25.1	31.3
Total, domestic production plus imports	72.6	96.9	110.0
Domestic consumption			
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	70.6	94.6	108.5
Exports			
Coal	1.8	1.9	2.1
Refinery loss	0.2	0.4	0.3
Total	2.0	2.3	2.4
Total, domestic consumption plus exports	72.6	96.9	110.9
Domestic consumption by end-use sector^b			
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	70.8	94.6	108.5

^aMid-Range Projection Series C.

^bThe difference between fuel consumption and end-use consumption is due mainly to conversion losses, particularly in the generation of electrical energy and in petroleum refining.

Table 3.2. National 1985 electric generation [GW(e)hr/year]
for Mid-Range Projection Series C Scenario

Federal region	Gas peak	Oil peak	Nuclear	Combined cycle	Coal steam	Gas steam	Oil steam	Hydro	Solar	Geothermal	Pumped storage	Other
1		400	23,908	7,319	22,629		37,370	4,400	250		1,219	
2	70	3,104	52,377	8,871	77,779	0	47,076	36,342	250		1,999	
3	570	3,139	85,985	540	197,774	2,130	12,191	2,500			3,531	0
4	461	16,139	154,918	25,890	440,525	2,870	61,145	41,164			2,621	0
5	2,658	7,356	131,670	580	425,019	240	17,486	3,680	250		1,510	0
6	1,350	10,297	42,387	0	154,970	160,428	0	9,589	320		230	
7	0	3,620	17,990	190	117,979	4,800	0	2,740			1,220	
8	260	1,271	1,880		80,909		0	27,496	69		410	
9	1,759	140	35,417	3,881	28,358	25,918	51,350	57,986	70	16,120	3,090	
10	0	340	19,062	0	6,131	0	0	176,404			230	

Table 3.3. National 1990 electric generation [GW(e)hr/year]
for Mid-Range Projection Series C Scenario

Federal region	Gas peak	Oil peak	Nuclear	Combined cycle	Coal steam	Gas steam	Oil steam	Hydro	Solar	Geothermal	Pumped storage	Other
1		430	57,324	5,940	21,361		18,482	4,869	2,000		1,249	
2	50	2,830	98,017	11,151	75,843		33,115	34,032	2,000		3,031	
3	570	2,628	93,457	540	245,110	3,630	12,937	2,850			5,710	0
4	0	21,110	267,930	25,639	587,581	0	35,268	40,506			4,070	0
5	1,841	10,565	200,952	15,151	461,016	0	6,907	4,110	2,000		1,511	0
6	1,340	12,082	77,587	0	214,506	123,952	0	9,161	3,070	7,010	570	
7	0	4,526	33,940	180	126,757	7,070	0	2,780			1,220	
8	260	1,461	1,880		91,865	0	0	28,900	1,070	6,310	410	
9	1,759	140	61,068	13,879	28,049	27,390	45,166	58,739	1,070	18,919	3,509	0
10		660	43,615	0	7,340	0	0	184,549		5,610	570	

Table 3.4. Energy supply/demand balance for Region VI
(10¹⁵ Btu/year)

Projection series ^a	1975	1985	1990
Domestic production			
Crude oil	12.54	9.92	8.18
NGL and butane	1.82	1.05	0.82
Shale oil	0.00	0.00	0.19
Natural gas	16.61	10.57	8.14
Coal	0.39	1.23	1.93
Nuclear	0.05	0.46	0.85
Hydro and geothermal	0.08	0.10	0.22
Total	31.49	23.33	20.33
Imports			
Crude oil		4.22	6.06
Coal		0.61	0.66
Natural gas			2.49
Total		4.83	9.21
Total, domestic production plus imports	31.49	28.16	29.54
Domestic consumption			
Oil	2.53	7.48	8.58
Natural gas	9.23	9.73	10.63
Coal	0.34	1.84	2.59
Nuclear	0.05	0.46	0.85
Hydro and geothermal	0.08	0.10	0.22
Total	12.23	19.61	22.87
Exports			
Crude oil	2.89		
Petroleum products	20.96	24.68	23.45
Natural gas	6.87	0.84	
Coal	0.03		
Refinery loss	0.09	0.17	0.12
Total	30.84	25.69	23.57
Total, domestic consumption plus exports	43.07	45.30	46.44
Domestic consumption by end-use sector^b			
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	12.73	19.11	22.57

^aMid-Range Projection Series C.

^bThe difference between fuel consumption and end-use consumption is due mainly to conversion losses, particularly in the generation of electrical energy and in petroleum refining.

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 3.4 through 3.11 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.

3.2.2 Causal factors

There are many facets to the interaction of the Mid-Range Projection Series C Scenario with the characteristics of a region; these give rise to the impacts summarized in this document. The factors contributing to each impact are complex and variable, but they may be roughly grouped into the following categories.

- Ambient Environmental Quality — Existing conditions [e.g., non-attainment in Air Quality Control Regions (AQCRs)] will create conflicts with assumed energy utilization.
- Population/Economic Stress — General patterns of economic and population growth and, therefore, energy demand assumed by the projection have a more significant impact than the specific technology mix (for example, water availability patterns due to changing regional demographic and economic patterns). This implies some scenario-independent impact.
- Energy Scenario — Specific technology mixes, assumptions, and demand levels generate impacts such as (1) requiring the conversion of a large number of oil- and gas-fired boilers to burn coal or (2) the replacement of these boilers over time with new coal units.

REFERENCES FOR SECTION 3

1. R. J. Olson et al., *MULTIREGION: A Simulation Forecast Model for BEA Area Population and Employment*, ORNL/RUS-25 (1977).
2. D. P. Vogt et al., *REBS: A Methodology for Addressing the Regional Implications of National Energy Scenarios*, ORNL/TM report (to be published).

1975 COAL STEAM CAPACITY IN REGION VI

Fig. 3.4. Total coal steam-electric capacity by county for 1975.

1990 COAL STEAM CAPACITY IN REGION VI

Fig. 3.5. Total coal steam-electric capacity by county for 1990.

1975 NUCLEAR CAPACITY IN REGION VI

Fig. 3.6. Total nuclear steam-electric capacity by county for 1975.

1990 NUCLEAR CAPACITY IN REGION VI

Fig. 3.7. Total nuclear steam-electric capacity by county for 1990.

1975 OIL STEAM CAPACITY IN REGION VI

Fig. 3.8. Total oil steam-electric capacity by county for 1975.

1990 OIL STEAM CAPACITY IN REGION VI

Fig. 3.9. Total oil steam-electric capacity by county for 1990.

1975 GAS STEAM CAPACITY IN REGION VI

Fig. 3.10 Total gas steam-electric capacity by county for 1975.

1990 GAS STEAM CAPACITY IN REGION VI

Fig. 3.11. Total gas steam-electric capacity by county for 1990.

4. REGIONAL ASSESSMENT

4.1 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 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.

4.1.1 Long-range transport/visibility

Region VI (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.

4.1.2 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 VI 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. Disagreement among federal, state, and local agencies with regard to control of energy resources and who will use them has become a major issue for the nation as well as for Region VI. 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 SO₂ and sulfates currently experienced by residents in Region VI, 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.

4.1.3 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, 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 for 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 are greatly needed to assess water availability conflicts.

4.2 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.

4.2.1 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 VI, 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 VI 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 4.1 gives a summary of SO₂ and TSP emissions by states for 1975 and 1990. Table 4.2 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 Fig. 4.1 for distribution of AQCRs). Although SO₂ may not be a

Table 4.1. Summary of SO₂ and TSP emissions for Region VI^a
(10³ tons per year)

State	SO ₂			TSP		
	1975	1990	Percent change from 1975	1975	1990	Percent 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
Total	1573	2887	+184	1245	1339	+8

^aData taken from the Strategic Environmental Assessment System residual analysis of the Mid-Range Projection Series C. Note: TSP = total suspended particulates.

Table 4.2. Annual SO₂ and NO_x emissions by air quality control regions

Air quality control region	SO ₂			NO _x		
	1975	1985	1990	1975	1985	1990
12 ^a Arizona-New Mexico southern border	986	194	206	13	20	22
14 ^a Four Corners	203	269	324	106	211	262
16 Central Arkansas	28	63	94	63	69	87
17 Metropolitan Fort Smith	5	37	56	22	36	46
18 ^a Metropolitan Memphis	114	100	93	65	67	57
19 Monroe-El Dorado	25	81	118	60	88	109
20 Northeastern Arkansas	17	18	26	41	31	36
21 Northwestern Arkansas	3	61	94	12	43	63
22 Shreveport-Texarkana-Tyler	62	323	536	168	257	337
106 Southern Louisiana-Southeastern 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 Northeastern Oklahoma	22	88	128	87	107	135
187 Northwestern Oklahoma	3	3	3	14	10	8
188 Southeastern Oklahoma	10	20	24	46	51	41
189 Southwestern Oklahoma	6	12	11	27	26	20
210 Abilene-Wichita Falls	16	33	50	68	55	55
211 Amarillo-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 Metropolitan Dallas-Fort Worth	33	162	319	262	257	293
216 Metropolitan Houston-Galveston	272	504	699	411	437	442
217 Metropolitan San Antonio	22	98	152	105	120	132
218 Midland-Odessa-San Angelo	11	19	27	42	35	36
Total	2483	3605	5103	2713	3348	3852

^aIncludes a portion outside Region VI [data taken from Strategic Environment Assessment System (SEAS), Mid-Range Projection Series C].

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AIR QUALITY CONTROL REGIONS IN REGION VI

Fig. 4.1. Air quality control regions in Region VI.

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.¹ 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 benzpyrene.² 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 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 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% 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. Prevention of Significant Deterioration (PSD) Class I areas are shown in Fig. 4.2.

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, real distribution of metallurgical coal, local air quality regulations, contributions from rural fugitive dust, and cross-county impacts.

Table 4.3 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 VI, there are data for 141 of the 502 counties, including three in Class I. In 1975, no counties were in nonattainment for SO_2 , but 33 counties were in nonattainment for TSP. This latter number will change to 36 in 1985 and 34 in 1990, while only one county will be in

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CLASS I AREAS - REGION VI

Fig. 4.2. Class I areas in Region VI.

Table 4.3. Number of counties in each state with violations in ambient and incremental air quality, 1975-1990^a

Number of counties				Number of counties with violations of air quality standards									
State	Total	With data ^b	Number of PSD Class I counties ^c	Ambient air quality ^d						Incremental air quality			
				1975		1985		1990		1985		1990	
				SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP	SO ₂	TSP
Arkansas	75	16			12		12		11				
Louisiana	64	30			2	1	3	1	3	2	2	4	2
New Mexico	32	9	2		6 ^e		5 ^e		5 ^e				
Oklahoma	77	22	1		2		4		3		2		1
Texas	254	64			11		12		12		5		3
Total	502	141	3	0	33	1	36	1	34	2	9	4	6

^aCounty data provided by Argonne National Laboratory.

^bSeveral counties lack historical data for predicting changes in air quality. This number reflects the total number of counties with existing air quality data.

^cPSD = prevention of significant deterioration.

^dTSP = total suspended particulates.

^eIncludes one county in a PSD Class I area.

nonattainment for SO_2 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 represent potential trouble spots which will have to be corrected by that date. In 1985, there will be two counties in PSD increment violation for SO_2 and nine counties for TSP. In 1990, the corresponding numbers are four and six. Figures 4.3 to 4.5 show the corresponding AQCRs involved. Figures 4.6 to 4.8 show the sulfur oxide (SO_x) emissions in the AQCRs of Region VI for the three years.

Table 4.4 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 4.1. 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 4.5 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^{2-}) 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.

4.2.2 Water quality/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 (Fig. 4.9), 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 (Fig. 4.10). 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-Sulfur (ASA 1107), Trinity-Galveston Bay (ASA 1202), and the Brazos (ASA 1203). Figure 4.11 illustrates the distribution of water-for-energy impacts assessed in Region VI.

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.

AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES
SHOWING NON-ATTAINMENT FOR TSP

Fig. 4.3. Air quality control regions with one or more counties showing nonattainment for total suspended particulates in 1975, 1985, and 1990.

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AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES EXCEEDING NAAQS OR PSD INCREMENTS IN 1985

Fig. 4.4. Air quality control regions with one or more counties exceeding national ambient air quality standards or prevention of significant deterioration increments in 1985.

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AQCR'S IN REGION VI WITH ONE OR MORE COUNTIES EXCEEDING NAAQS OR PSD INCREMENTS IN 1990

Fig. 4.5. Air quality control regions with one or more counties exceeding national ambient air quality standards or prevention of significant deterioration increments in 1990.

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1975 SO_x EMISSIONS IN REGION VI (tons/mi²)

Fig. 4.6. SO_x emissions in 1975.

1985 SO_x EMISSIONS IN REGION VI (tons/mi²)

Fig. 4.7. SO_x emissions in 1985.

1990 SO_x EMISSIONS IN REGION VI (tons/mi²)

Additional projected
coal plants.

Fig. 4.8. SO_x emissions in 1990.

Table 4.4. Number of counties in each state assessed as having air quality impacts^a

	PSD Class I increment exceeded ^b		Nonattainment continues for SO ₂		Nonattainment continues for TSP ^c		National ambient air quality standard exceeded		PSD Class II increment exceeded		>25% increase in SO ₂ emissions ^d		>25% increase in TSP emissions ^d	
	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
Total	0	0	0	0	32	31	5	4	4	4	30	41	4	1

^aCounty data provided by Argonne National Laboratory.

^bPSD = prevention of significant deterioration.

^cTSP = total suspended particulates.

^dThere is no 1975 air quality data.

Table 4.5. Fuel consumption, electric generation, and SO₂ emission in Region VI

Scenario	Coal			Oil			Total		
	SO ₂ ^a	Electric output (quads/year) ^b	Fuel use (quads/year)	SO ₂	Electric output (quads/year)	Fuel use (quads/year)	SO ₂	Electric output (quads/year)	Fuel use (quads/year)
1975									
Utilities	196	0.085	0.249	42	0.737	2.237	238	0.820	2.486
Industries	5		0.005	216		2.752	221		2.757
1985									
Utilities (85%) ^c	806	0.529	1.508	104	0.035	0.100	910	0.564	1.608
Utilities (90%) ^c	804	0.529	1.508	104	0.035	0.100	910	0.564	1.608
Industries	93		0.116	749		5.420	841		5.536
1990									
Utilities (85%) ^c	928	0.732	2.087	124	0.041	0.118	1052	0.773	2.205
Utilities (90%) ^c	903	0.732	2.087	124	0.041	0.118	1027	0.773	2.205
Industries	124		0.152	1045		6.745	1169		6.897

^aEmission in 1000 tons per year.^b1 quad = 10¹⁵ Btu.^cAssumed percent control of SO₂ emissions for plants built after 1982.

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AGGREGATED SUBAREAS IN REGION VI

Fig. 4.9. Water Resources Council aggregated subareas in Region VI.

1975 WATER-FOR-ENERGY QUANTITY IMPACTS REGION VI Mid-Range Projection Series C Scenario

Fig. 4.10. Water-for-energy quantity impacts in the 1975 base year.

1990 WATER-FOR-ENERGY QUANTITY IMPACTS REGION VI Mid-Range Projection Series C Scenario

Fig. 4.11. Water-for-energy quantity impacts in 1990.

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 Figs. 4.12 to 4.14. 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.

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.

4.2.3 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 (Fig. 4.15). 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 multicounty sources. As indicated in the National Coal Utilization Assessment for the South,³ 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 floodplain regions of Louisiana and Arkansas. Also there is a potential impact on commercial forests, primarily pine species, in Texas, Louisiana, and Arkansas (Fig. 4.16). Note should be further made that the effects of sulfates (acid precipitation), NO_x, and ozone are not documented for this region.

1975 WATER QUALITY IMPACTS IN REGION VI

Fig. 4.12. Water quality impacts in 1975.

1985 WATER QUALITY IMPACTS IN REGION VI

Fig. 4.13. 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.

Fig. 4.14. Water quality impacts in 1990.

IMPACTS ON LAND USE IN REGION VI COUNTIES Mid-Range Projection Series C Scenario

Fig. 4.15. Impacts on land use.

SO₂ IMPACTS ON VEGETATION-ECOLOGY IN REGION VI AQCR'S **Mid-Range Projection Series C Scenario**

Fig. 4.16. Impacts of SO₂ emissions on vegetation ecology in 1975, 1985, and 1990.

Solid waste. Solid waste disposal does not involve a significant scenario impact in Region VI. 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 VI, 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.

Potential impacts from increased strip mining may be mitigated by the adherence 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 VI 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.⁴ The sites available to utilities have the basic attributes needed for on-site storage. Furthermore, most existing plant sites are apparently large enough 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 elicit images of danger to the public.

Although 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.⁵ 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 or land unsuited to waste disposal traditionally ship their waste to commercial disposal facilities or release liquid wastes directly into the sewer system of 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 increase 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.

4.2.4 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 VI 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 of 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) 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 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 state-wide 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 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 VI cannot be established from data made available for the region. Instead, data for a larger area, the 14-state southern region, were assigned to ORNL (Region VI minus New Mexico, plus DOE Region IV, Virginia, and West Virginia). Because Region VI is such a large component of 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 here, as in the South.

The importance of the South's role in the national energy picture is clearly demonstrated in Table 4.6. 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.

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 Fig. 4.17. 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 the region's current and future energy use as measured by operating costs and employment requirements. Table 4.7 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

Table 4.6. Total annual costs of constructing and operating energy facilities in the South (percent of total U.S. energy facility costs)

	1975	1976-1980	1981-1985	1986-1990
<u>Construction</u>				
Capital	47	46	46	48
Manpower	47	45	44	45
Resource (materials)	49	48	47	49
<u>Operation</u>				
Costs	51	50	58	46
Manpower	49	48	46	44
Resource (materials)	48	47	45	43

Table 4.7. The South's energy mix (OC/MR)^a

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

^aOC = operating costs; MR = manpower requirements.

THE SOUTH'S 1975 SHARE OF ENERGY PRODUCTION MEASURED BY OPERATING EXPENSES AND FUEL TYPE

COAL (48%)

OIL (55%)

GAS (63%)

NUCLEAR (50%)

OTHER (36%)

LEGEND

REMAINDER OF
UNITED STATES

THE SOUTH

Fig. 4.17. The South's 1975 share of energy production, measured by operating expenses and fuel type.

relative decrease measured in operating costs is approximately 31% over 15 years, and the absolute decrease in gas utilization is approximately 12%.

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 with 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.

Indirect economic impacts. The indirect economic impacts on Region VI 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 for the 14-state southern region. The economic activity created by such construction will be heavily concentrated in a few sectors, as is evidenced in a 368-industrial 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 4.8.

The degree of concentration of the indirect impacts is clearly evidenced in the projections that between 45 and 46% of the Region VI 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 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 service will experience particularly significant increased annual demands. The fabricated plate industry warrants particular concern because the projections of the

Table 4.8. Indirect impacts on Region VI of the nationwide capital and manpower expenditures for construction of energy facilities^a

Leading industrial sectors	Sector description	Increase in Region VI's gross output from energy facility construction (millions of 1977 dollars)					
		1976-1980		1981-1985		1986-1990	
800	Crude petroleum and natural gas	270	(1.5) ^b	305	(1.7) ^b	329	(1.8) ^b
3101	Petroleum refining; related services	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 increase of regional gross output for the top 10 sectors	2217		2452		2652	
	Total increase of regional gross output for 368 sectors	4816		5399		5866	
	Concentration of increased gross output in top 10 sectors	46.0%		45.4%		45.2%	

^aGross output data provided by Lawrence Berkeley Laboratory.

^bNumbers in parentheses indicate the increase in gross output as a percentage of that sector's regional gross output in 1972, measured in 1977 dollars.

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 VI. Such a projected demand, if accurate, may be impossible for that industry to meet and could jeopardize attainment of the 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 of 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.

- 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 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.^{6,7}
- 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.⁸
- 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 NEA and the Clean Air Act Amendments of 1977 are in direct conflict.^{6,8} There is also the possibility that new surface mining regulations may bring about decreases in coal production.⁸
- Attitude of the states toward growth vs no growth, both economic and population — This attitude and the existence of pressure groups influence the acceptability and expansion of energy production facilities in the state.
- Need for information by industries on the choice of technology and technical and economic problems encountered in converting from gas or oil to coal.⁸

- Inadequate funding for state energy conservation programs.
- Nuclear licensing reform — Concern exists about the time delays in nuclear plant licensing. The Southern Governor's 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."^{7,8}
- 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.^{7,8}
- 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.^{7,8}
- 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).^{6,7,9}
- Standards for solar equipment inspection and installation.⁸
- 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.^{7,10}
- 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.^{7,9}

4.2.5 Health/safety

Table 4.9 summarizes estimated health effects of air pollution from the Series C Scenario for all states in Region VI 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.

Table 4.9. 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

^a Mortality projections developed from Brookhaven National Laboratory damage functions.

^b Confidence limits based on health damage function only.

^c 1975 SO₄, utility and industrial.

^d 1985 and 1990 SO₄, utility (85% control) and industrial.

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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5. STATE ASSESSMENTS

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 Sect. 4. 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 readers' understanding. Finally, matrices summarizing the impacts for each state are found in Appendix A. 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 administration.

5.1 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.

5.1.1 Institutional/political issues

- Institutional/political issues are not expected to restrain the 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 hydro-electric power. In 1975 the state used 0.7 quads of energy. 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 under way on lignite production and use within the state. The construction of a new mine mouth power plant using lignite may be announced by the end of 1979. 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 $\approx 4,800$ MWe in 1975 to $\approx 12,400$ MWe in 1990 (Figs. 5.1 to 5.5). 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 projects, but projections for other technologies are comparable (Fig. 5.5). 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.

5.1.2 Socioeconomic issues

- 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. Under the Series C Scenario energy development is expected to occur in seven Arkansas counties. 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 in-moving 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 operating period of the projects.

5.1.3 Water quality/availability issues

- In the Red-Sulphur River (ASA 1107) and Lower Arkansas River (ASA 1104) basins, utility plant effluents 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

Fig. 5.1. Changes in coal steam-electric capacity by state.

NUCLEAR CAPACITY IN REGION VI

EXISTING 1975 CAPACITY

PROJECTED 1985 AND 1990 CAPACITY

Fig. 5.2. Changes in nuclear steam-electric capacity by state.

OIL STEAM CAPACITY IN REGION VI

EXISTING 1975 CAPACITY
PROJECTED 1985 AND 1990 CAPACITY

Fig. 5.3. Changes in oil steam-electric capacity by state.

GAS STEAM CAPACITY IN REGION VI

EXISTING 1975 CAPACITY

PROJECTED 1985 AND 1990 CAPACITY

Fig. 5.4. Changes 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.

Fig. 5.5. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Arkansas.

- 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, called ASAs, are shown for Region VI in Fig. 4.9. 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 mg/liter) in the Arkansas and Sabine Rivers and in the main stems of the Mississippi and White Rivers (120-350 mg/liter). They are lower (less than 120 mg/liter) in most tributary areas. Suspended sediment levels are also highest (100-200 mg/liter) in the Mississippi and Arkansas Rivers. They are somewhat lower (50-100 mg/liter) in the White and Sabine-Ouachita systems, especially in tributary areas.^{1,2}

Existing water supply problems are found within the Lower Arkansas (ASA 1104) and Red-Sulphur (ASA 1107) basin 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.³

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 mg/liter), are expected to increase by 60 mg/liter in 1985 and 126 mg/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 801). 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.³

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 mg/liter by 1990. While existing TDS background concentrations (at 200-500 mg) per liter already violate domestic water supply criteria, the predicted increase of 230 mg/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 Mgd 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.

5.1.4 Air quality/visibility issues

- 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.⁴

Existing 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 VI. No counties are currently experiencing SO₂ problems.

Scenario-induced changes. Twelve counties in AQCRs 16, 17, 18, 19, 20, and 22 are forecast to continue nonattainment for TSP for 1985 and 1990. Although no areas are predicted to have significant increases in SO_2 and SO_4 , some concern exists for the possibility of acid rain becoming a problem due to increased coal burning.⁵

The Caney Creek Wilderness and the Upper Buffalo Wilderness (Fig. 4.2) are the only areas in Arkansas concerned with plume blight or regional haze. No significant impacts are expected by 1990.

5.1.5 Land/ecological issues

No serious impacts are predicted for the state of Arkansas.

5.1.6 Health/safety issues

- 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.
- 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, uranium mining and milling, and nuclear electric generation. Figure 5.6 shows the estimated pattern of risk from all mining of coal by county 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 workers 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 1980s⁶ (Fig. 5.6). 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.⁷

ORNL-DWG 79-12648

**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

Fig. 5.6. Estimated mortality due to occupational accidents among coal miners in Arkansas.

5.2 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 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,⁴ and these problems may become more serious with the increased coal burning proposal in the scenario.

5.2.1 Institutional/political issues

- 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. Most of Louisiana's electricity is generated by gas-fired plants. In 1975 the state used 2.5 quads of energy. 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 with 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 requires the state's generating capacity to almost double from 1975 ($\approx 11,000$ MWe) to 1990 ($\approx 22,000$ MWe), with the increase being accounted for mainly by coal steam ($\approx 3,800$ MWe) and nuclear (3,000 MWe) (Figs. 5.1 to 5.4). 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. 5.7). A Louisiana official reports that 950 MWe 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 were willing to allow test drillings for the lignite, one official says some landowners may be unwilling to lease the productive farmland for actual lignite development.

The scenario requires development of 500 MWe of electricity from geothermal sources by 1990. State officials say that although the impacts of this type of development are hard to assess, the questions of ownership, liability, brine disposal, and subsidence need resolution.

ORNL-DWG 79-16685

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	
Oil Steam	2,579	1,585	1,370	1,585	1,420	
Oil Peaking	10	2,734	16	2,734	16	
Gas Steam	8,307	10,057	10,208	9,952	10,133	
Gas Peaking	121	121	121	121	121	
Nuclear	0	1,165	3,045	3,045	3,045	
Combined Cy.	100	180	100	180	100	
Solar	0	0	0	100	0	
Geothermal	0	0	0	500	0	
Refuse	0	0	80	0	80	
TOTAL	11,123	17,452	18,170	21,978	18,675	

*ORNL's Data from utility data file.

Fig. 5.7. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Louisiana.

5.2.2 Socioeconomic issues

- Louisiana is not expected to experience significant local socio-economic impacts from the construction of energy facilities. The parishes receiving energy development will require moderate amounts of worker in-migration, if any at all.

Background. Under the scenario, energy development is expected to occur in ten Louisiana parishes. 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.

5.2.3 Water quality/availability issues

- 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 underlaid by unconsolidated aquifers.
- 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 modifications 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. 5.5). 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 differences in average concentrations of the major water quality constituents. Suspended sediment levels are very high (greater than 500 mg/liter) in the Red River basin, low (less than 50 mg/liter) in the Ouachita basin, and moderately high (100-200 mg/liter) in the rest of the state. Dissolved solids are highest in the coastal rivers (500-1000 mg/liter) and in the main stems of the other major rivers including the Sabine, Ouachita, Mississippi and Red Rivers (120-500 mg/liter). They are lowest (less than 120 mg/liter) in tributaries in the central parts of the state.^{1,2}

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, which contributes sediment, pesticides, bacteria, and point and non-point oil field brine pollution.³

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, as 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 mg/liter) levels of TDS in ASA 1107 may be significantly increased by the predicted levels of electricity generation along the Red River. Water quality model projections indicate a final TDS concentration of 238 mg/liter from all energy-related sources, and 227 mg/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 mg/liter in 1975 to 55 mg/liter in 1985 and 70 mg/liter in 1990. The total concentrations attributable to energy may reach 97 mg/liter in 1990, an increase in 43 mg/liter over the period of the analysis. Background concentrations of 200-500 mg/liter would be increased 20% by energy activities.

5.2.4 Air quality/visibility issues

- Some degradation in air quality (particularly for TSP) may be expected for selected parishes in Louisiana and population exposure to SO₂ and SO₄²⁻ could increase by 1990 due to increased coal burning by industry.

Existing conditions. Several parishes currently have slightly elevated ambient levels of SO_2 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 SO_2 and SO_4 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. 4.2) 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.

5.2.5 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 floodplain 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 SO_2 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 over 1.9 million acres of soybeans.⁸ 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 SO_2 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 studies⁴ the overlaying of predicted SO_2 levels showed considerable potential SO_2 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.

5.2.6 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 projected coal use, Louisiana's population is expected to be exposed to the largest concentration of fossil fuel combustion products in the region by 1990. This hazard is considered to be of moderate risk by Starr's ranking.⁷ This scenario, however, does not include the increase in occupational mortality and morbidity from anticipated development of lignite resources.

5.3 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.

5.3.1 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 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 MWe in 1975 to ≈ 3800 MWe 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 from solar sources is forecast for 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. 5.1 to 5.4 and Fig. 5.8).

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 MWe.

The scenario forecasts only an additional 180 MWe from coal steam sources in the 1985 to 1990 period, although 2170 MWe are planned. However, all projects depend on the approval of leases from the 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.

ORNL-DWG 79-16686

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN NEW MEXICO

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975		1985		1990
	SERIES C	SERIES C	UTILITY*	SERIES C	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	5,881	6,217	7,468

*ORNL's Data from utility data file.

Fig. 5.8. 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 the 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.

5.3.2 Socioeconomic issues

- 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. 5.9). 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 of between 28 and 30% beyond the baseline population in 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.

5.3.3 Water quality/availability issues

- The primary type of energy development projected is coal and uranium extraction which is concentrated in the northwestern portion of New Mexico. Very high levels of ammonia (NH₃) pollution will result from the projected amount of surface coal mining within the Lower Colorado Basin (ASA 1501-Little Colorado).
- 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 operation (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.

ORNL-DWG 79-12636

PROJECTED POPULATION GROWTH RATES FOR IMPACTED NEW MEXICO COUNTIES (Dashed Line = BEA Boundary)

Fig. 5.9. Projected population growth rates for impacted counties in New Mexico.

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 is important as a toxicant to fish and other aquatic life, and as a consumer of dissolved oxygen. 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.

5.3.4 Air quality/visibility issues

- 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 Doña 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.

5.3.5 Land/ecological issues

- 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-buffalograss, 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.⁸ As the ecological regions and natural vegetation varies, so does the climate, especially annual precipitation. Precipitation averages 6 to 7 in./year in the west to near 20 in./year in the east with up to 40 in./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 peregrine falcon and the bald eagle, both species being reported as nesting in the vicinity, and the black-footed ferret. In addition, the Colorado squawfish, an endangered species, inhabits the San Juan River downstream from planned coal gas and liquefaction 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 you compare the data with the in-depth EPA sponsored study of the Navajo/Farmington area in San Juan County.⁵ 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 51,100 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 area 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 to the new growth already in place. Consequently waste disposal will be a problem.

5.3.6 Health/safety issues

- 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 mining, 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 5.10 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).

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.

ORNL-DWG 79-12647

**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

Fig. 5.10. Estimated mortality due to occupational accidents among coal miners in New Mexico.

Because strip mining is the dominant method of coal extraction in New Mexico, total deaths 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 5.10 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).

5.4 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.

5.4.1 Institutional/political issues

- Institutional/political issues are not expected to restrain energy development in Oklahoma.

Existing conditions. Oklahoma's electricity generation has been almost completely from gas-fired plants. In 1975 the state used 1.14 quads 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 VI 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 adopted 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 MWe in 1975 to 16,000 MWe in 1990 (Fig. 5.11). This agrees generally with the utility projections. Most of the increase is estimated to come from coal and nuclear (Figs. 5.1 to 5.4). 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.

SCENARIO - UTILITY PROJECTED ELECTRIC GENERATION IN OKLAHOMA

ENERGY SOURCE	GENERATING CAPACITY (MEGAWATTS)				
	1975	1985	1985	1990	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.

Fig. 5.11. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Oklahoma.

5.4.2 Socioeconomic issues

- 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 the scenario. The majority of these counties are rural with low population. Rural counties will have a lower assimilative capacity for impacts from substantial amounts of in-movers.

Scenario-induced changes. Significant impacts from coal and nuclear power plant construction are expected for two counties in the Tulsa BEA region (Fig. 5.12). These counties should experience at least one year of population growth greater than 10% from the construction of coal and nuclear plants. 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 5472 in-migrants, including dependents, during the peak construction year.

At the construction peak, the two significantly impacted counties could experience an increase of \$.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.

5.4.3 Water quality/availability issues

- 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.
- 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.

PROJECTED POPULATION GROWTH RATES FOR IMPACTED OKLAHOMA COUNTIES (Dashed Line = BEA Boundary)

Fig. 5.12. Projected population growth rates for impacted counties in Oklahoma.

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 (>2500 mg/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 highest (>500 mg/liter) in the central parts of the state in the Canadian, Cimarron, Washita, and Red River basins.¹

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 component, except in the southeastern part of the state.³

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-Cimarron (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 mg/liter in 1975 to 482 mg/liter in 1990. It also has a 22 mg/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 mg/liter. The national water quality model shows it increasing to 145 mg/liter in 1985 and 205 mg/liter in 1990. Almost all of the increase 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 (ASA 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 decrease 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-Sulphur (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.

5.4.4 Air quality/visibility issues

Existing conditions. Annual average SO₂ concentrations do not exceed 8 µg/m³. Eight counties have annual average TSP concentrations in the range of 50 to 110 µg/m³, while background values are in the range of 20 to 45 µg/m³.

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 forecasted 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.

5.4.5 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.

5.4.6 Health/safety issues

- Projected expansion in underground coal production will significantly increase the accidental death/injury and occupational disease incidence from the zero value existing in 1975.
- 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, 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 5.13 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.

ORNL-DWG 79-12651

**ESTIMATED MORTALITY DUE TO OCCUPATIONAL
ACCIDENTS AMONG OKLAHOMA 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

Fig. 5.13. Estimated mortality due to occupational accidents among coal miners in Oklahoma.

5.5 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.

5.5.1 Institutional/political issues

- 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.

Existing conditions. Texas' electricity generation was mainly from gas steam plants in 1975, with a small assist from coal. In 1975 the state used 7.11 quads 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 VI 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 Clear 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. One 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."⁹ 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 mechanisms for providing localities enough information on which to make these decisions.

Scenario-induced changes. The scenario projects that Texas would increase its coal-fired electric generating capacity from $\approx 2,300$ MWe in 1975 to over 21,000 MWe in 1990 (Figs. 5.1 to 5.4 and Fig. 5.14). 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 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 plants 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 deposit site.

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.

Fig. 5.14. Comparison of Mid-Range Projection Series C Scenario and utility construction plans in Texas.

5.5.2 Socioeconomic issues

- 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.

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. 5.15). 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.

5.5.3 Water quality/availability issues

- In east Texas, the national water quality model indicates 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), Saline-Neches (ASA 1201), Trinity (ASA 1202), and Brazos (ASA 1203) River basins.

ORNL-DWG 79-12622

PROJECTED POPULATION GROWTH RATES
FOR IMPACTED TEXAS COUNTIES
(Dashed Line = BEA Boundary)

Fig. 5.15. Projected population growth rates for impacted counties in Texas.

- 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 energy development contributing to problems in the middle Rio Grande (ASA 1302). All five ASAs have water problems associated with both surface and groundwater supplies.
- 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 1203), the Colorado of Texas (ASA 1204), the San Antonio and Nueces (ASA 1205), and the Rio Grande and Pecos (ASAs 1302, 1303, and 1305).

Dissolved solids levels are very high (>2500 mg/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 mg/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 mg/liter. They are generally 120 to 350 mg/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 mg/liter CaCO_3). They are somewhat softer (181 to 250 mg/liter CaCO_3) in the eastern portions of most drainages, and much softer (0 to 60 mg/liter CaCO_3) in the extreme northeastern part of the state.^{1,2}

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.¹⁰

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.¹¹ 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 extremely low flows and highly mineralized waters in these basins, the national water quality analysis indicates zero discharge 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 frequent severely 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 Mgd in 1975 to 75 Mgd in 1990, with peak load demands increasing from 33 Mgd to 145 Mgd. 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 VI 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.¹²

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 Mgd 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 area¹¹ and could cause violations of water quality standards for total dissolved solids by 1985.

Saltwater intrusion resulting from increased consumption during low-flow periods has the potential for contaminating freshwater supply at existing intake facilities.¹¹

Groundwater problems. The groundwater in the Texas High 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.

5.5.4 Air quality/visibility issues

- 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 SO₂ concentration of 9 µg/m³, with a value of 23 µg/m³. Thirteen counties have annual average TSP concentrations in the range of 75-125 µg/m³, while some background values range up to 50 µg/m³.

Scenario-induced changes. Several counties currently have high levels of SO₂ 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 are no projected significant impacts due to changes in regional haze through 1990.

5.5.5 Land/ecological issues

Existing conditions. Texas is one of the most diverse states within the South with areas ranging from Chihuahuan Desert in the southwest 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 forests.

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 ft 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 Carrizo-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.⁹

5.5.6 Health/safety issues

- Texas leads the region for total occupational health hazards in all energy technologies except oil electric generation, and uranium mining and milling.

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 5.16 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.

ESTIMATED MORTALITY DUE TO OCCUPATIONAL ACCIDENTS AMONG TEXAS COAL MINERS

Mid-Range Projections Series C
(Values Given as Deaths per Million Miner Population)

Fig. 5.16. Estimated mortality due to occupational accidents among coal miners in Texas.

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APPENDIX A
STATE MATRICES

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Table A.1. Environmental impacts of the Mid-Range Projection Series C Scenario
at the regional or state level in Arkansas^a

Energy source	Air quality	Water		Land		Health and safety ^d	Socioeconomics			
		Quality	Availability ^c	Ecology/ land use	Solid waste		Local socio- logic factors	Local economics	Regional economics	Legislative/ institutional
Utilities										
Coal	L	M	M			H ^d	L	L	L	L
Oil	L						L	L	L	L
Gas	L						L	L	L	L
Nuclear	L					L	M	M	M	H
Conservation										
Efficiency improvements							L	L	L	M
Urban wastes							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

^aCriteria for ranking impacts found in Table 1.2.

^bIncludes occupational and other health effects not covered by air quality.

^cIncludes groundwater.

^dFor combustion.

Table A.2. Environmental impacts of the Mid-Range Projection Series C Scenario
at the regional or state level in Louisiana^a

Energy source	Air quality	Water		Land		Health and safety ^b	Socioeconomics			
		Quality	Availability ^c	Ecology/ land use	Solid waste		Local socio- logic factors	Local economics	Regional economics	Legislative/ institutional
Utilities										
Coal	L	M	M	M		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										
Efficiency improvements							L	L	L	L
Urban wastes							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

^aCriteria for ranking impacts found in Table 1.2.

^bIncludes occupational and other health effects not covered by air quality.

^cIncludes groundwater.

Table A.3. Environmental impacts of the Mid-Range Projection Series C Scenario
at the regional or state level in New Mexico^a

Energy source	Air quality	Water		Land		Health and safety ^b	Socioeconomics			
		Quality	Availability ^c	Ecology/ land use	Solid waste		Local socio- logic factors	Local economics	Regional economics	Legislative/ institutional
Utilities										
Coal	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										
Efficiency improvements			L	L	L	L				H
Urban wastes			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	

^aCriteria for ranking impacts found in Table 1.2.

^bIncludes occupational and other health effects not covered by air quality.

^cIncludes groundwater.

Table A.4. Environmental impacts of the Mid-Range Projection Series C Scenario
at the regional or state level in Oklahoma^a

Energy source	Air quality	Water		Land		Health and safety ^b	Socioeconomics			
		Quality	Availability ^c	Ecology/ land use	Solid waste		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

^aCriteria for ranking impacts found in Table 1.2.

^bIncludes occupational and other health effects not covered by air quality.

^cIncludes groundwater.

Table A.5. Environmental impacts of the Mid-Range Projection Series C Scenario
at the regional or state level in Texas^a

Energy source	Air quality	Water		Land		Health and safety ^b	Socioeconomics			
		Quality	Availability ^c	Ecology/ land use	Solid waste		Local socio- logic factors	Local economics	Regional economics	Legislative/ institutional
Coal										
Electric	M	H	E	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							L	L	L	L
General										
Utility	M		H				M	M	M	H
Industry	L	L					M	M	M	H
Mining		L		H			L	L	L	H

^aCriteria for ranking impacts found in Table 1.2.

^bIncludes occupational and other health effects not covered by air quality.

^cIncludes groundwater.

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