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Coal and Energy: A Southern Perspective

Regional Characterization Report for The National Coal Utilization Assessment

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ORNL
REGIONAL
STUDIES
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OPERATED BY UNION CARBIDE CORPORATION FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5205 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy ~~\$6.00~~ Microfiche \$3.00

#650

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Contract No. W-7405-eng-26

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for
The National Coal Utilization Assessment

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Date Published: August 1977

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ABSTRACT

This publication is the first of several reports to be produced for the National Coal Utilization Assessment, a program sponsored by the Assistant Administrator for Environment and Safety through the Division of Technology Overview of ERDA. The purpose of the report is to present the state and regional perspective on energy-related issues, especially those concerning coal production and utilization for 12 southern states. This report compiles information on the present status of: (1) state government infrastructure that deals with energy problems; (2) the balance between energy consumption and energy production; (3) the distribution of proved reserves of various mineral energy resources; (4) the major characteristics of the population; (5) the important features of the environment; and (6) the major constraints to increased coal production and utilization as perceived by the states and regional agencies.

Many energy-related characteristics described in this report vary significantly from state to state within the region. Regional and national generalizations obscure these important local variations. The report provides the state and regional perspective on energy issues so that these issues may be considered objectively and incorporated into the National Coal Utilization Assessment. This Assessment is designed to provide useful outputs for national, regional, and local energy planners.

1. INTRODUCTION

This report is the first of several reports scheduled to be produced under the National Coal Utilization Assessment (NCUA). The NCUA is a two-year assessment program sponsored by the Assistant Administrator for Environment and Safety through the Division of Technology Overview (AES/DTO) of ERDA. The NCUA is a major effort conducted as part of the ERDA-sponsored Regional Studies Program at six ERDA laboratories. The purpose of the NCUA is to evaluate the potential environmental, social, and economic effects of increased coal development and increased utilization of coal technologies.

This report presents selected baseline information on state government infrastructure, energy balance, environmental conditions, and resource characterization. It also contains a listing of the problems, constraints, and issues related to increased coal utilization as perceived by state and regional officials in the South. The purpose of this effort is to provide input to the NCUA on state and regional perspectives of energy issues, especially coal issues, from available reports by state and regional agencies, and interviews with state and regional officials. Information is included for 12 states in the Oak Ridge National Laboratory (ORNL) region: Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The report is not intended as a comprehensive regional assessment. Such an assessment will be completed as part of the NCUA research program and will be released as a separate report. However, ERDA and ORNL believe that it is vitally important that local perspective be incorporated into the Regional Assessment. In order to assure local significance and utility, it is necessary that the study incorporate input from state and regional groups during the planning and conduct of the NCUA Program. This report is intended to document and provide such input from regional and state agencies in order to increase the report's utility to these agencies.

Information in this document should be useful for several purposes. It serves as an initial statement of present baseline energy conditions and coal-related issues in the 12-state region for which ORNL is responsible. Secondly, the NCUA researchers at ORNL who are responsible for conducting the assessment will use the information regarding state concerns as one set of indicators of areas in which to direct NCUA study efforts. Thirdly, this report documents work already completed by state and regional agencies that provides a starting point for the research conducted under the NCUA. Finally, it provides a means for communicating key energy issues and management options between states and regional agencies and the research team.

The Energy Research and Development Administration's guidelines for the NCUA refer frequently to the study as one which will be both national and regional in scope and one which will initiate and maintain contacts with both national and local agencies. This publication reflects

the continuing communication process that has been established between state and regional officials and the NCUA research team. This process also includes periodic meetings, workshops, correspondence and related communications that are now being conducted by ORNL as part of the NCUA and the Regional Studies Program.

The "Program Plan for the National Coal Utilization Assessment at the Oak Ridge National Laboratory" includes nine tasks. The first of these, "Coordination with State and Regional Agencies," provides for extensive interaction between ORNL and state and regional decision makers. Under this task the project team set out to contact these key officials and agencies for the following purposes:

1. Introduce the NCUA and discuss its purpose and scope;
2. Establish a system for communicating with state and regional agencies;
3. Meet with state decision makers to obtain their perception of important coal development and conversion problems, issues, and management options.

The Program Plan specified that the results of these meetings, as well as summaries of existing literature, would be presented in a Regional Characterization Report. This is that report. An initial draft of the report was circulated for review in May 1977 to each of the 12 state energy offices, to the regional agencies listed in Appendix A-1, to ERDA staff in Washington, D.C., and to selected staff in ORNL. The draft was revised on the basis of comments received, and the present publication printed for distribution to the same group.

Appendix A contains a detailed description of the procedures used in meeting with state officials, and also includes:

- A detailed list of agencies visited and persons contacted;
- A sample list of questions sent to the agencies before the visit;
- A sample meeting agenda;
- A copy of printed materials left with each agency describing the NCUA; and
- A list of documents collected from state and regional offices.

It should be noted that most of the visits with state energy officials occurred during the worst weeks of the natural gas crisis. Despite this, the officials did their best to schedule meetings. The ORNL team members were impressed with the competence, knowledge, and courtesy of these persons who were acting under very heavy pressure. The ORNL staff members wish to take this opportunity to express their appreciation for the cooperation and assistance provided by these state and regional agencies.

2. CHARACTERIZATION OF STATES

Responsibility for the National Coal Utilization Assessment has been divided among six national laboratories with the Oak Ridge National Laboratory assigned the 12 southern and southeastern states pictured in Fig. 1.

This chapter of the report provides information describing each of the 12 states. The information is arranged within six major topical headings: Government Infrastructure, Energy Balance, Proved Reserves, Human Resources, Environmental Baseline, and Problems/Issues/Constraints. Because environmental characteristics do not coincide with state political boundaries, the section on Environmental Baseline is organized on the basis of ecological regions which occur in different combinations explained in Section 2.5.

2.1 GOVERNMENT INFRASTRUCTURE RESPONSIBLE FOR ENERGY

Many state agencies influence energy utilization and energy planning for the state. For example, the Department of Transportation, the Public Utility Commission, the Water and Air Quality Commissions, and the State University's energy research programs all affect the state's energy situation. However, during the past 3-4 years, each of the 12 states has established a central "energy office" designed to coordinate all energy-related activities and to act as an information source and source of recommendations to the legislature and governor. It is the summation of the legislative and executive actions that really define the state's energy policy. This report focuses mainly on the functions of the energy office and its relation to the governor and legislature, but it provides a review of other agencies within the state having energy-related functions as well.

Table 1 provides a concise summary of the formal state government arrangements for setting up the energy office. Information for the table was provided by energy office directors and abstracted from copies of the legislative and executive acts creating the energy offices.

Each of the 12 states has created a special office to look after energy-related matters, and all of the offices were established shortly after the Organization of Petroleum Exporting Countries embargo in 1973. Approximately half of the offices were established by executive order and half by legislative act.

The administrative pattern encountered most frequently is one which places the energy office within one of the governor's executive offices - Development Cabinet, Office of Planning and Budget, Division of Administration, etc. - and requires that the energy office provide information and advisory services to the governor and to the state legislature. In addition to the state energy office, many states have

ASSESSMENT PARTICIPANTS

SIX NATIONAL LABORATORIES ARE PARTICIPANTS IN THE NCUA

Fig. 1. Geographic areas of responsibility for laboratories participating in the NCUA.^a
^aOklahoma and Arkansas will be included in ORNL's responsibility for future regional assessments.

Table 1. State government offices responsible for energy

State	Title of state energy office	Date office established	Established by legislature - governor	Major functions of energy office as abstracted from legislative or executive acts creating office
Alabama	Alabama Energy Management Board	1973	X	Develop an equitable distribution of energy supplies; prepare study of sources of energy available to state; prepare energy conservation program; implement state and Federal laws pertaining to energy; recommend to the Governor plans as may be necessary.
Florida	Florida State Energy Office	1975	X	Energy conservation activities; petroleum allocation and contingency planning; policy analysis and recommendations; energy data collection, analysis, and forecasting.
Georgia	Georgia Office of Energy Resources	1975	X	Administer Federal energy funds and programs; prepare emergency fuel allocation plan for governor's approval; carry out energy-related research and predict energy demands; inform and educate public about conservation and alternate energy technologies; evaluate policies governing prices for energy and make recommendations; report and make recommendations annually to governor.

Table 1 (continued)

State	Title of state energy office	Date office established	Established by legislature - governor	Major functions of energy office as abstracted from legislative or executive acts creating office
Kentucky	Kentucky Department of Energy	1975	X	Inventory energy requirements; formulate energy management program and contingency fuel allocation plan; administer conservation policies and review building codes for energy conservation; encourage wise development of energy and recommend R&D for energy development; develop process for energy facility siting; review utility rates for impact on energy usage.
Louisiana	Research and Development Division of the Louisiana Department of Natural Resources	1973	X	Regulate use and conservation of state's energy resources; provide for equitable distribution of energy supplies to users; insure the maintenance of energy supplies.
Mississippi	Mississippi Fuel and Energy Management Commission	1974	X	Administer petroleum allocation program; monitor fuel energy program; disseminate information on fuel problems; conduct surveys; develop list of priority uses of fuel; develop contingency plans; recommend legislation.

Table 1 (continued)

State	Title of state energy office	Date office established	Established by legislature - governor	Major functions of energy office as abstracted from legislative or executive acts creating office
North Carolina	North Carolina Energy Division	1974	X	Authorization of fuel allocations under Federal authority; development and implementation of conservation programs; publication of energy research reports. (The North Carolina Energy Policy Council recommends energy legislation to governor and legislature.)
South Carolina	South Carolina Energy Management Office	1976	X	Serve as data source; provide "positive influence" on legislative and regulatory actions; implement actions required by state and Federal laws; build cadre of trained personnel in energy fields; provide clearing house for information about federal energy agencies; develop conservation programs and educate public; encourage R&D impacting energy.
Tennessee	Tennessee State Energy Office	1974	X	Advise governor and general assembly on energy matters; coordinate state-sponsored energy activities; inform the public regarding conservation; analyze energy consumption trends; develop plan for allocating energy resources;

Table 1 (continued)

State	Title of state energy office	Date office established	Established by legislature - governor	Major functions of energy office as abstracted from legislative or executive acts creating office
Texas	Governor's Energy Advisory Council	1975	X	Recommend energy policy to legislature and governor; develop energy data base; analyze manpower needs and technological developments; review policies of state and federal agencies; foster conservation policies; administer "public awareness program"; review and comment on Federal actions; administer the Energy Development Fund.
Virginia	Virginia Energy Office	1974	X	Act as State Office of Energy Allocation to administer set-aside program; promulgate energy conservation programs; coordinate state energy programs; maintain liaison with federal energy agencies; establish contingency fuel allocation plans.
West Virginia	West Virginia Fuel and Energy Office	1973	X	Administer petroleum allocation program and state set-aside; provide information regarding energy availability; promote conservation; recommend legislation; develop contingency plans; collect data; locate coal producers who will make coal available to low-income families; implement state energy conservation plans; assess Federal coal R&D initiatives; investigate coal development and utilization alternatives.

an energy advisory panel or commission which sits at the pleasure of the governor. If such a commission exists, the energy office acts as a support arm for the commission. Fig. 2 shows a typical pattern for administratively locating the state's energy office.

Analysis of the major functions assigned to the state energy offices, as specified in the various legislative and executive acts, shows that five functions are set forth for almost every office:

- Preparation of an emergency fuel allocation plan;
- Education of the public regarding conservation practices;
- Compilation of energy data and analysis of future demands;
- Liaison with Federal energy agencies; and
- Recommendation of energy policies for consideration by the governor and/or the legislature.

In addition, there are a number of functions which appear in only one or two of the acts establishing the energy offices:

- Encourage "wise development of energy" (Kentucky);
- Recommend R&D impacting energy (South Carolina, Kentucky);
- Review building codes as they involve energy (Kentucky);
- Review utility rates as they impact energy (Kentucky);
- Build cadre of trained personnel (South Carolina).

In general, the wording of the executive and legislative acts stresses the functions of: "coordinate," "inform," "evaluate," "advise," "review," and "encourage." It is clear that the state governors and legislatures will continue to formulate and enact the states' energy policies. The energy offices will serve as information sources, facilitate the implementation of policy, and recommend policy upon request.

Energy problems cannot be boxed neatly into a single compartment of state government. Energy-related issues pervade almost all aspects of the citizen's life, and as a result, a great variety of agencies within the state must be concerned directly with these issues. A recent survey by the Southern Interstate Nuclear Board summarizes, by state, the principle energy-related agencies, in addition to the state energy office. (See Table 2.)

The variety of agencies listed in Table 2 reflects the variety of concerns related to energy: discovery and extraction of mineral energy; protection of air, water, and land quality; transportation of energy resources; energy price regulation; basic energy-related research; planning for economic growth; concern for public health, including mine safety; and conservation of the state's natural resources. Clearly, the state governor and the legislators face a difficult task in coordinating these agencies.

ORNL-DWG 77-13407

Fig. 2. Typical administrative location for state energy offices.

In addition to the state-level agencies listed in Table 2, there are a number of regional agencies concerned with energy issues in the South. These include the Federal Regional Centers in Atlanta and Dallas with representatives from FEA, EPA, and other agencies; the Southern Interstate Nuclear Board; the Appalachian Regional Commission; the Coastal Plains Regional Commission; the Southern Growth Policies Board; and the Tennessee Valley Authority. These regional agencies also must coordinate their energy activities to provide the needed services while avoiding duplication. ORNL collected input from most of these regional agencies through in-person meetings and collecting and reviewing available agency reports as one of its initial activities under the NCUA program.

2.2 ENERGY BALANCE: PRODUCTION-CONSUMPTION

This section of the report provides information describing the production and consumption of mineral energy forms in each of the 12 southern states.

As background, it is useful to compare a few statistics for the total United States production and consumption of energy. A common unit used in the following tables is the "quad", which is a measure of the energy content of the fuel and is equal to 10^{15} Btus (British thermal units) or 1.055×10^{18} joules. Use of a common unit for the different fuels allows for easy, quantitative comparisons among the fuels.

Recent information distributed through a news release by the Department of Interior, Bureau of Mines, on March 14, 1977, provides the following information:

U.S. energy consumption (quads)

1976 = 74.0
 1975 = 70.6
 1973 = 74.6 (all time high)

Table 2. Principle energy-related agencies, by state (excludes state energy office)

ALABAMA:

Alabama Geological Survey and
State Oil and Gas Board...responsible for resource development.
Center for Energy and Environmental Studies, University of Alabama
(Huntsville)...solar energy research and information dissemination.
Public Research Division, Auburn University...contractual support to
the Energy Management Board in energy conservation.

FLORIDA:

Florida Solar Energy Center...R&D activities in solar energy.
Solar Energy Laboratory, University of Florida, Gainesville...solar
energy research.
Division of State Planning...prepares energy part of state comprehen-
sive plans, reviews 10-year site plans of electrical utilities.
Division of Community Services...oversees weatherization programs.
Division of Technical Assistance...develops statewide building code.
Bureau of Geology...regulates oil and gas extraction.
Bureau of Coastal Zone Management...prepares coastal zone management
plans.
Office of Public Council...represents public interest in utility rate
cases.
Resource Recovery Council...promotes energy recovery from waste.

GEORGIA:

Georgia Institute of Technology...solar energy research; general energy-
related research.
Georgia Power Company...programs emphasizing energy conservation.

KENTUCKY:

Kentucky Center for Energy Research...coordinates all state universities'
energy R&D activities.
Institute of Mining and Mineral Research.
Department of Finance...EPC planning.
Department of Transportation...EPC planning.
Fire Marshall's Office...EPC planning.
Department of Natural Resources and Environmental Protection...environ-
mental aspects of energy production and utilization.
Department of Mines and Minerals...mine safety; oil and gas well permits.
Kentucky Geological Survey...basic geologic data collection.

Table 2 (continued)

LOUISIANA:

State Mineral Board.
 Offshore Terminal Authority.
 Several universities in the state have energy-related projects funded by state and Federal grants.

MISSISSIPPI:

Mississippi Research and Development Center.
 Mississippi State University.
 Department of Agriculture and Commerce.
 Oil and Gas Board.
 Air and Water Pollution Central Commission.
 Agricultural and Industrial Board.
 Interstate Oil Compact Commission.
 Governor's Office of Science and Technology.

NORTH CAROLINA:

Governor's Energy Panel.
 Utilities Commission.
 Building Code Council.
 Energy Policy Council.

SOUTH CAROLINA:

Public Service Commission.
 Department of Health and Environmental Control.
 Governor's Nuclear Advisory Council.
 Water Resources Commission.
 Land Resources Commission.
 Clemson University and the University of South Carolina have energy responsibilities as a subcontractor to state agencies.

TENNESSEE:

Conservation Department (Oil and Gas Board).
 Wild Life Resources.
 Public Health Department.
 Public Service Commission.
 Memphis State University (Regional Center for Nuclear Studies).
 University of Tennessee (Environmental Center).

TEXAS:

Texas Railroad Commission...regulates oil and gas production and transportation.
 Texas Public Utilities Commission...regulates electric utilities.
 Texas Water Development Board...delivery of water.

Table 2 (continued)

TEXAS (Continued)

Texas Water Quality Board.
 Texas Water Rights Commission.
 Department of Agriculture...energy and water supply to farmers.
 General Land Office...coastal zone management leasing state lands for mineral production.
 State Planning Commission.
 Texas Highway Department.
 Texas Department of Parks and Wildlife.
 Texas Coastal and Marine Council
 Office of the Governor, Division of Planning Coordinator and Office of Budget and Planning.
 Texas A & M University (Center for Energy and Mineral Resources).
 University of Texas (Center for Energy Studies).
 University of Houston (Energy Institute).
 Texas Tech University (Institute for Energy Research).

VIRGINIA:

Division of State Planning...coordinates energy conservation plans made by other agencies.
 Housing Authority...building codes.
 Some universities in the state are involved in energy research.

WEST VIRGINIA:

Northern West Virginia Coal Association.
 West Virginia Coal Association.
 West Virginia Oil and Natural Gas Association.
 West Virginia Oil Jobbers and Distributors Association.
 West Virginia Petroleum Council.
 West Virginia Surface Mining and Reclamation Association.
 Economic Opportunity Office.
 West Virginia Commission on Energy, Economy and Environment.
 West Virginia University Engineering Experiment Station.
 West Virginia Oil and Gas Conservation Commission.
 Department of Natural Resources.
 Department of Mines.
 Public Service Commission.
 West Virginia University has a number of energy-related research activities.

Source: State-Level Energy Agencies in the South, Southern Interstate Nuclear Board, February 1977.

The 74.0 quads of energy consumed in 1976 was distributed among the various energy types as shown below.

U.S. energy consumption by fuel type (quads)

Petroleum =	34.9	=	47.2%
Natural gas =	20.2	=	27.3
Coal =	13.8	=	18.6
Nuclear =	2.1	=	2.8
Hydro =	3.0	=	4.1
	<u>74.0</u>		<u>100.0%</u>

Conservation efforts and sluggish economic activity account for the decrease in consumption between 1973 and 1975, but economic recovery coupled with an unusually cold winter drove energy consumption back up during 1976. Fossil fuels account for almost all of the energy consumption in the United States.

Total domestic production for the United States in 1976, as presented in the Bureau of Mines news release, is just under 60 quads.

U.S. energy consumption by fuel type (quads)

Petroleum =	17.2	=	30.0%
Natural gas =	19.4	=	33.7
Coal =	15.8	=	27.4
Nuclear =	2.1	=	3.6
Hydro =	3.0	=	5.3
	<u>57.5</u>		<u>100.0%</u>

Most of the deficit between production and consumption was supplied by importing 2.6 billion barrels of petroleum in 1976 (approximately 14 quads.) Petroleum and natural gas, both of which are limited domestic resources, accounted for two-thirds of total production and three-fourths of the total U.S. energy consumption.

Shifting from a national to a regional perspective, the data in Fig. 3 and Table 3 show an energy balance for the 12 states in the southern region. The data are taken from reports of studies by the various states, and therefore the baseline years and the classification categories are only approximate.

It is obvious that few generalizations may be made about the 12-state region which would not obscure the great variability which exists among the states. Some states supply much more energy than they consume (Kentucky, Louisiana, Texas, and West Virginia); some produce very little energy, remaining dependent upon imported energy (Florida, Georgia, North Carolina, and South Carolina); and the remainder are almost in balance between energy production and consumption.

The four major energy-producing states fall into two groups - the coal-producing states of Kentucky and West Virginia and the oil-and-gas producing states of Louisiana and Texas. These four states account for over 90% of the total energy production of the region and over half of the total U.S. domestic energy production.

Fig. 3. Energy balance, by state and region, quacrilion BTU(Q), 1974.^a

^aData are approximate for the year 1974 only and have been drawn from various available reports published by state and regional agencies.

Table 3. Energy balance, by state, by sector, and by type of fuel.^a

State	Sector	Energy consumption within state		Energy production within state		Net energy balance	Data sources: state publications
		Amount of energy	Type of basic fuel	Amount of energy	Type of basic fuel	Amount of energy	
Alabama	1972	$\times 10^{12}$ Btu	1972	$\times 10^{12}$ Btu	1972	$\times 10^{12}$ Btu	<i>Coal in Alabama</i> , p. 8, 27 <i>Petroleum in Alabama</i> , p. 2, 17. <i>Gas in Alabama</i> , p. 5, 11.
	Res.-Comm.	142	Coal 27.6×10^6 T	= 649	Coal 20.8×10^6 T	= 489	
	Industrial	445	Petroleum 72×10^6 Bbl	= 432	Petroleum 9.93×10^6 Bbl	= 50	
	Transportation	296	Gas 288×10^9 ft ³	= 298	Gas 4.6×10^9 ft ³	= 5	
	Elec. Power	447		1379		554	
	Misc.	52					
		1392					
	Total = 1.39 quads		Total = 1.38 quads		Total = 0.55 quads	-0.83 quads	
Florida	1975	$\times 10^{12}$ Btu	1975	$\times 10^{12}$ Btu	1976	$\times 10^{12}$ Btu	<i>Forecasts of Future Supply and Demand of Energy in Florida</i> , p. 19, 28. <i>Sources of Energy Used in Florida</i> , p. 117, 118.
	Residential	436.7	Petroleum	1341	Petroleum 44.5×10^6 Bbl	= 257	
	Commercial	343.9	Gas	298	Gas 46.8×10^9 ft ³	= 47	
	Industrial	266.9	Coal	132		314	
	Government	42.3	Nuclear	89			
	Transportation	703.2	Hydro	2			
	Other	70.6		1863			
	Total = 1.863 quads		Total = 1.863 quads		Total = 0.314 quads	-1.55 quads	
Georgia	1973	$\times 10^{12}$ Btu	1973	$\times 10^{12}$ Btu			<i>Energy Consumption in Georgia</i> , 1973.
	Res.-Comm.	181	Coal	256			
	Industrial	243	Petroleum	601			
	Transportation	465	Gas	357	Hydro = 3.3×10^9 kWhr		
	Elec. Gen.	353	Hydro	31	= 0.01 quads		
		1246		1246			
	Total = 1.246 quads		Total = 1.246 quads			-1.24 quads	
Kentucky	1972	$\times 10^{12}$ Btu	1972	$\times 10^{12}$ Btu	1972	$\times 10^{12}$ Btu	<i>Energy in the Kentucky Economy</i> , p. 13, 19.
	Res.-Comm.	193	Coal	605	Coal 120×10^6 T	= 2770	
	Industrial	232	Gas	274	Gas 72.7×10^9 ft ³	= 75	
	Transportation	288	Petroleum	345	Petroleum 14×10^6 Bbl	= 72	
	Elec. (all above)	551	Hydro	40	Hydro	= 36	
		1264		1264		2953	
	Total = 1.264 quads		Total = 1.264 quads		Total = 2.953 quads	+1.69 quads	

Table 3 (continued)

State	Sector	Energy consumption within state		Energy production within state		Net energy balance	Data sources: state publications
		Amount of energy	Type of basic fuel	Amount of energy	Type of basic fuel	Amount of energy	
Louisiana	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	<i>Louisiana Energy Report</i> , p. 8, 9, 11.
	Industry	1256.7	Gas	1854.3	Petroleum 738 $\times 10^6$ Bbl	= 4,400	
	Utilities	475.4	Petroleum	463.6	Gas 7.84 10^{12} ft ³	= 7,800	
	Transportation	390.5		2317.9		12,200	
	Res.-Comm.	195.3					
		2317.9					
	Total = 2.318 quads		Total = 2.318 quads		Total = 12.2 quads	+9.88 quads	
Mississippi	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	Data supplied by Mississippi Research and Development Center.
			Petroleum	321.4	Nat. Gas	83.98	
			Nat. Gas	292.6	Petroleum	294.52	
			Coal	33.3		378.50	
				647.3			
			Total = 0.65 quads		Total = 0.38 quads	-0.27 quads	
North Carolina	1975	$\times 10^{12}$ Btu	1975	$\times 10^{12}$ Btu	1975	$\times 10^{12}$ Btu	<i>Energy Consumption in North Carolina, 1975-1976</i> , and data supplied by the North Carolina Energy Division.
	Residential	250.4	Coal	389.2	Nuclear	= 114.9	
	Commercial	180.4	Petroleum	686.4	Hydro	= 15.3	
	Industrial	352.9	Nat. Gas	100.6		130.2	
	Transportation	399.3	Nuclear	114.9			
	Other	123.4	Hydro	15.3			
		1306.4		1306.4			
	Total = 1.306 quads		Total = 1.306 quads		Total = 0.130 quads	-1.18 quads	
South Carolina	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	1974	$\times 10^{12}$ Btu	Data supplied by South Carolina Energy Management Office.
	Residential	122.8	Coal	155.0	Hydro	35.5	
	Commercial	102.0	Petroleum	331.6	Nuclear	116.1	
	Industrial	289.2	Nat. Gas	120.2		151.6	
	Transportation	227.6	Hydro-Nuc.	151.6			
	Other	16.8		758.4			
		758.4					
	Total = 0.758 quads		Total = 0.758 quads		Total = 0.152 quads	-0.61 quads	
Tennessee	1970	$\times 10^{12}$ Btu	1970	$\times 10^{12}$ Btu	1970	$\times 10^{12}$ Btu	<i>Energy in Tennessee</i> , p. 6, 14.
	Res.-Comm.	166	Coal	414	Coal	186.11	
	Indus.-Govt.	239	Petroleum	319	Petroleum	1.79	
	Transportation	252	Gas	264	Gas	.07	
	Elec. Gen.	368	Hydro	28	Hydro	27.52	
		1025		1025		215.49	
	Total = 1.025 quads		Total = 1.025 quads		Total = 0.125 quads	-0.81 quads	

Table 3 (continued)

State	Sector	Energy consumption within state		Energy production within state		Net energy balance	Data sources: state publications
		Amount of energy	Type of basic fuel	Amount of energy	Type of basic fuel	Amount of energy	
Texas	1975	x10 ¹² Btu	1975	x10 ¹² Btu	1975	x10 ¹² Btu	<i>Texas Energy Outlook: The Next Quarter Century</i> , pp. viii, ix, xi, xiii, xiv.
	Res.-Comm.	856	Petroleum	2809	Petroleum	= 5157	
	Industrial	3598	Gas	4052	Gas	= 7390	
	Transportation	1536	Coal, Lig.	173	Coal	= 154	
	Elec. loss	1063	Hydro	19	Nuclear	= 240	
		7053		7053	Hydro	= 19	
						12960	
	Total = 7.05 quads		Total = 7.05 quads		Total = 13.0 quads		
						+5.95 quads	
Virginia	1974	x10 ¹² Btu	1974	x10 ¹² Btu	1974	x10 ¹² Btu	<i>Energy and Virginia's Future</i> , pp. II-ii, II-v, II-19, II-41.
	Household	197	Petroleum	782.7	Gas 7x10 ⁹ ft ³	= 7	
	Commercial	88	Gas	154.5	Coal		
	Industrial	173	Coal	186.7	35x10 ⁶ Tons	= 864	
	Transportation	433	Hydro	13.3		871	
	Elec. Gen.	365	Nuclear	71.7			
		1257		1208.9			
	Total = 1.257 quads		Total = 1.209 quads		Total = 0.871 quads		
						-0.34 quads	
West Virginia			1975-1973	x10 ¹² Btu	1975	x10 ¹² Btu	<i>West Virginia Energy Handbook</i> , pp. 4, 72, 89, 31, 76, 90, 118.
			Coal	824	Coal		
			Petroleum	220	109x10 ⁶ Tons	= 2616	
			Nat. Gas	198	Petroleum 2.56x	= 14	
				1242	10 ⁶ Btu		
					Gas 154.5x		
					10 ⁹ ft ³	= 158	
						2788	
			Total = 1.242 quads		Total = 2.788 quads		
						+1.55 quads	

^aData are approximate for the year 1974 only and have been drawn from various available reports published by state and regional agencies.

Fossil fuels account for most of the energy produced in the region. Hydro, nuclear, and all other sources account for less than 5% of the production.

Patterns of consumption of primary fuels vary from state to state. Alabama, Kentucky, Tennessee, and West Virginia are heavy coal users, and each is a large producer of coal. If these states must shift from natural gas and oil to an even greater use of coal, the transition will be relatively easy. Virginia, Texas, Georgia, and Florida are heavy users of petroleum, but all except Texas must import petroleum. As might be expected, Louisiana and Texas are highly dependent upon natural gas.

Some of the states which are heavily dependent upon imported energy are those along the southeastern Atlantic coast. They are not in a favorable position to import coal or oil by river barge. Faced with natural gas curtailment, these states must depend upon railroads, ocean-going ships, or upon pipelines to bring in their primary energy sources.

In summary, the 12 state region consumes approximately 22 quads of primary energy or almost 30% of the U.S. total. It produces approximately 36 quads of energy or about 62% of total U.S. domestic production. The 12 state region, and especially the four states of Kentucky, Louisiana, Texas, and West Virginia, is a major net energy source for the rest of the nation.

2.3 ENERGY: PROVED RESERVES

The preceding section discussed annual energy production and annual energy consumption for the 12 state region. This section of the report provides information regarding "proved reserves" of mineral energies in the states, the region, and the nation, and compares patterns of energy production with patterns of proved reserves of coal, natural gas, and petroleum.

The Bureau of Mines defines "proved reserves" of coal as measured, in place quantities of coal in beds 28" or more thick that occur at depths to 1000 ft. (In contrast, National Coal Association data are based on beds that occur to depths of 3000 ft.) Proved reserves of petroleum and natural gas are "reserves that can be recovered with reasonable certainty from known reservoirs under existing economic and operating conditions."

The 12 state region contains 27% of the total U.S. population and occupies 21% of the U.S. land area, including Alaska, but accounts for over 60% of the total annual domestic energy production and contains one-fifth of the proved reserves of fossil energy.

Table 4 shows the state-by-state distribution of proved reserves of fossil fuels with a comparison to regional and national totals. Most of the data in the table are from Federal, not state, sources, and the coal

Table 4. Twelve-state fossil fuel proved reserves, 10¹⁵ Btu, 1972^a

State	Type of fossil fuel				Total fossil reserves Bureau of Mines total
	Coal		Petroleum	Natural Gas ^b	
	National Coal Association	Bureau of Mines data	Bureau of Mines data	Bureau of Mines data	
Alabama	367	70	0.32	0.37	71
Florida			1.16	0.22	1
Georgia					
Kentucky	1,555	613	0.27	1.17	614
Louisiana			28.20	86.45	115
Mississippi			1.75	1.20	3
N. Carolina	3				
S. Carolina					
Tennessee	62	24			24
Texas	309	79	68.10	110.40	258
Virginia	233	88		0.04	88
W. Virginia	2,414	350	0.19	2.77	953
12-State total (% of reserves)	4,943	1,324 (85%)	100 (4.5%)	203 (9.5%)	2,127 (100%)
U.S. totals (% of reserves)	37,920	10,280 (95%)	204 (2%)	303 (3%)	10,787 (100%)

^aBureau of Mines proved coal reserves include measured in-place coal beds 28 in. or more thick (lignite 60 in. or more) at depths to 1000 ft. National Coal Association reserves include measured beds to depths of 3000 ft.

^bNatural gas category includes "natural gas, dry" plus "natural gas, liquid."

Sources: *Fuel and Energy Data: United States by States and Regions, 1972*, United States Department of the Interior, Bureau of Mines Information Circular, 1974; *Coal Facts: 1974-75*, National Coal Association.

data are presented from two different sources: the Bureau of Mines and the National Coal Association. The two sources differ in a ratio of about 3:1, but NCA includes known reserves of coal to 3000 ft, while the Bureau of Mines limits the beds to 1000 ft.

From Table 4 it is apparent that coal is, by far, the major fossil fuel reserve for both the region and the nation. Kentucky and West Virginia contain 85% of the region's proved coal reserves.

The 12-state region has half the U.S. domestic proved petroleum reserves and two-thirds of the proved natural gas reserves. Louisiana and Texas contain 96% of the petroleum reserves and 97% of the natural gas reserves in the region.

Table 5 shows energy production in the region during 1972. The data are from the Bureau of Mines. Comparison of data in Table 5 (Federal data) with production data obtained from the state reports in Table 3 show very good agreement, if allowances are made for the differing time periods of the reports. Total regional and U.S. energy production figures reported in Table 5 are somewhat higher than the corresponding production figures reported in the preceding section. These differences are caused by the fact that U.S. oil and gas production has been decreasing since 1972, and Table 5 is based on 1972 data. The state data reported in the preceding section are more recent and therefore reflect this lower gas and oil production.

Comparison of the energy-production patterns and energy-reserves patterns reveals a well known but critical problem. Petroleum and natural gas account for only 5% of the nation's proved reserves and 14% of the region's reserves; yet these two fuels account for 72% and 80%, respectively, of the national and regional energy production. At the present rate of production, the nation will soon use up its store of proved reserves of oil and gas. There exists a serious mismatch between fuel reserve pattern and fuel production-use pattern which must be corrected soon (see Fig. 4). However, conversion from oil and gas to another basic energy source, such as coal, entails large changes in modes of energy production, energy transportation, and energy utilization. What coal combustion technologies will be most suitable for the varied needs within the region during the next decade? What will be the likely environmental, economic, and social impacts of this change of fuel base? These are central problems that need to be addressed by the NCUA.

Whether considering annual production or proved reserves, it is obvious that the 12 states are not equally well endowed. The region is energy rich, but the riches are highly concentrated in four states (see Fig. 5).

Unfortunately energy riches do not translate directly into community riches. Maintaining coal-haul roads, reclaiming stripped land, and coping with air and water pollution are problems that accompany the possession and use of large coal resources.

Table 5. Twelve-state energy production, 10¹⁵ Btu, 1972

State	Type of basic energy source					Total, all sources
	Coal	Petroleum	Natural gas	Nuclear	Hydro	
Alabama	0.50	0.06	0.01		0.11	0.68
Florida		0.10	0.02			0.12
Georgia						
Kentucky	2.91	0.06	0.07		0.04	3.08
Louisiana		5.00	8.87			13.87
Mississippi		0.34	0.11			0.45
N. Carolina					0.07	0.07
S. Carolina				0.05	0.03	0.08
Tennessee	0.27				0.12	0.39
Texas	0.10	7.30	10.29		0.01	17.70
Virginia	0.82			0.01	0.01	0.84
W. Virginia	2.97	0.02	0.22		0.01	3.22
12-State Total	7.57	12.88	19.59	0.06	0.40	40.5
(% Production)	(19%)	(32%)	(48%)	-	(1%)	(100%)
U.S. Total	14.47	19.38	25.93	0.58	2.84	63.2
(% Production)	(23%)	(31%)	(41%)	(1%)	(4%)	(100%)

Source: *Fuel and Energy Data: United States by States and Regions, 1972*, United States Department of the Interior, Bureau of Mines Information Circular, 1974.

ENERGY BASELINE FOR THE SOUTHERN REGION

Proved Reserves and Annual Production of Fossil Fuels,
in Quads, for 12 NCUA States, 1972

Fig. 4. Proved reserves and annual production, in quads, for the 12-state region, 1972.

PROVED RESERVES: (PROPORTIONS OF 12-STATE TOTAL)

ANNUAL PRODUCTION: (PROPORTIONS OF 12-STATE TOTAL)

Fig. 5. Distribution of proved reserves and annual production among 12 states, 1972.

In general, many citizens of the states in this region are not economically secure. Exploitation of the region's energy reserves has not resulted in adequate family income or in adequate tax resources to support high-quality public services. These problems have been recognized and highlighted in a report by the Southern Growth Policies Board.*

"In the past, mineral extraction was viewed as such an important part of the economic base that tax policy favored the exploitation of the South's resource by local and absentee firms alike. Now there are many who question whether those who profit should not also pay higher taxes. There is growing support for a higher percent of the revenue from the extraction of energy resources to be retained in the South for public and private benefits within the region. There is also increased insistence that pollution costs and other adverse effects associated with extraction be borne by producers and consumers rather than being passed on to local and state public agencies as external 'clean up' costs that must be borne by local citizens rather than by those who benefit."

The following section of the report attempts to provide a brief description of some economic and demographic variables for the 12-state region.

2.4 HUMAN RESOURCES

The 12-state region is one of the fastest growing sections of the country in recent years and now accounts for 27% of the U.S. resident population. The data in Table 6 compare growth rates for the various states during the period 1970 to 1976.

Texas and Florida together have a population of almost 21 million or 35% of the regional population. At the other extreme, Mississippi and South Carolina have relatively small populations. The rate of population growth (1970-1976) also varies greatly among the states, from 24% for Florida to 4% for West Virginia. Overall, the 12-state region is increasing in population at about twice the rate of the United States as a whole.

Population density for the 12-state region is approximately 80 persons/square mile compared to about 60 persons/square mile for the total United States. Florida has the highest population density and Texas the lowest for the region.

* *Growth Management Policies for the South*, Southern Growth Policies Board, December 1974, p. 29-30.

Table 6. Resident population,^a by state and region, 1970 and 1976

State	Resident population (thousands)		Percent change: 1970-1976
	1970 (census)	1976 (provisional estimate)	
Alabama	3,444	3,665	6.4
Florida	6,789	8,421	24.0
Georgia	4,590	4,970	8.3
Kentucky	3,219	3,428	6.5
Louisiana	3,643	3,841	5.4
Mississippi	2,217	2,354	6.2
N. Carolina	5,082	5,469	7.6
S. Carolina	2,591	2,848	9.9
Tennessee	3,924	4,214	7.4
Texas	11,197	12,487	11.5
Virginia	4,648	5,032	8.3
W. Virginia	1,744	1,821	4.4
Region	53,088	58,550	10.3
U.S.	203,235	214,659	5.6

^aResident population includes armed forces.

Source: Bureau of Census, Series P-25, No. 646.

Rapid growth in a region which already has greater than average population density suggests a need for growth policies. State agencies and regional agencies in the South, especially in states such as Florida which are already impacted, are studying growth management policies rather carefully. The effects of coal extraction and coal use will be considered in these policies.

The growth rate of the South has been affected by a dramatic reversal in net migration during the past decade (see Fig. 6). From 1900 to 1960, the South experienced a net out-migration for both blacks and whites, but since 1960, whites have migrated to the South in large numbers. Blacks continued to migrate away from the region during the decade of the 1960s; however, recent statistics indicate a net in-migration for blacks to the South during the 1970s.

Not only is the population increasing but the South is also becoming an urban society (see Table 7). In 1970 almost two-thirds of the people in the 12-state region lived in communities of 2500 or more inhabitants as compared to three-fourths urban population for the total United States. There is a great deal of variability among the individual states, ranging from 39% urban for West Virginia to 80% for Texas and Florida.

Table 7 indicates that there is no significant difference in male:female ratios among the states, but there is a great variation in the racial compositions. In general, the region has almost twice the proportion of nonwhites as compared to the U.S. total, but West Virginia and Kentucky have 4-7% nonwhites as compared to 37% nonwhite in Mississippi.

The distribution of population by age group in the region is almost identical to that for the nation as a whole — 30% between 0 and 18 years old; 40% between 18 and 44; 20% between 45 and 64; and 10% over 65. The only exception to this pattern occurs in Florida which has a disproportionate (16%) "over-65" population.

Over one-third of adult Southerners drop out of school before ninth grade. This is greater than the national average and probably indicates basic literacy problems for this large segment of the population. As the region becomes more industrialized and urbanized, these persons might expect to find it increasingly difficult to find employment or to profit from technical training opportunities (see Table 8).

Per capita income is a very rough index of economic well-being of a state or region. Table 9 statistics show that income increased somewhat more rapidly in the South than in the rest of the country over the past five years, but Southern income still lagged far behind the national average. Percentage changes (1970-1975) did not show much variation among the 12 states, ranging only from 51% for Florida to 60% for West Virginia. The actual per capita incomes did show considerable variation

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Fig. 6. Net migration from the South census (15 Southern Growth Policies Board states plus Delaware and D.C.), 1900-1970.

Source: *Southern Growth Policies Board, The Future of the South: 1974.*

Table 7. Population characteristics, by state, 1970

State	Percent urban ^a	Percent male	Percent nonwhite
Alabama	58.4	48.3	26.4
Florida	80.5	48.3	15.8
Georgia	60.3	48.6	26.1
Kentucky	52.3	49.1	7.4
Louisiana	66.1	48.6	30.2
Mississippi	44.5	48.4	37.2
N. Carolina	45.0	48.9	23.2
S. Carolina	47.6	49.1	30.7
Tennessee	58.8	48.4	16.1
Texas	79.7	48.9	13.2
Virginia	63.1	49.4	19.1
W. Virginia	39.0	48.5	4.1
Region	63.4	48.7	20.8
U.S.	73.5	48.9	12.5

^a Places with 2500 inhabitants or more.

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States: 1971*.

Table 3. Years of education, by state, 1970,
for persons 25 and older

State	Percent of population, by years of education				
	0-8 (grade sch.)	9-12 (high sch.)	13-15 (jr. coll.)	16 (sr. college)	17+ (grad. sch.)
Alabama	36.8	47.8	7.5	5.1	2.7
Florida	27.8	50.4	11.6	6.3	4.0
Georgia	36.2	45.6	9.0	6.1	3.1
Kentucky	44.8	40.7	7.2	4.3	3.0
Louisiana	38.6	43.9	8.5	5.5	3.6
Mississippi	38.7	44.3	9.0	5.4	2.7
N. Carolina	37.1	46.0	8.4	5.5	2.9
S. Carolina	38.0	44.7	8.3	6.2	2.7
Tennessee	40.0	43.9	8.2	4.9	3.0
Texas	30.2	47.5	11.4	6.4	4.5
Virginia	32.2	45.2	10.3	7.2	5.1
W. Virginia	40.8	45.1	7.3	4.0	2.8
Region	34.9	46.2	9.5	5.3	3.6
U.S.	28.3	50.5	10.6	6.1	4.6

Source: Computed from U.S. Bureau of Census, *1970 General Social and Economic Characteristics*, vol. PC(1)-C1, tables 156, 157.

Table 9. Per capita income, 1970 and 1975, and poverty rate,^a
by state, region, and United States

State	Per capita income		% change 1970-75	Poverty rate, ^a 1970, % of population
	1970	1975		
Alabama	2947	4643	58	25.4
Florida	3741	5638	51	16.4
Georgia	3357	5086	52	20.7
Kentucky	3118	4871	56	22.9
Louisiana	3097	4904	58	26.3
Mississippi	2630	4052	54	35.4
N. Carolina	3256	4952	52	20.3
S. Carolina	2992	4618	54	23.9
Tennessee	3124	4895	57	21.8
Texas	3600	5631	56	18.8
Virginia	3720	5785	56	15.5
W. Virginia	3070	4918	60	22.2
Region	3221	4999	55	22.5
United States	3966	5902	49	13.7

^aNonfarm family of four, \$3745; female individual, \$1751; farm family of four, \$3197.

Sources: U.S. Bureau of Census, *1970 General Social and Economic Characteristics*, PC(1)-C1, table 182; *Statistical Abstract of the United States*.

between \$4,052 for Mississippi and \$5,785 for Virginia. All 12 states fell appreciably below the national average of \$5,902.

In view of the low income, it is not surprising to find that almost one-fourth of all Southerners find themselves below the Federal definition of poverty as compared to about one in seven for the nation. The data in Table 9 show large state variations.

Unemployment statistics show the South differing very little from the national averages - about 5% unemployed in 1970 and 8.5% in 1975.

The major sources of personal income in the South are listed in Table 10. It is interesting to note that the three fastest growing sectors involve the extraction and processing of the three fossil fuels.

Manufacturing in the South is very energy intensive. It has been estimated that Southern manufacturing requires 55,000 Btus per dollar of value added to the product. This compares to about 27,000 Btus for manufacturing in the rest of the United States.

In summary, the South is somewhat a paradox. It has recently become a region of high population growth and in-migration, and yet it is also a region with low per capita income, high poverty level, and high rates of school drop-out. Obviously the region has attractions which are not simply economic. Some have suggested that mild climate, abundant and varied recreational facilities, and the beauty of mountains, seashore, and rural landscapes compensate for the other factors. If, indeed, these environmental elements are important to the population, then the development of the energy industries should be planned so as to minimize negative impacts upon this environment.

The factors considered in this section of the report - population concentration and economic activity - are primary drives to regional energy demand. Apparently the South can expect much more than average population increases during the next decade, and this will be coupled with industrial expansion of energy-intensive industries. As a result, the region will continue to be both a major producer and consumer of energy in the near future. The NCUA research teams will investigate the probable impacts of likely coal technologies upon these population shifts and upon the economic activities of the region. They will then be able to consider the environmental impacts of these activities.

2.5 CHARACTERIZATION OF SOUTHERN ECOREGIONS

2.5.1 Introduction

The 12-state southern region spans the range from the topographically dissected Appalachian Mountains to the sandy flats and marshes of Florida and from the rich forests of the Smoky Mountains to the shrubby semi-desert, steppe grasslands of western Texas. The area is one of great

Table 10. Sources of personal income in the south, 1969-1975,
arranged by rate of growth (millions of dollars)

Sector	1969	1975	% change 1969-75
Coal mining	791	2,492	215
Oil and gas extraction	1,913	4,242	122
Petroleum and coal proc.	792	1,605	103
Services	19,873	39,138	97
State and local	14,642	28,736	96
Machinery	2,340	4,531	94
Fabricated metal	2,063	3,468	92
Finance, insurance, real estate	6,769	12,928	91
Miscellaneous manufacturing	3,052	5,716	87
Motor vehicles	805	1,485	85
Wholesale and retail trade	25,479	45,481	79
Transportation, communication	10,597	18,914	79
Nonmetallic mining, excl. fuel	319	569	78
Contract construction	10,157	17,162	69
Federal, civilian	8,622	14,451	68
All other			

Source: Survey of Current Business (April, 1974, August, 1976).

ecological variety, generally high but varied productivity, and abundant resources. It is a rapidly growing area in terms of population and industry, owing primarily to its favorable climate, abundance of available labor, and abundance of resources. It is a region of increasing energy consumption in which the mounting pace of industrialization and other development places ever greater pressure on the finite natural resource base.

Generally, the ecosystems of the southern region are probably quite resilient in comparison to those of more climatically rigorous areas such as the southwestern deserts or the arctic tundra. Because of their intrinsic biotic richness the natural communities of the South can withstand substantial human pressure. Yet, the massive forces at work, for example in surface mining of the steep Appalachian slopes, exceed the capacity to recover, even for this resilient biota. In other parts of the region (e.g., much of Texas) moisture is limiting and the ecosystems are subject to many stresses besides those related directly to mining and coal use. Precipitation in Oklahoma and Texas counties averages near 34 in. and 29 in. (or 84 and 74 cm) respectively (NOAA 1974; Balwin 1973). A positive moisture index in the remaining southeastern states is related to precipitation of 40 to 56 in. (1 to 1.4 m). Figure 7A summarizes the frequency distribution of counties for different combinations of temperature and precipitation and mean annual temperature (from county file of Webb 1976). The scattered lower points reiterate the lower mean precipitation just mentioned for Texas and Oklahoma counties, which are mostly dominated by mid-continental climate. Western Texas counties and the remaining states eastward are more influenced by precipitation from the Gulf of Mexico (slightly higher on average for warmer states than for the cooler ones).

In contrast with the considerable scatter on Fig. 7A, we find the frequency distribution by annual temperature and Thornthwaite's Annual Evapotranspiration Index (Thornthwaite 1948) in Fig. 7B shows remarkably strong regularity from the coolest states (West Virginia and Maryland at lower left) to Texas and Florida (upper right). For any given mean annual temperature, the more maritime counties have less annual range of monthly temperatures and slightly less evaporation because of summer temperatures (and because of higher humidity as well). It follows from the close mathematical and physical relation between evaporation and temperature that a 5°C (9°F) difference in temperature is equivalent to approximately 7 point difference in Thornthwaite's index of evapotranspiration in the cooler states, and up to 9 points difference in the hottest states. This relation shown in the present climate of the South is important for the assessment of coal (and fossil fuels in general) because our forthcoming assessment will show substantial reasons for projecting a warming trend of climate in the next century, overriding the relatively minor fluctuations of cooling noted in our region in early 1977 and some other years since 1940. The risks of enhanced drought, and related matters of agriculture and soil blowing, would probably follow right along with any such warming, unless the enhanced evapotranspiration were accompanied by a substantial increase in precipitation.

Fig. 7A. Relation of mean annual temperature for counties from Texas to Maryland to mean annual precipitation. Degree of shading indicates incidence of counties, with darkest shading reflecting the greatest number of counties.

Fig. 7B. Relation of mean annual temperature for counties from Texas to Maryland to the Thornthwaite Index of potential evapotranspiration. Degree of shading indicates incidence of counties, with darkest shading reflecting the greatest number of counties.

Hottest summer temperatures, greatest yearly temperature contrast, and greatest uncertainty in the rain which does fall occur in the Dry Domain in the western Texas and Oklahoma counties where desert or steppe ecosystem patterns occur. Eastern Deciduous Forest covers the combinations of July and January monthly temperatures cooler than other ecoregions of the South. Between the Deciduous Forest and Outer Coastal Plain Forest is the area of intermediate summer and winter temperatures where the Southeastern Mixed Forest occurs.

2.5.2 Ecological characterization

Bailey's (1976) map on the "Ecoregions of the United States" (Fig. 8A,B) provides one useful framework for organizing facts and judgments about terrain, ecosystems, and some of the more striking ways in which ecological impacts might differ from place to place. This map, published recently by the Forest Service for the Fish and Wildlife Service, provides a broad preliminary stratification of most Provinces into sections of more or less homogeneous ecological character and potential.

The Everglades Province (4110) comprises the southernmost portion of the Florida peninsula. Bedrock geology of this area, like that of most of the remainder of Florida, consists of relatively recent flat lying deposits of upper Tertiary and Quaternary age. The area is very flat, and, as the name implies, most is covered by swamp vegetation. Soils of the province are primarily inceptisols, entisols, and histosols - all relatively poorly drained soils often highly organic, with sandy or gley to humic-gley finer textured parent materials predominating on the Gulf of Mexico coast side of the peninsula.

Climatically and biologically this province is part of the "Savannah Division" of Bailey's Humic Tropical Domain. The region is dry in winter but wet (sometimes flooded over vast areas) when torrential summer rains occur. Sawgrass and other marshy communities evolved good adaptations to such a fluctuating environment. Very slight rises in terrain provide the extra drainage required for slash pine stands (especially on sand in the East) and small, scientifically important "hammock" (i.e., hummock) stands of broadleaved tropical or subtropical trees and associated wildlife.

Vegetation is mostly Everglades swamp, with mangrove along the gulf coast, some cypress savanna, some southern Coastal Plain forest species, palmetto prairie, and, along the Atlantic coast north of Miami, sand pine scrub.

Wildlife species abound in the Everglades. Both the flora and fauna of this area contain many threatened and rare species, and conservation is a major requirement. Land development has taken place primarily along the eastern south-Florida coast where the entire coastline is either "strip development" or urban-suburban development. Both Dade and Broward Counties average over 250 persons per square mile despite the fact that the majority of the land area of these counties is in forest

EXPLANATION

DOMAIN	DIVISION	LOWLAND ECOREGIONS		HIGHLAND ECOREGIONS*		
		PROVINCE	SECTION	PROVINCE	SECTION	
1000 POLAR	1200 TUNDRA	1210 ARCTIC TUNDRA		M1210 BROOKS RANGE		
		1220 BERING TUNDRA				
	1300 SUBARCTIC	1310 YUKON PARKLAND		M1310 ALASKA RANGE		
		1320 YUKON FOREST				
2000 HUMID TEMPERATE	2100 CONTINENTAL COOL - SUMMER	2110 LAURENTIAN MIXED FOREST	2111 SPRUCE-FIR FOREST 2112 NORTHERN HARDWOODS FIR FOREST 2113 NORTHERN HARDWOODS FOREST 2114 NORTHERN HARDWOODS SPRUCE FOREST	M2110 COLUMBIA FOREST (DRY SUMMER)	M2111 DOUGLAS FIR FOREST M2112 CEDAR-HEMLOCK-DOUGLAS FIR FOREST	
	2200 CONTINENTAL WARM - SUMMER	2210 EASTERN DECIDUOUS FOREST	2211 MIXED MESOPHYTIC 2212 BEECH-MAPLE FOREST 2213 MAPLE-BASSWOOD FOREST + OAK SAVANNA 2214 APPALACHIAN OAK FOREST 2215 OAK-HICKORY FOREST			
	2300 HOT - SUMMER	2310 OUTER COASTAL PLAIN FOREST 2320 SOUTHEASTERN MIXED FOREST	2311 BEECH-SWEETGUM-MAGNOLIA-PINE OAK FOREST 2312 SOUTHERN FLOOD-PLAIN FOREST			
	2400 MARITIME	2410 WILLAMETTE-PUGET FOREST		M2410 PACIFIC FOREST	M2411 SITKA SPRUCE-CEDAR-HEMLOCK FOREST M2412 REDWOOD FOREST M2413 CEDAR-HEMLOCK DOUGLAS FIR FOREST M2414 CALIFORNIA MIXED EVERGREEN FOREST M2415 SILVER FIR-DOUGLAS FIR FOREST	
	2500 PRAIRIE	2510 PRAIRIE PARKLAND	2511 OAK-HICKORY-BLUESTEM PARKLAND 2512 OAK + BLUESTEM PARKLAND			
		2520 PRAIRIE BRUSHLAND	2521 MESQUITE-BUFFALO GRASS 2522 JUNIPER - OAK - MESQUITE 2523 MESQUITE - ACACIA			
		2530 TALL GRASS PRAIRIE	2531 BLUESTEM PRAIRIE 2532 WHEATGRASS - BLUESTEM NEEDLEGRASS 2533 BLUESTEM - GRAMA PRAIRIE			
	2600 MEDITERRANEAN (DRY - SUMMER SUBTROPICAL)	2610 CALIFORNIA GRASSLAND		M2610 SIERRAN FOREST M2620 CALIFORNIA CHAPARRAL		
	3000 DRY	3100 STEPPE	3110 GREAT PLAINS SHORT-GRASS PRAIRIE	3111 GRAMA - NEEDLEGRASS-WHEATGRASS 3112 WHEATGRASS - NEEDLEGRASS 3113 GRAMA - BUFFALO GRASS	M3110 ROCKY MOUNTAIN FOREST	M3111 GRAND FIR DOUGLAS-FIR FOREST M3112 DOUGLAS-FIR FOREST M3113 PONDEROSA PINE - DOUGLAS-FIR FOREST
			3120 PALOUSE GRASSLAND		M3120 UPPER GILA MOUNTAINS FOREST	
3130 INTERMOUNTAIN SAGEBRUSH			3131 SAGEBRUSH - WHEATGRASS 3132 LAHONTAN SALTBU-SH - GREASEWOOD 3133 GREAT BASIN SAGEBRUSH 3134 BONNEVILLE SALTBU-SH - GREASEWOOD 3135 PONDEROSA SHRUB FOREST	P3130 COLORADO PLATEAU	P3131 JUNIPER PINYON WOODLAND + SAGEBRUSH SALTBU-SH MOSAIC P3132 GRAMA-GALLETA STEPPE + JUNIPER - PINYON WOODLAND MOSAIC	
3140 MEXICAN HIGHLANDS SHRUB STEPPE				A3140 WYOMING BASIN	A3141 WHEATGRASS - NEEDLEGRASS-SAGEBRUSH A3142 SAGEBRUSH - WHEATGRASS	
3200 DESERT		3210 CHIHUAHUA DESERT	3211 GRAMA - TOBOSA 3212 TARBU-SH - CREOSOTE BUSH			
		3220 AMERICAN DESERT (MOJAVE-COLORADO-SONORAN)	3221 CREOSOTE BUSH 3222 CREOSOTE BUSH - BUR SAGE			
4000 HUMID TROPICAL		4100 SAVANNA	4110 EVERGLADES			
	4200 RAINFOREST		M4210 HAWAIIAN ISLANDS			

*Key to letter symbols: M - mountains, P - plateau, A - altiplano

Fig. 8B. Table shows sections within provinces of the Humid Temperate, Dry and Humid Tropical domains represented in the Southern states.

or swampland. Various types of land development have been proposed and promoted for the area. Despite the fragility of the swamp ecosystem, drainage, canal building, land filling, and other types of development are a constant consideration in the area. Truck farming (e.g., tomato farming) and other specialized uses compete for land.

The southernmost tip of the Everglades is protected by the Everglades National Park. National concern for this unique heritage has been sufficiently strong to override plans for interrupting the natural water drainage that occurs southward over much of the peninsula from Lake Okeechobee.

Most of western Texas includes the eastern extreme of Chihuahuan Desert (tarbush, creosotebush). Southern (Grama-Buffer Grass) Great Plains Shortgrass Prairie or Steppe in the Dry Domain of North America occupies most of northwestern Texas. Both areas are important rangeland, already devastated periodically, roughly at 22-year intervals, by notorious dustbowl droughts. Recently heavy capital investments and high energy costs for irrigating parts of this area have endeavored to replace sporadic dryland farming by irrigated agriculture.

Bordering the Dry Domain in central Texas is the Prairie or mesquite-oak Brushland. Important admixtures are buffalo grass in the north, juniper and oak on the Edwards Plateau of central Texas, and acacia in southern Texas. All of these in turn grade into the original forest via Prairie Parkland. These large areas are still important for rangeland and agricultural uses: taller grasses are mixed with groves of post oak or live oak. The Parkland in particular is most likely to be affected by expanded excavation of lignites from the Coastal Plain sediments - relatively hydrated precursors of coal, of younger geologic age than eastern true coals. A special study of the lignite region and its impacts is needed as part of a balanced coal assessment. Because it is relatively uneconomical to transport bulky lignite considerable distances, the very areas subject to most impact from excavating this fuel will also be subject to the effluents from its burning or from its eventual conversion to fluid fuels.

From eastern Texas through southeastern New Jersey is a belt of landscapes which include extensive "southern pine" forests. Numerous deciduous species typical of this region are limited to regions of long growing seasons and relatively mild winter temperatures. The whole area is included in the Eastern Deciduous Forest Biome, in its broadest sense (Braun, 1950), along with the regions immediately to the north where deciduous species are more predominant (2210).

Fires, abandonment of cropland and pasture, or certain other kinds of disturbance favor new seedlings of pine. As young stands mature, many of the areas of pure pine or of pine-deciduous mixtures show

tendencies for replacement by dominantly (or purely) broadleaved trees in later generations. On the other hand, disturbance has been a part of the natural system (e.g., hurricanes, lightning fires); Indians were active in burning for hunting and (local) corn-growing activities; and the waves of crop expansion and abandonment (following soil erosion, pest problems, etc.) kept repeating opportunities for the pines and certain other pioneer successional species to gain and retain the prevalence which even the layman associates with typical "southern" landscapes of the region.

The Outer Coastal Plain Forest illustrates the contrast with the rest of the eastern USA most boldly, in both of its sections.

The Beech-Sweetgum-Magnolia-Pine-Oak or Southern Mixed Forest (2311) section occupies a comparatively narrow belt with long growing seasons. Frosts are sufficiently frequent that the term "subtropical" may not be appropriate except in parts of Florida. In a narrow belt along the coast the evergreen live oak adds to the distinctive appearance of the wild and cultivated vegetation. Laurel oak and the semievergreen water oak extend to or beyond the inland limits of the section, especially the moist lowlands. Spanish moss adds to the traditional image of this region.

Other forests consist of beech, sweetgum, magnolia in mixtures with pine and/or oak. Large commercial forests of the area are primarily pine - termed locally "piney woods." Because so much of the section is low, or of poor local drainage, slash pine and other species tolerant of poor aeration are widespread. Longleaf pine ranges from moist to dry sandhill areas, where fire history has favored its regeneration. Sand pine has more localized indicator value: e.g., on dunes of former shorelines. In many areas hardwood species are considered more a nuisance to be overcome through forest management practices (for pine) than an asset. In bottomlands hardwood production is excellent. Wildlife management is an important consideration throughout the area.

Mostly flat topography is underlain by Tertiary and Quaternary sedimentary formations. Soils are highly varied, ranging from deep well-formed ultisols to a variety of spodosols and histosols in Florida. These soils are generally not very fertile, but properly treated (fertilized, drained, and sometimes irrigated) they are capable of high rates of production. Climate is highly favorable throughout this area and a variety of specialty crops is grown.

The Southern Floodplain Forest (2312) section of the Outer Coastal Plain is mappable through the Mississippi embayment of the Coastal Plain, i.e., from the Louisiana Delta to lowlands around Cairo, Illinois. Geologically this area is underlain by recent sedimentary rocks of Quaternary or late Tertiary age. Bedrock geology resembles that of the southeastern Coastal Plain. At the peak of each glacial age, sealevel lowered and previous floodplain sediments were trenched; interglacial and post-glacial times saw the filling of each previous trench with new alluvial and delta deposits. Dust blown from drying floodplains accumulated as loess for deep, fine soils on uplands east of the Mississippi.

Throughout this area soils are mostly of recent origin and tend to be highly organic. For several centuries, this area has received the deposition of much of the fine textured silts and clays, as well as organic matter from the upper Midwest. Consequently, soils are generally fertile and productive.

The native vegetation of southern floodplain forest consists mainly of lowland oaks, cypress, and gums. These are species-rich forests of high productivity. Although some of the area is covered by swampland, during the past two decades much of the land has been cleared and drained for cotton, soybeans, sugar cane, and feed grain production. Essentially similar ecosystems occur in narrower valleys throughout the areas mapped 2311 and much of 2320.

Not only swamp hardwood species of great economic value but bald cypress, spanish moss, and a rich variety of animal life make these lowland forests famous as national assets. Wildlife reservations and many economically important areas, which are not formally designated for these purposes or legally protected in other ways, are of importance on a continental scale - i.e., as refuges for game birds and for an abundance of nongame wildlife which holds active interest for much of the non-hunting population.

Southeastern Mixed Forest (2320) is a broad province, not yet divided into sections by Bailey (1976). A transitional or mosaic pattern combines some of the features noted above with others more typical of the central core of deciduous forest. This is the classical oak-hickory-pine forest region of the Southeast and midsouth.

This region includes the southeastern Piedmont, southernmost Appalachian ridge and valley (around Birmingham) and plateau, as well as the Ouachita Mountains and their borderlands. Geologically it includes younger Precambrian, Paleozoic and softer Mesozoic rocks inland. Coals of Triassic age are of minor importance in parts of the Piedmont Province, but Pennsylvanian bituminous coals are very important in Alabama's Warrior Basin and in small areas of the Arkansas Ouachita Mountains. The predominantly hard-rock areas hold up the higher elevations while softer Cretaceous, Tertiary, and Quaternary sediments are associated with rolling relief on the inner Coastal Plain.

Soils are mostly ultisols (red and yellow lateritics) of relatively low intrinsic fertility. Surface landform ranges from high hills (bordering on low mountains) along the inland border of the province to flat plains nearer the coast. Generally, topography is not limiting to commercial development in this region.

The vegetation of the unit is typically a mixture of oak, hickory, and pine. Along the northern border hardwood forests are more common, and toward the coast pine predominates. Loblolly and shortleaf pines are the major commercial species but longleaf and slash pines are also abundant locally. Loblolly pine and some of the other pines are potentially important as producers of oleoresins and other organic

feedstocks to supplement petroleum or coal sources. These and other considerations, related directly or indirectly to energy policy, support foresters' strong arguments urging active protection and, if possible, expansion of the loblolly pine ecosystem for its future value.

In the East during the 18th and early 19th century the area was extensively logged off and much of it was developed into plantation agriculture (cotton, tobacco). Exploitive agricultural practices led to soil erosion. Extensive young pine forests started early in the 20th century. Evidence suggests that loblolly pines will diminish, or possibly disappear in many present stands, in the course of normal ecological succession - unless fairly expensive, energy intensive (or labor intensive) procedures are used systematically to suppress the up and coming hardwoods and favor the declining pine.

In the main, originally forested part of the southeastern states, deciduous trees of very many species dominate the potential vegetation types having most capability for self-perpetuation under climatic conditions of the recent centuries and millenia. The climatic divisions which Bailey labelled "hot continental" and "subtropical" refer to summer conditions, not to year long average climate. "Warm temperate" is the terminology which seems more familiar and appropriate in ecological literature and common American usage.

Contrary to a theory advocated by Braun (1950), evidence from pollen and other fossils in occasional deposits such as peat now suggest that such widespread deciduous species were preceded by northeastern conifers and by broadleaved species with present distribution in northeastern North America only 11 to 22 thousand years ago when continental glaciers advanced almost to the Ohio River.

The Mixed Mesophytic Forest section (2211) of the Eastern Deciduous Forest was formerly interpreted as one area in the Cumberland Mountains and Cumberland Plateau where numerous trees persisted in place despite the climatic changes that must have accompanied the glaciations. Presently, new evidence for species migrations suggests that the famous floristic richness of this area (and of the higher Appalachians further east) instead reflects the highland's diversity of habitats, and their location as a crossroads for species invading from the Southeast and the Southwest within the last 10,000 years.

The Cumberland (and, northward, Allegheny) areas which almost served for Braun's definition of borders of "Mixed mesophytic" forest happen to be the locations of most of the Appalachian coals - mostly in gently dipping beds, layered between thick (locally pyritic) shales and more or less massive sandstones which hold up the bold cliffs and other topographic features of these regions. Scenic resources have already been degraded over much of the Mixed Mesophytic forest by surface mining of coal. The area is characterized by soils having weakly differentiated horizons showing alternation of parent materials. Generally these are only poor to fair agricultural soils. Forests are rich in species,

including maples, buckeye, beech, tulip tree, oaks, hickories, and basswood. Prior to the chestnut blight, chestnut was important throughout the area. From a point of view of commercial timber this area produces far below its potential. The forests have, for the most part, been repeatedly and severely highgraded leaving genetically and commercially inferior trees over much of the area. Likewise, wildlife production is far below potential due to poaching and relatively little management.

The term "mesophytic" refers to the communities and species of plants thriving where moisture supplies tend to remain moderate - mostly well drained by slopes and porous subsoils, but with unsaturated moisture flow from uphill tending to replenish losses by evaporation except in summers of severe drought. Actually the lower slopes and hollows and cooler north-facing slopes which were typified by mesophytic communities occupy less area than the drier hillsides and various intermediate quality sites where oak, hickory, maples, and many species of wide distribution are commonly seen.

The Appalachian Oak Forest section (2214) lies east of the Mixed Mesophytic section. Geologically the southeastern Blue Ridge physical Division (often called "Older Appalachian" belt) consists chiefly of Precambrian metamorphic and igneous rocks at higher elevations interspersed with younger Precambrian and Paleozoic rocks. Along the northwest belt or Valley and Ridge division of the section, Paleozoic (Cambrian to Mississippian) rocks occur. Throughout the whole area sedimentary rock beds are often faulted, folded, or dipping, due to late Paleozoic mountain-building (orogenic) activity in the area.

The older Appalachian range, containing the Blue Ridge and the Smoky Mountains, displays local topographic relief up to approximately 1000 meters, with elevations reaching nearly 2000 meters. This is an area of vast scenic beauty with long vistas, beautifully sculpted valleys, clear mountain streams, waterfalls, and rich upland forests.

On the higher elevations, forests of spruce and fir occur. These grade with decreasing elevation into hemlock-hardwood forests and then into tulip poplar, oak-hickory, mixed and pine forests. Finally, at lower elevations forests of tulip poplar, sycamore (on floodplains), and many additional deciduous species predominate.

The soils of the area are generally shallow, rocky, and poor for agriculture. Rapid erosions of hill slope farms led to reduction in fertility and eventually to abandonment of the land or shift to small pastures. Second growth (pine) forest became established over much of the area (including much white pine, especially on the Blue Ridge above 800 meters altitude). Only within the past two decades has forest recovered from exploitive logging near the turn of the century. Peak levels of productivity may require closer management. Extensive national forests offer prospects of a leading forest products area in addition to intensive and wilderness recreation use. Fish and wildlife are abundant and commercially important throughout the area.

Notable exceptions to the rugged mountainous terrain of the Blue Ridge Division are found in the "Valley and Ridge" physical division province laying along the section's northwestern belt. This area, from the valleys of the Clinch, Powell, Holston, and Tennessee rivers to Virginia's Shenandoah River, is characterized by thrust-fault-originated topography consisting of a series of "washboard" like alternating ridges and valleys. The limestone valleys tend to be fertile and those underlain by shale are used mostly for pasture and small fields (gardens).

The red spruce on the highest peaks of the Great Smoky and Blue Ridge crest reminds the public of times when vegetation now typical of Canada's maritime provinces once spread down to the lower slopes of the whole Appalachian chain. Some of the highest pinnacles also have relics of Fraser Fir, an endemic tree species which long ago became genetically isolated from the more commonplace balsam fir which spans the North American continents further north.

Tourism is important in many parts of Appalachia, but especially so in this section because of the climate and the landscapes which it has helped to produce.

Oak-Hickory Forest (2215) as mapped covers a wide area of Interior Uplands west of the Cumberland Plateau. Oak and hickory forest systems are typical of this area, especially on many of the drier sites. On the moister slopes and valley soils particularly, mesophytic communities are so important that Braun (1950) used the term "Western Mesophytic" for the section east of the Mississippi.

Eastward outliers of prairie or prairie savanna were recognized by early settlers in the term "Barrens" for the county south of Mammoth Cave and adjacent areas which had predominantly underground drainage (karst or sinkhole topography), hence little surface water and easy spread of fires from either natural or Indian causes. In the Nashville Basin and other parts of Tennessee, "glades" and other outliers of former prairie similarly are also related to shallow soils over limestone. In these and limited other areas red cedar or juniper glades occur on calcareous bedrock outcrops. These often contain rare plant species. Commercially valuable hardwood timber is produced throughout the area. In the Cumberland River valley and other tributary valleys of the Mississippi bottomland forests of gum, sycamore, silver maple, elm, and ash are highly productive. Wildlife is important in the area.

The whole area consists of predominantly Paleozoic and (bordering the Mississippi embayment) Cretaceous and Tertiary sedimentary rocks. In the basins older sediments may be found. Soils are residual and generally only moderately fertile. Most are ultisols, gently to moderately sloping. The area supports a borderline agricultural economy. Some portions (in western Kentucky) are underlain by bituminous coal-bearing strata amenable to surface mining, as well as by oil and gas. Land reclamation following mining on such gently sloping topography is much more economical than on the steep slopes further east. The western

Kentucky coal region is geologically and topographically akin to its counterparts in southern Illinois.

2.5.3 Enumeration of environmental concerns

2.5.3.1 Appalachian highlands and interior low plateau

The Appalachian Plateaus provide one of the major resources of the region in the form of coal. This mountainous area which extends through portions of West Virginia, Virginia, Kentucky, Tennessee, and northern Alabama includes the presently richest coal producing land in the nation. Environmental concerns within these states focus for the most part on problems associated with the strip mining of coal. Impacts of strip mining on land, subsequent impacts of strip mining on water quality, and the special need for properly designed and maintained roads to transport coal are of critical importance. Increasing demands upon the region's coal resources are sure to place additional stress upon the fragile environments found in these areas. The Appalachian Regional Commission has tried to encourage Federal, state, and local governments to work together with private groups to formulate a development plan which will provide for the economic and social growth of the area while maintaining a delicate environmental balance. The mixed-mesophytic forested area, which comprises this part of the Appalachians, provide some of the most environmentally and recreationally rich areas of the region (2211).

The Appalachian oak forests (2214) of the Valley and Ridge and Blue Ridge Divisions lie east of the Appalachian plateaus. This area, along with the mixed-forested area lying just south (2320), comprises one of the most rapidly expanding commercial areas of the South. Nearly continuous urban corridors are developing along the eastern Piedmont between Baltimore, Maryland, and Richmond, Virginia, and southwest from Raleigh and Charlotte, North Carolina to Atlanta, Georgia. Similar urban development has sprung up along the Interior Low Plateau from Louisville and Lexington on into northern Alabama. The Valley and Ridge region from Birmingham extending northeast to Roanoke is another urban corridor developing with more topographic interruptions in this heart of the Appalachian area. The last would seem to be particularly favored by proximity to coal.

Industry is a larger component of this area's economy than any other province in the region. Portions of Virginia, North Carolina, South Carolina and Georgia as well as parts of Kentucky, Tennessee, and Alabama are connected by urban-suburban corridors. Questions of air quality, water quality, and in certain cases, water quantity, pose major problems in each industrialized region. Invariably development within this region is not governed by any organized land use plan. Although the location of new utilities is overseen by state groups, the groups which shape other development within the region are mostly concerned with development districts of relatively few neighboring counties.

2.5.3.2 Coastal and interior plains

The outer Coastal Plain forest (2311, 2312) and the Prairie Parkland (2510) and Brushland (2520) presently occupy an area which is typically referred to as the Coastal Plain, Central Lowland and Great Plains. Major urban growth in the South has bypassed large parts of this region, but major exceptions occur on the Gulf Coast of Florida and East Texas. This area was once the predominant agricultural region of the South. Portions of Florida, southern Georgia, southern Alabama, southern Mississippi, southern Louisiana and Texas comprise this region. Water availability is a major constraint in Texas, southern Florida, and sometimes in states like Mississippi which have high rainfall on average. Water does not constitute a constraint in Louisiana, but other states have most counties lacking the reliable supplies which would seem essential for large coal combustion and conversion facilities. Other major questions concern regulations on air and water quality and the ability of industry to meet EPA guidelines. In certain parts of the region transportation is a constraint to coal development while in other parts surface mining regulations are said to limit the degree to which existing coal resources can be developed. A major challenge is to ensure that social and economic growth is carried out in an optimum fashion with minimum detrimental impact on the environment.

The coastal zone is shared by 9 of the 12 states in this study. This zone has long been identified by regional planners as one of the critical areas for future growth in the South. Ultimately it is also one of the most fragile of the environments in the South. Already the environments of south Florida (Everglades: 4110) and some parts of the Gulf Coast have been stressed severely as a result of large uncontrolled growth. Future demands will be versed in terms of superports as well as oil exploration and production. Each of these offshore activities will place demands on this coastal area. These activities will then give way to expanding barge transportation and docking for coal. The bulky nature of coal with normal storage in open piles, subject to rain and runoff, suggests that many coastal land and water areas of premium value for private and public use will be threatened physically or subjected to extreme competition among incompatible uses.

3. CONSTRAINTS TO INCREASED COAL UTILIZATION: THE VIEW FROM THE STATES

One objective of the NCUA was to include in the assessment, where feasible, problems associated with increased coal utilization as viewed by state officials. To this end, members of the ORNL staff visited each of the 12 state energy offices, five state universities, two Federal regional centers, and four southern regional commissions and boards. In addition to interviewing these officials, the ORNL staff visited numerous state offices and collected printed reports of state studies relevant to the NCUA. (See Appendix for listings of persons and agencies contacted and listings of reports collected.)

It is very difficult, perhaps impossible, to compact the analysis of many documents and the gist of many hours of conversation into a tabular summary without appreciable distortion and omission. Nevertheless, Table 11 attempts to show, in very condensed format, the major constraints to increased coal utilization as identified from interviews and from analysis of key state reports. Table 12 is a somewhat more detailed tabulation for each of the 12 states.

Some states, such as Florida and South Carolina, had few comments regarding coal because they neither produce nor use large amounts of coal at present. Comments from the remainder of the states show a reasonably consistent pattern.

- Federal regulations appear as a bone of contention in both lists. State officials generally agreed upon the need for some Federal regulation (EPA, FEA, etc), but many felt the regulations were too inflexible - not sensitive to regional or state differences and not sensible concerning conflicting priorities.
- The lack of a clear-cut Federal energy policy with regard to coal was viewed by many as a constraint to future utilization of coal. The state officials recognized the interrelation between state and Federal energy policies, and many felt hampered in formulating state policies in the absence of a Federal model. In this regard, it is interesting to note that the Southern Growth Policies Board has recommended that the south formulate a regional energy policy.

Recommendation #9

To help formulate a regionwide energy policy, studies of net energy production and consumption from the development of the South's energy resources should be undertaken. As part of a regional approach to energy policies, the southern states should work together in planning and coordinating a unified facility site selection process. As part of their energy planning efforts, the state should encourage multiple uses of energy rights-of-way and place a high priority on

Table 11. Summary: Constraints to increased production and use of coal
as identified by state officials and by state reports

State	From interviews with officials								From state reports								
	Federal regulations hinder production, use	Lack of federal energy policy regarding coal	Transportation of coal is a problem	Shortage of materials and skilled manpower	Water shortage	Lack of capital investment in coal	Lack of information regarding coal technology	Public reaction to environmental damage	Other	Federal regulations hinder production, use	Lack of federal energy policy regarding coal	Transportation of coal is a problem	Shortage of materials and skilled manpower	Lack of capital investment in coal	Lack of market structure	Public reaction to environmental damage	Other
Alabama	X			X				X								X	X
Florida									X								
Georgia	X		X	X	X		X	X		X						X	X
Kentucky		X	X	X		X		X		X	X	X	X	X			X
Louisiana		X	X							X	X			X		X	X
Mississippi	X	X	X		X		X	X		X			X		X	X	
N. Carolina	X	X						X		X	X						X
S. Carolina	X					X				X			X			X	X
Tennessee	X																
Texas	X				X					X		X		X			X
Virginia	X		X					X	X	X			X		X		X
W. Virginia	X		X	X				X	X								

Table 12. Constraints to coal utilization

From interviews	From state reports
<u>Alabama</u>	
<ul style="list-style-type: none"> • Federal regulations on surface mining could restrict Alabama's coal production. • If the environment is not protected, public reaction would be a constraint. • Equipment shortages, such as hopper cars and mining equipment, could hinder production. • There is a shortage of skilled miners. 	<ul style="list-style-type: none"> • Increased coal production could cause an increase in land damage, but reclamation techniques are getting much more effective (p. 1, <i>Coal - Its Importance to Alabama</i>). • Much work must be done to locate and delineate Alabama's coal deposits. <i>ibid.</i>, (p. 25). • Water damage by acid mine drainage is a problem, but control techniques are improving (p. 5, <i>Coal: Alabama's Energy for the Future</i>). • Air pollution from coal emission remains a serious problem. <i>ibid.</i>, (p. 6). • Mine safety is being improved <i>ibid.</i>, (p. 7).
<u>Florida</u>	
<ul style="list-style-type: none"> • Florida's state air quality standards are more strict than Federal standards and could hinder use of coal. 	<p>Note: Florida is not a coal-producing state, nor does it consume much coal at present. Therefore, there is little direct comment in state reports concerning coal.</p>

Table 12 (continued)

From interviews	From state reports
<u>Georgia</u>	
<ul style="list-style-type: none"> • Intermediate and small industries need to convert to coal but need technical help with conversion. • Industries have difficulty getting boilers. • IRS tax policies can hurt certain coal technology (beneficiation) and help others (scrubbers). • Transporting coal into Georgia would be a problem. • There is not enough planning for direct burning of coal vs. indirect use by electricity. • Some coordination is needed among states in their energy R&D efforts — some do coal research, some solar, etc. • EPA regulations are too restrictive on smaller industries. • State needs an early site review system for power plant siting. • Water is an important limit for state energy development. • The Federal government has provided no active encouragement to industry to convert to coal. • The state is about saturated with power plants — need for less centralized power systems. 	<ul style="list-style-type: none"> • Use of coal is constrained by potential harm to environment (p. 94, <i>Governor's Policy Statement</i>). • Georgia is dependent for 97% of its basic energy from out-of-state sources, <i>ibid.</i>, (p. 94). • The state needs more control over energy resources, especially since the Federal government has no firm energy policy, <i>ibid.</i>, (p. 95).

Table 12 (continued)

From interviews	From state reports
<u>Kentucky</u>	
<ul style="list-style-type: none"> • Lack of risk capital will limit expansion of coal production and use. • Trained manpower in short supply under rapid coal development, but this would be only a short-term constraint. • Transportation is a problem - coal-haul roads and some (but not all) rail beds are in poor condition. Who should pay for upkeep and for upgrading the quality of roads and rail beds? • High sulfur in western Kentucky coal limits its use. • Boom-bust coal cycle coupled with lack of Federal policy regarding coal limits coal industry growth. 	<ul style="list-style-type: none"> • Coal production limited by trained manpower (p. 7, <i>Kentucky's Coal Production Constraints</i>). • Labor strikes cut production, <i>ibid.</i>, (p. 11). • Poor worker morale results in absenteeism and turnover, <i>ibid.</i>, (p. 12). • Shortage of hopper cars and poor rail beds restrict transportation, <i>ibid.</i>, (p. 15). • Small mines do not have long-term contracts and do not have volume to justify unit trains, <i>ibid.</i>, (p. 15). • Locks on rivers are too small for tows to pass in single operation (p. 15). • Would cost \$33 million/yr to maintain coal-haul roads, <i>ibid.</i>, (p. 21). • High conversion costs from gas-oil to coal restrains conversion, <i>ibid.</i>, (p. 25). • Federal regulations on SO₂ emission will determine demand for Kentucky coal vs western coal, <i>ibid.</i>, (p. 26). • Federal policies regarding power plant conversion to coal will affect market. (p. 26). • Risk capital is needed, (p. 26).

Table 12 (continued)

From interview	From state reports
	<ul style="list-style-type: none">• Shortage of mining equipment.• "Lack of markets is governing constraint on expanding coal production" (p. iii, <i>Marketing Kentucky Coal</i>).
<u>Louisiana</u>	
<ul style="list-style-type: none">• Lack of a Federal energy policy hampers development of a state energy policy regarding coal.• Transportation problems might restrict use of coal.	<ul style="list-style-type: none">• Coal may not be easily obtained if many states convert to coal and compete for it (p. 20, <i>Louisiana Energy Report</i>).• It would be expensive to convert from gas to coal, <i>ibid.</i>, (p. 20).• Environmental restrictions reduce the use of coal, <i>ibid.</i>, (pp. 20, 22).• Land requirements to store coal might limit its use by some, <i>ibid.</i>, (p. 20).• Conversion to coal would cause Louisiana to change from seller to buyer of energy with unwanted economic consequences, <i>ibid.</i>, (pp. 20, 22).• Lack of long-range Federal energy policy hurts state energy planning, <i>ibid.</i>, (p. 32).• Air quality problems would accompany a shift to coal (<i>Impact of Fuel Switching on Louisiana Air Quality</i>).

Table 12 (continued)

From interviews	From state reports
<u>Mississippi</u>	
<ul style="list-style-type: none"> • Lack of definite state or Federal coal policy restricts to coal. • Transportation could be a problem, but coal traffic might allow railroads to upgrade road beds. • Lack of tax incentives conversion to coal. • Industry is uncertain of future costs of various alternative fuels. • EPA standards make coal hard to burn. • Water might be a constraint to power plant development. 	<ul style="list-style-type: none"> • Since there is very little coal use at present, no formal market structure for sale of coal exists (p. 21, <i>Energy Sources: A Guide to Mississippi Companies</i>). • SO₂ emissions present air quality problems, <i>ibid.</i>, (p. 21). • Equipment to burn coal is very expensive due to environmental regulations, <i>ibid.</i>, (p. 24). Only large consumers can economically burn coal. • Long waiting time exists to obtain equipment to burn coal (p. 28, <i>Meeting the Energy Crisis - A Challenge to Mississippi</i>). • Congressional restrictions on strip mining will increase cost of coal, <i>ibid.</i>, (p. 29).
<u>North Carolina</u>	
<ul style="list-style-type: none"> • Psychology of industry's Board of Directors — each year they hope the oil-gas situation will ease. • Government regulations restrict production and push price up. • Competition from nuclear restricts coal use by utilities. • Lack of national energy policy regarding coal retards conversion to coal. 	<ul style="list-style-type: none"> • Because of interrelationships between state and Federal energy policies, it is difficult for a state to chart an energy policy without having a national policy (p. A-2, <i>Annual Report: North Carolina Energy Policy Council</i>). • Competition from nuclear reduced importance of coal for electricity, <i>ibid.</i>, (pp. C-3, C-5).

Table 12 (continued)

From interviews	From state reports
	<ul style="list-style-type: none"> • Clean Air Act created uncertainties as to how much coal would be permitted to be burned. • Short-run increase in supply of coal is uncertain; takes 4-7 years to plan and build new boiler, <i>ibid.</i>, (C-4). • Electricity demand is growing at slower rate than expected and so less need for coal, <i>ibid.</i>, (C-4). • Lessened demand for steel and so less demand for coal, <i>ibid.</i>, (C-4). • Electricity conservation would reduce demand for coal, <i>ibid.</i>, (C-6). • Increased solar energy technology will decrease demand for coal, <i>ibid.</i>, (C-6).

South Carolina

• EPA standards restrict the use of coal. • Lack of investment capital restricts conversion to coal. Perhaps long-term, low-interest loans would encourage conversion.	(No state report was available describing constraints to coal development.)

Tennessee

• Tennessee has more than its share of Federal agencies (TVA, ERDA) and Federal regulations. Consequently, the state has less than normal control over energy policy.	• Coal mining regulations indicate several problems: • Reclamation of surface mined land; • Mine safety; • Water and air quality. (pp. 55, 56, <i>Coal in Tennessee</i>).

Table 12 (continued)

From interviews	From state reports
	<ul style="list-style-type: none"> • Coal is not a "convenient" fuel, and this restricts its use (p. 71, <i>Energy in Tennessee</i>). • Air pollution control standards retard use of coal, <i>ibid.</i>, (pp. 71, 72). • Rising labor costs, Federal safety standards, and reclamation costs force up price of coal, making it less competitive, <i>ibid.</i>, (p. 71). • Acid drainage, siltation, landslides, and aesthetic damage are severe problems, <i>ibid.</i>, (p. 71). • Lack of skilled labor may restrict coal production, <i>ibid.</i>, (p. 76).

Texas

• Natural dust level in Texas makes it difficult to burn coal without exceeding EPA restrictions. • Restricted water resources hinder power siting. • Coastal sites ruled out for power site by air quality standards.	• Certain legal restrictions hinder combined generation of electricity and process steam — i.e., Public Utilities Regulatory Act. <i>Policy Position on Selected Energy Issues of the Governor's Energy Advisory Council.</i> • High cost of pollution controls — these should be required only as a result of a clear expression of public willingness to pay the price involved.

Table 12 (continued)

From interviews	From state reports
	<ul style="list-style-type: none"> • Leasing of Federal coal lands should recognize economic, environmental, social characteristics of states. Need Federal-state coordination of lease policy. • Divestiture laws may limit capital necessary to develop energy resources such as coal. • Federal surface mine regulations are not needed; should be with state. • Coal slurry pipelines cannot develop until they have right of eminent domain. • Need to renovate rail beds for coal transportation. • Federal secondary ambient air quality standards preclude coal in Texas because of high natural dust levels (p. xi, <i>Texas Energy Outlook</i>).

Virginia

• Environmental damage could limit coal mining in Virginia. • EPA and OSHA regulations have forced some smaller mines to close. • Coal-haul roads are in bad shape. • Strip mining has resulted in water quality damage. • Fly ash is a problem.	• Lack of certified mine foremen limit production (p. 44, <i>Annual Report</i>, 1975). • State imports 80% of its energy but has little voice over prices and availability (p. II-i, <i>Energy and Virginia's Future</i>). • Virginia produces coal but uses little of it — need to convert to coal, <i>ibid.</i>, (pp. II-iii, II-22).

Table 12 (continued)

From interviews	From state reports
<ul style="list-style-type: none"> • How can we make it economically attractive to capture methane gas around coal seams and not waste it? • Federal regulations are too inflexible. Laws appropriate for one region may not make sense to another. • Federal and state governments need to push gasification and liquefaction research. 	<ul style="list-style-type: none"> • Conflict between energy needs and environmental protection limits coal use, <i>ibid.</i>, (p. II-vi). • Federal regulations have forced smaller mines to close. • Venting of methane from mines loses \$10,000,000/year, <i>ibid.</i>, (p. II-27). • Strength of coal industry is not resource limited but is demand limited, <i>ibid.</i>, (p. II-28).

West Virginia

• Environmental quality standards restrict production and use of coal. • The high-sulfur coal is hard to market. • Transportation is a minor problem. • Number of West Virginia coal miners has decreased from 150,000 to 48,000. Industry says there are too few trained workers; labor says too little industry-financed training. • Midwestern coal markets are going to western coal as opposed to eastern coal because industry calculates it costs less to transport coal than install sulfur cleaning equipment. • Much of the coal property in the state is owned by companies other than coal companies and, therefore, is not accessible for coal production.	(State documents did not comment on constraints.)

energy conservation. (p. 48, *Land and Natural Resources in the South*, S.G.P.B., December, 1974).

- Transportation of coal from mine to user was viewed as a problem in several sites, especially those not blessed with river routes to coal fields. Also, coal-producing states face the problem of severe damage to coal-haul roads. Should the citizens of these states pay the upkeep costs on the roads? Who should pay for upgrading the quality of coal-haul roads and upgrading rail beds?
- Increased production and use of coal presupposes availability of the necessary materials and labor. Some state officials question that skilled miners and foremen are available in the quantities needed, but many state technical schools are initiating special programs to remedy this need. Coal production not only requires mining equipment, but it requires large earth moving machinery to reclaim stripped land. Such machinery is already in short supply. Coal-burning boilers are also said to be difficult to find.
- Conversion from a gas-oil system to a coal system would require large capital investments. Some state officials report that industries are not sure that coal is to be a long-range national policy. Some industries view coal as a "swing fuel" which will be replaced as soon as a cleaner, more convenient alternative appears on the scene. Therefore, there is considerable hesitancy to invest heavily in coal.
- The energy office officials in several states viewed water availability as a constraint to future energy development. The state reports did not comment on this problem.
- Some state reports listed adverse public reaction to environmental damage caused by coal mining, transportation, and burning as a constraint to increased utilization of coal. The state officials were less likely to mention this factor.
- Lack of information regarding newer coal technologies and lack of a developed coal market structure were cited as problems by several states.

The information in Table 12 provides a more detailed listing of the problems cited by officials and by reports from the states. Some of the problems listed have been widely discussed in the media, but many have not.

One problem area is conspicuous by its absence in these listings. Social impacts caused by a change in the energy base of the society were mentioned by only one respondent as a constraint and seldom brought forth in publications. Nevertheless, the NCUA study will address the social

impact problems as well as those which have been so well pointed out by state officials and in state reports.

4. SUMMARY AND REGIONAL CHARACTERIZATION

This report is the first of several reports to be produced under the National Coal Utilization Assessment (NCUA). The NCUA is a two-year assessment sponsored by the Assistant Administrator for Environment and Safety through the Division of Technology Overview of ERDA. Its purpose is to evaluate potential environmental, social, and economic effects of increased coal production and utilization.

The preceding section of this report presented selected baseline information regarding state government infrastructure, energy balance, environmental conditions, resource characterization, and listings of constraints to coal utilization for each of the 12 states in the ORNL study region. This summary presents broad regional generalizations based upon the state data, but it should be stressed that the South is not uniform and homogeneous regarding most of the energy-related factors described in this report.

4.1 GOVERNMENT INFRASTRUCTURE

- Each of the 12 states has created a special office to look after energy-related matters. All of the Offices were established shortly after the OPEC embargo in 1973. Approximately half of the offices were established by executive order and half by legislative act.

The administrative pattern encountered most frequently places the energy office within one of the Governor's executive divisions.

Analysis of the executive and legislative acts establishing the energy offices shows five functions set forth for almost every office:

1. preparation of an emergency fuel allocation plan;
2. education of the public regarding conservation;
3. compilation of energy data and analysis of future energy demand;
4. liaison with Federal agencies; and
5. recommendation of energy policies for consideration by the governor and/or the legislature.

Other functions are specified for offices in individual states. In general, the offices act in an advisory and consultive mode. The governors and state legislatures formulate and enact energy policy.

- Because energy-related problems pervade almost all aspects of the citizen's life, a great variety of agencies within the state--in addition to the energy office--must be concerned directly with these issues. The variety of agencies listed in Table 2 reflects the scope of concerns related to energy: discovery and extraction of mineral energy; protection of air, water, and land quality; transportation of energy resources; energy price

regulation; basic energy-related research; planning for economic growth; concern for public health, including mine safety; and conservation of the state's natural resources.

- In addition to state-level agencies, a number of regional agencies are concerned with energy issues in the South. These include the Federal Regional Centers in Atlanta and Dallas with representatives from FEA, EPA, and other agencies, the Southern Interstate Nuclear Board, the Appalachian Regional Commission, the Coastal Plains Regional Commission, the Southern Growth Policies Board and the Tennessee Valley Authority.

4.2 REGIONAL ENERGY BALANCE

- An energy balance between production and consumption for each of the 12 states in the ORNL study region reveals great variability among the states. Four states supply much more energy than they consume, and most of the rest produce little energy being highly dependent upon imported energy. The two coal-producing states of Kentucky and West Virginia plus the two oil-and-gas producing states of Louisiana and Texas account for over 90% of the total energy produced in the region and over half of U.S. domestic energy production.
- Some of the states that are heavily dependent upon imported energy are clustered along the South Atlantic Coast. If faced with natural gas curtailment, they must use railroads, ocean-going ships, or pipelines to import primary energy.
- Most of the 12 states are primarily dependent upon oil and natural gas. If they must shift to another primary fuel, such as coal, the costs of plant conversion and transportation will be burdensome.
- Overall, the region consumes about 22 quads of energy (30% of U.S. total) and produces about 36 quads of energy (60% of U.S. domestic production). The region, and especially Kentucky, Louisiana, Texas, and West Virginia, is a major net energy source for the nation.
- In terms of proved reserves, the region contains about 15% of the nation's coal reserves, half of the U.S. petroleum reserves, and two-thirds of the natural gas reserves. Kentucky and West Virginia contain 85% of the region's coal, and Louisiana and Texas contain over 95% of the natural gas and petroleum in the region.
- Comparison of energy production patterns with energy resource patterns reaffirms conclusions from other studies that a serious mismatch exists. Petroleum and natural gas account for only 5%

of the nation's fuel resources and 14% of the region's fuel resources, but the two fuels account for 72% and 80%, respectively, of national and regional production. At present rates of production, the nation and region will soon exhaust its petroleum and natural gas reserves, but conversion to another basic energy source, such as coal, entails changes in modes of energy production, transportation, and utilization which are very expensive financially and perhaps environmentally.

- State possession of energy resources does not always correlate with high socioeconomic status for the people of the state. States are beginning to consider methods to ensure that more benefits accrue to the citizens of the state from the energy resources of the state.

4.3 REGIONAL SOCIO-ECONOMIC STATUS

- The 12-state region is one of the nation's fastest growing sections accounting for 27% of U.S. population. However, growth rates vary, for the period 1970-76, from 24% for Florida to 4% for West Virginia. Overall, the region's population growth rate is about twice that for the U.S.
- Population density for the region is approximately 80 persons/square mile compared to 60 persons/square mile for the total U.S. Rapid growth coupled with above average population density suggests a need for growth management policies, especially for states such as Florida which are already heavily impacted.
- The region has experienced a dramatic reversal in migration. From 1900 to 1960, there was net out-migration for both blacks and whites, but since 1960, whites have migrated South in large numbers and recent statistics show a net in-migration of blacks.
- The South, along with the rest of the nation, has become an urban society. Almost two-thirds of the people in the region live in communities of over 2500 persons compared to three-fourths for the total U.S. As might be expected, the states show great variability in this statistic, ranging from 39% urban for West Virginia to 80% for Texas and Florida.
- The 12-state region has almost twice the proportion of nonwhites as compared to the U.S. total.
- More than one-third of adult Southerners (35%) have dropped out of school before ninth grade as compared to 28% for the total U.S. This would indicate a serious literacy problem with consequent difficulties in finding employment or profiting from technical training opportunities for these persons.

- Per capita income increased somewhat more rapidly in the region than in the rest of the country over the past five years, but Southern income still lags behind the national average. Consequently, almost one-fourth of the 12-state population is below the Federal definition of poverty as compared to about one in seven for the whole nation.
- The three fastest growing sectors that act as major sources of personal income for the region involve extraction and processing of coal, natural gas, and petroleum.
- Manufacturing in the South is very energy intensive, requiring almost 55,000 BTu/dollar value added. This is about twice as high as for the rest of the nation.
- Despite low per capita income, high poverty level, and above average school drop-out levels, the region continues to grow rapidly due to noneconomic factors. Mild climate, varied outdoor recreational facilities, and natural beauty compensate for other shortcomings. Development of energy industries should attempt to preserve these environmental assets.
- Rapid population growth and concentration of energy intensive industry suggests that the region will continue to be both a major producer and consumer of energy.

4.4 ENVIRONMENTAL STATUS

The ecological problems - risks and constraints - from production and consumption of coal will be quite different for contrasting ecological regions (ecoregions). The South ranges from Florida's tropical Everglades savanna to the desert of western Texas and the coal-rich hill forests of West Virginia.

- The Everglades Province is already stressed by competing trends of land and water development, and is particularly vulnerable along shorelines where utilization is expected to accelerate.
- Chihuahuan Desert and shortgrass Steppe already have severe problems of depleting water resources which will be aggravated by rising prices for energy to drill for and pump water and even by modest energy facilities to serve the sparsely populated regions.
- Prairie Brushland and Parkland has more intensive competition for its highly variable water supply, plus air quality (particulate) problems posed by dustbowl erosion from chronic drought areas in the panhandle areas to the west. Intensive development of lignite resources deserves comparison with the more matured impacts of bituminous coal development in Appalachia and the Midwest.

- Outer Coastal Plain Forest has wide representation of southern pines and important hardwood forest resources (partly broad-leaved evergreen), which could be significantly impacted by air and water pollution. Issues of land and water use on many floodplain forests and farm areas particularly may be so severe that counties otherwise seeming appropriate for energy facilities or storage may not find actual tracts available for them.
- Southeastern Mixed Forest combines the pollution sensitivity problems of pine and of choice hardwood forests and of agriculture. A variety of land use problems are expected around several rapidly urbanizing areas.
- The whole complex of stripmining problems will require closer review under new reclamation laws in Alabama's Warrior Basin field of the Southeastern Mixed Forest and especially in the Mixed Mesophytic Forest.
- Eastern Deciduous Forests also have other serious problems of land and water use on the steep terrain throughout much of the Mixed Mesophytic Forest and Appalachian Oak Forest sections (Ridge and Valley and Blue Ridge Divisions): e.g. slope erosion and valley flooding, possibly aggravated by mining and transportation and use of coal.
- The oak-hickory section and the forests on drier sites over all ecoregions of the southeast are already susceptible to decreased forest and wildlife production during drought years, with increasing susceptibility to fires.
- Agriculture in all these ecoregions is increasingly dependent on reliability of energy and/or water supplies - even where climate has been generally favorable for the species and varieties presently used.

4.5 REGIONAL CONSTRAINTS TO INCREASED COAL UTILIZATION

- One purpose of the NCUA was to ascertain problems associated with increased utilization of coal as perceived by the states. Members of ORNL staff visited the 12 state energy offices, a number of state universities, the Federal Regional Centers, and Southern regional commissions and boards. In addition to interviewing officials and visiting state offices, the staff collected printed state reports relevant to the NCUA. Based on a summary of interviews and analysis of key state reports the following appear to be the major constraints to increased utilization of coal as viewed from the states' perspective:
 1. Federal regulations involving coal mining and use appear to many states as too inflexible. They are not sensitive to regional differences and not realistic about conflicting priorities.

2. Lack of a firm Federal energy policy was viewed by many as a constraint to coal use. A clear commitment by the Federal government to a coal policy would help the industrial sector decide upon the wisdom of investing heavily in conversion to coal.
3. Transportation of the coal from mine to user was viewed as a serious problem in several states.
4. Shortage of critical materials and of skilled labor were cited by some states as limiting factors to rapid expansion of coal production and use.
5. Lack of risk capital to finance the expensive conversion from an oil-gas system to a coal-system might hinder the switch to coal. Many are skeptical of coal's "boom and bust" history. They fear coal may be just a swing fuel that would be replaced as soon as a "cleaner" replacement was available.
6. Water shortages for energy use were pointed to in several states as constraints to any kind of major power plant expansion.
7. Some state reports indicated that adverse public reaction to environmental damage caused by mining and burning coal would hamper its use.
8. Lack of information regarding the status of newer coal technologies and lack of a developed coal market structure were also cited by some as constraints.
9. Social impacts caused by a shift of energy base by the region were seldom mentioned in the interviews. However, one respondent did point out a major potential problem for regions whose main economic base is coal and whose coal reserves are running out. Under increased coal utilization, these regions will deplete their remaining reserves rapidly. What are the social and economic consequences? Can adverse effects be minimized?

REFERENCES

- Bailey, Robert G. 1976. *Ecoregions of the United States*. Intermountain Forest and Range Experiment Station, United States Forest Service, Ogden, Utah.
- Balwin, John L. 1973. *Climates of the United States*. National Oceanographic and Atmospheric Administration, U.S. Government Printing Office, Washington, D.C., 113 pp.
- Braun, E. Lucy. 1950. *The Deciduous Forests of Eastern North America*. Balkistron Company, Inc., Philadelphia, 596 pp.
- National Oceanographic and Atmospheric Administration. 1974. *Climates of the States. Vol. 1 - Eastern States Plus Puerto Rico and the U.S. Virgin Islands - A Practical Reference Containing Basic Climatological Data of the United States. Vol. 2 - Western States (including Alaska and Hawaii)*. Water Information Center, Inc., Port Washington, New York, 974 pp.
- Thorntwaite, C. W. 1948. "An Approach Toward a National Classification of Climate." *Geographical Review* 38: 55-94.
- Webb, T. 1976.. *A Final Report on the Climatological Data Added to the ORNL Geoecological Data Base*. Brown University Memorandum, September 23, 1976

APPENDIX

APPROACH AND PROCEDURES USED TO COLLECT
INFORMATION FOR THE
REGIONAL CHARACTERIZATION REPORT

The procedure used in Task 1 of the ORNL program plan to develop the Regional Characterization report is outlined in this Appendix.

- During the month of December, a team from ORNL visited a number of regional agencies in the Southeast including the Southern Governors' Conference, the Southern Growth Policies Board, the Appalachian Regional Commission, the Southern Interstate Nuclear Board, and the Coastal Plains Regional Commission. At these meetings the team described the NCUA for members of these agencies and collected study reports which might pertain to the program.
- ORNL staff also visited the Federal Regional Commission Offices in Atlanta and Dallas during February and March meeting particularly with members of the Federal Energy Administration and the Environmental Protection Agency. They were informed of the NCUA study, and the FEA and EPA personnel were helpful in providing copies of reports and suggestions of persons to contact for information useful to NCUA.
- ORNL staff met with selected faculty members from seven universities within the 12-state region in order to describe the NCUA and obtain comments from the university faculty regarding the overall plan for the study and to discuss work completed or under way at the universities that potentially could contribute to the program.
- The most extensive contacts, however, were those between ORNL staff and the state energy offices and related state agencies. During January, February, and the first part of March appointments were made with each of the 12 energy office directors (or the persons performing equivalent functions). The energy office director was requested to arrange for persons from other state or Federal offices and from relevant industries to attend these meetings. The ORNL team generally consisted of R. M. Davis, Program Manager of NCUA; Dennis Parzyck of the Environmental Sciences Division of ORNL; and Fred Boercker, Faculty Research Participant assigned temporarily to the Energy Division of ORNL. (See Appendix A-1 for list of agencies visited and persons contacted.)

GENERAL APPROACH TO MEETINGS

Before each visit the state energy director was sent a letter from ORNL confirming the date of the visit and describing in very broad terms the purpose of the NCUA. In addition, he/she was sent a list of somewhat detailed questions to illustrate the kinds of information the ORNL team would be seeking. (A sample list of questions is attached as Appendix A-2.)

The ORNL team approached these meetings with a general, but flexible, format and interview schedule as described in Appendix A-3. In general, Davis and Parzyck described the NCUA using transparencies and then left permanent copies of the transparencies with the energy office. Copies of the transparencies are attached as Appendix A-5. Following the description of NCUA, Davis would lead a discussion to determine the state officials' perceptions of the problems/issues/constraints/management options related to increased coal utilization. At the conclusion of the meeting the ORNL team would obtain copies of reports from the energy office (including a copy of the state office telephone directory) and obtain a list of other state offices to visit. All three ORNL staff took notes at each meeting and summarized these in "trip reports." The trip reports contain also a list of documents collected from both state and regional offices and these are listed in Appendix A-4.

APPENDIX A-1

STATE AND REGIONAL AGENCIES VISITED BY ORNL STAFF:
TASK 1, NCUA

STATE OFFICES

Alabama:

Alabama Energy Management Board
Geological Survey of Alabama

Peter A. Boone

Chief Geologist, Geological Survey of
Alabama

Bo Daniel

Geological Survey of Alabama

Donna Robinson

Alabama Energy Management Board

Florida:

Florida State Energy Office

Florida State Planning Commission

Florida Department of Environmental Regulations

Florida Department of Natural Resources

Florida A&M University

Carlos Warren

Director, State Energy Office

Thomas Krilowicz

Division of State Planning

Hamilton Owen

Dept. Environmental Regulation

Bruce Johnson

Dept. Natural Resources

Shirley Burggraf

Florida A&M University

Georgia:

Georgia State Energy Office

Omi Walden

Director, State Energy Office

Bill Mitchell

Air Quality Control Officer

Kentucky:

Kentucky Department of Energy

University of Kentucky

Kentucky Center for Energy Research

Damon Harrison

Commissioner, Dept. of Energy

John Stapleton

Deputy Commissioner, Dept. of Energy

Samuel Bruntz

Env. Engr., Dept. of Energy

O. J. Hahn

Assoc. Dir., Inst. for Mining &

Minerals Research, Univ. of Kentucky

W. Birge

Biology, Univ. of Kentucky

H. Conrad

Metallurgical Engr., Univ. of Kentucky

W. Dennen

Geology, Univ. of Kentucky

W. Ehmann

Chemistry, Univ. of Kentucky

R. Eichhorn

Mech. Engr., Univ. of Kentucky

J. Flesher

Pharmacology, Univ. of Kentucky

J. Funk

Dean, Coll. of Engr., Univ. of Kentucky

F. Gabbard

Physics, Univ. of Kentucky

R. Grieves

Chem. Engr., Univ. of Kentucky

C. Harvey	Economics, Univ. of Kentucky
W. Royster	Dean, Grad. School, Univ. of Kentucky
F. Wright	Civil Engr., Univ. of Kentucky
W. Hagan	Ky. Geol. Survey
David Drake	Kentucky Center for Energy Research
Don Hartman	Kentucky Center for Energy Research
Ron Sanders	Kentucky Center for Energy Research
Charles Eilerman	Kentucky Center for Energy Research
Lucy Monsour	Kentucky Center for Energy Research
Randal Ihara	Kentucky Center for Energy Research
Ernest Van Hoose	Kentucky Center for Energy Research

Louisiana:

Louisiana Natural Resources and Energy Division

Thomas Landrum	Director, Nat. Resources & Energy Div.
Arnold Chauviere	Asst. Comm., Dept. of Conservation
Jim Porter	Radiation Control, Dept. of Conservation
Thomas Becker	Dept. of Conservation
Corbett Gaulden	Univ. of Southwestern La.
William Rense	Univ. of Southwestern La.
Joseph Moffatt	Univ. of Southwestern La.
D. P. Harrison	Louisiana State Univ.

Mississippi:

Mississippi Fuel and Energy Management Commission

George Cochran	State Fuel Coordinator
P. J. Bankston	Dir., Off. of Sci. and Technology
Milton Williams	Mississippi Res. & Dev. Center
Dwight Wylie	Mississippi Air & Water Pollution Control Board
Larry Marble	Mississippi Board of Water Commissioners
Jim Miller	Agricultural and Indus. Board
Gerald Stuckey	Illinois Central Gulf RR
Donald Rineart	Illinois Central Gulf RR

North Carolina:

North Carolina Department of Military and Veteran's Affairs

Paul Hitchcock	Director, Energy Division
Warren Rock	Asst. Dir., Energy Division
Anne Hughes	Allocations Officer, Energy Division
John Sweeney	Economist, Energy Division
Harry Tiller, Jr.	Pres., N.C. Coal Institute
Nick Gajewski	Dev. Analyst, Div. Econ. Dev.
Dennis Nightingale	Util. Engr., N.C. Util. Commission
Fowler Martin	Energy Coordinator, School of Engr., North Carolina State Univ.

South Carolina:

South Carolina Energy Management Office	
David Harter	Director, Energy Office
Marion Crum	Energy Office
Dennis Black	Energy Office

Tennessee:

Tennessee Energy Office	
Edward Spitzer	Director, Energy Office
Leon Guthrie	Asst. Dir., Energy Office
Michael Huggins	Allocation & Conservation Office
Jack Thomas	Spec. Projects Officer
Bill Barrick	Staff Counsel
John Black	Staff Counsel

Texas:

Governor's Energy Advisory Council	
Texas A&M Univ.	
Univ. of Texas	
David White	Forecasting & Analysis, Energy Office
Kenneth Monts	Forecasting & Analysis, Energy Office
Milton Holloway	Forecasting & Analysis, Energy Office
Roy Ray	Energy Information, Energy Office
Michael Smoller	General Land Office
Hal Cooper	Univ. of Texas
Sally Lopreato	Univ. of Texas
Debbie Stinson	MIT Student
Kurt Irgolic	Assoc. Dir., Center for Energy & Mineral Resources, Texas A&M University
C. D. Holland	Chem. Engr., Texas A&M University

Virginia:

Virginia State Energy Office	
Department of Labor and Industry	
J. Temple Bayliss	Conservation Control, Energy Office
Edmond Boggs	Commissioner of Labor & Industry

West Virginia:

West Virginia Fuel and Energy Office	
West Virginia University	
Jeff Herholdt	Chief Program Manager, W. Va. Commission on Energy, Economy and Environment
Walter Page	Economics, W. Va. Univ.

REGIONAL AGENCIES

Southern Growth Policies Board

David Gillespie

Coastal Plains Regional Commission (Columbia, S.C.)

Archie Todd

Dir., Office of Coastal Plains Affairs

Pat Mallia

Appalachian Regional Commission

Hugh Montgomery

Director of Research

Jack Cambell

Southern Interstate Nuclear Board

Kenneth Nemeth

Director

Federal Regional Center (Atlanta)

Donald Allen

FEA Regional Administrator

Mickey Feltes

FEA representative to FRC

Truxton Moebis

EPA representative to FRC

Federal Regional Center (Dallas)

William Nikolis

FEA

Charles Pfeiffer

FEA

Charles Northington

EPA

January 26, 1977

NATIONAL COAL UTILIZATION ASSESSMENT (NCUA)

LIST OF QUESTIONS SENT BEFORE VISIT

One important task of the NCUA is to obtain input to the study from state energy offices. We would like to gather answers to as many of the following questions as possible in our visits with state energy offices:

1. Who is responsible for energy planning and analysis in the state? What offices, commissions, boards, etc. are concerned with energy policy?
2. Does the state have a written energy plan or policy?
3. Does the state have access to energy data bases?
4. How important is coal (and coal-generated electricity) to the present and future energy plans for the state?
5. What constraints might hinder increased production/conversion/utilization of coal in the state? What management options does the state plan to deal with the above constraints? Does the state have plans for natural gas curtailment?
6. Are there plans to introduce new coal technologies, such as coal gasification or coal liquefaction plants, within the state?
7. What economic factors influence the growth of coal technology within the state?
8. What social impact factors constrain the growth of coal technology in the state?
9. How does the state determine the siting of future power plants? Is there a siting commission?
10. What are the critical air and water quality questions related to energy development? Does the state plan limitation of stream use for energy development?
11. What impacts on human health might be associated with increased coal utilization within the state?

APPENDIX A-3

NATIONAL COAL UTILIZATION ASSESSMENT (NCUA)

INFORMATION INTERVIEW SCHEDULE

- I. Circulate paper to obtain names and titles of those at meeting.
- II. Present information regarding NCUA.
- III. Discussion
 - A. Open-ended questions:
 1. Who is responsible for energy planning and analysis in state?
 2. What is the current and future energy balance in the state? How important is coal to this balance?
 3. What constraints do you foresee that would hinder increased production/conversion/utilization of coal in the state in the near future?
 4. What management options do you plan to deal with these problems?
 5. Does the state have an energy siting agency? What plans does it have?
 - B. Structured questions related to NCUA tasks:
 1. Are there any more plans for new coal developments and technologies to be introduced within the state? (Task 2)
 2. What economic factors will facilitate or hinder coal production/conversion/utilization? (Task 3.1)
 3. What social factors will facilitate or constrain coal development and relate/technology?
 4. What procedure will be used to determine future sites? (Task 4)
 5. What constraints do air/water quality pose? (Tasks 5, 6, 7.1, 7.5)
 6. What effects do you anticipate on forests, animals, general natural beauty? (Task 7.2-7.4)
 7. What health impacts might be associated with increased coal utilization? (Task 8)
 - C. Other structured questions:
 1. Does the state have a written "energy plan" or policy?
 2. Does the state have access to energy data bases?
 3. Is Directory of State Energy-Related Agencies accurate and complete?
- IV. Ask for reports. Establish contacts for continued communication. Hand out hard copy of slides. Hand out ORNL reports.

Appendix A-4

LIST OF REPORTS COLLECTED

DOCUMENTS FROM ALABAMA APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

1. *Index and List of the Publications of the Geologic Survey of Alabama and the State Oil and Gas Board; Geologic Survey of Alabama, Oil and Gas Board, 1977.*
2. *Bills of Interest: Senate - 1977.*
Bills of Interest: House - 1977.
3. *Mineral Laws of Alabama, Geologic Survey of Alabama, Information Series 5, 1975.*
4. *Coal in Alabama; Gas in Alabama; Petroleum in Alabama; Electricity in Alabama, Alabama Energy Management Board, 1*
5. *Fingertip Facts on Alabama, Alabama Development Office.*
6. *Mining and Minerals in Alabama, Geologic Survey of Alabama, 1975.*
7. *Energy Distribution Systems of Alabama, Geologic Survey of Alabama, Circular 98, 19*
8. *The Alabama Surface Mining Reclamation Act of 1975, Dept. of Industrial Relations.*
9. *Planning Considerations: Energy Resources, Alabama Development Office, June 1975.*
10. *Coal: Alabama's Energy for the Future, Geologic Survey of Alabama, 1974.*
11. *Coal - Its Importance to Alabama, Geologic Survey of Alabama, January 10, 1975.*
12. *Use of Water in Alabama, 1970, with Projection to 2020, Geologic Survey of Alabama, 1972.*

March 3, 1977

DOCUMENTS FROM FLORIDA APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *Forecasts of Future Supply and Demand of Energy in Florida*, State Energy Office, March 2, 1977 (draft).
2. *Energy: Policy and Recommendations for Florida*, Florida Energy Committee, March 1975.
3. *Florida's Energy Profile*, Florida Energy Committee, February 1975.
4. *Energy Law in Florida*, Florida Energy Committee, May 1975.
5. *Sources of Energy Used in Florida: 1960-1973*, State Energy Office, October 1975.
6. *Bases for Development of a Viable Energy Conservation Policy for Florida Residents*, State Energy Office, January 1977.
7. *Statistics of the Florida Electric Utility Industry 1960 through 1975*, State Energy Office, September 1976.
8. *Annual Report to the Legislature, 1975-76*, Florida Energy Office, February 1976.
9. *Monthly Florida Motor Gasoline Consumption, January 1967 through December 1975*, State Energy Office, June 1976.
10. *Monthly Florida Crude Oil and Natural Gas Production, 1943 through 1975*, State Energy Office, April 1976.
11. *The Energy-Related Responsibilities of State Government Agencies in Florida, 1976*, State Energy Office, December 15, 1976.
12. *Proposed Energy Policy for Florida*, State Energy Office; Ten Regional Energy Action Committees; State Energy Advisory Council, October 19, 1976.
13. *Florida Environmentally Endangered Lands Plan*, Florida Department of Natural Resources, February 17, 1975.
14. *State and National Outdoor Recreation Areas in Florida*, January 1, 1976 (map).
15. *Statistical Inventory of Key Biophysical Elements in Florida's Coastal Zone*, Florida Department of Natural Resources, May 1973.

16. *Recommendations for Development Activities in Florida's Coastal Zone*, Florida Department of Natural Resources, April 1973.
17. *An Atlas of Florida's Coastal Zone*, Florida Department of Natural Resources.
18. *Suggested State Objectives, Policy, and Criteria for Coastal Management in Florida*, Florida Department of Natural Resources, January 1977.
19. *Florida Coastal Zone Management Program (Section 305): Status Report to the Governor and Cabinet*, Florida Department of Natural Resources, January 1977.
20. *Atlas of Environmental Jurisdictions in Florida*, Florida Power and Light Company, April 1976.
21. *1976 Ten-Year Site Plan, State of Florida, Electric Generating Facilities and Associated Transmission Lines*, Florida Electric Power Coordinating Group, May 1, 1976.
22. *City of Lakeland: Annual Report of Ten-Year Site Plans for Electrical Generating Facilities and Associated Transmission Lines*, April 1, 1976.
23. *Energy: The Power of the State's Land Use Regulation*, The Center for Governmental Responsibility, April 1975.
24. *Energy: The Power of the State's Energy Emergency Powers*, The Center for Governmental Responsibility, April 1975.
25. *Econometric Models and Forecasts of Major Fuels in Florida*, Shirley Burggraf, Florida A&M University, December 1976.
26. *An Econometric Model of Demand for Gasoline in Florida*, Shirley Burggraf, Florida A&M University (no date).

DOCUMENTS FROM GEORGIA APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *Energy Consumption in Georgia, 1973*, prepared by the Georgia State Energy Office, March 1975.
2. *Baseline Energy Data System*:
 - Volume 1 Methodology
 - Volume 2 Data Base 1973
 - Volume 3 Energy Supply Network
 - Volume 4 Energy Indicators
 - Volume 5 Analysis of In-State Energy Alternativesprepared for the Georgia State Energy Office by Applied Science Laboratory and Economic Development Laboratory, Georgia Institute of Technology, June 1976.
3. *Governor's Policy Statement, 1977*, Georgia Office of Planning and Budget, 1977.

January 19, 1977

DOCUMENTS FROM KENTUCKY APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

1. *Energy in the Kentucky Economy*, Charles Hultman, Tom Patrick, James Ramsey, James Watts, 1975.
2. *Kentucky's Coal Transportation, A Special Situation Report, Coal Markets, Distribution and Movement*, June 1975.
3. *Marketing of Kentucky Coal*, Kentucky Center for Energy Research, April 1976.
4. *Kentucky's Response, Research and Development to Meet the Nation's Energy Needs*, Second Edition, 1975.
5. *A Kentucky Energy Resource Utilization Program*, prepared by the Institute for Mining and Minerals Research, January 1-June 30, 1976.
6. *Project Descriptions in the Process Development Area*, Kentucky Energy Resource Utilization Program, Institute for Mining and Minerals Research, July 1976.
7. *Kentucky Coal and Its Transportation Impacts: An Updated Look — Two Years Later*, C. Ian MacGillivray, Paul C. Oakley, James Buchholz, May 17, 1976.
8. *Kentucky's Future Transportation Needs*, prepared by Kentucky Department of Transportation, September 1975.
9. *Goals and Objectives of the Kentucky Center for Energy Research*.
10. *Goals and Objectives of the Kentucky Department of Energy*.
11. *Memorandum of Understanding*, Kentucky Center for Energy Research and Kentucky Department of Energy.
12. *A Summary of Kentucky Energy Issues*.
13. *Some Thoughts about Kentucky's Energy Future*.
14. *Kentucky's Energy Position and Issues To Be Faced*.
15. *National Energy Outlook — 1976 Executive Summary*.
16. *Staffing for Task Force on Energy*.
17. *Basic Energy Data for Kentucky*.

18. *Developing Solutions to Energy Supply Problems.*
19. *Toward a Kentucky Energy Conservation Program, synopsis of Energy Policy and Conservation Act of 1975.*
20. *A Proposal for the Development of a Priority End-Use Policy for Natural Gas Curtailments.*
21. *Energy Related Legislation Passed in 1976 Kentucky Legislature.*
22. *Summary of Pending Federal Energy Legislation, review of Federal Energy Legislation.*
23. *1976 National Energy Outlook, Executive Summary.*

March 1, 1977

DOCUMENTS FROM LOUISIANA APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

1. *Fiscal Impact of the Changing Energy Picture in Louisiana*, Energy Management Program Report, Natural Resources and Energy Division, November 29, 1974.
2. *Current Energy Profiles: Project Scope and Task List*, Energy Management Program Report, Natural Resources and Energy Division, March 21, 1975.
3. *A Demonstration Pipeline Simulation*, Energy Management Program Report, Natural Resources and Energy Division, April 28, 1975.
4. *Scope of Work for the Pipeline System Simulation Project*, Energy Management Program Report, Natural Resources and Energy Division, November 27, 1974.
5. *Transportation and Distribution Problems of Coal Utilization in Louisiana*, College of Commerce, Department of Marketing, University of Southwestern Louisiana (draft copy).
6. *Using the Louisiana Electricity Demand Model*, Energy Management Program Report, Natural Resources and Energy Division, June 1976.
7. *Louisiana Electricity Demand Model: An Executive Summary*, Energy Management Program Report, Natural Resources and Energy Division, June 1976.
8. *Louisiana Electricity Demand Forecast: A Constitutive Approach*, Energy Management Program Report, Natural Resources and Energy Division, June 1976.
9. *Louisiana Energy Production and Consumption Indexes*, Energy Management Program Report, Natural Resources and Energy Division, August 1976.
10. *Louisiana's Electric Utility Industry in a Decade of Decision*, Energy Management Program Report, Natural Resources and Energy Division, December 1974.
11. *1973 Louisiana Gas Statistics*, Economics and Statistics Report, Natural Resources and Energy Division, January 31, 1974.
12. *Incremental Cost Estimates for Converting Louisiana Boiler Fuel from Intrastate Gas to Refined Petroleum Fuels*, Economics and Statistics Report, Natural Resources and Energy Division, March 6, 1975.

13. *An Economic Atlas: Louisiana's Petrochemical and Refining Industries Provisional Edition*, Energy Management Program Report, Natural Resources and Energy Division, 1976.
14. *An Economic Atlas: Louisiana's Electric Utility Industry Provisional Edition*, Energy Management Program Report, Natural Resources and Energy Department, October 1975.
15. *Louisiana Energy Study*, The Ozarks Regional Commission, June 10, 1974.

February 28, 1977

DOCUMENTS FROM MISSISSIPPI APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

1. *Industrial Energy Survey — An Analysis of Energy Use by Mississippi Manufacturers*, Business and Industry Development Division, Mississippi Research and Development Center, Jackson, Mississippi, September 1975.
2. *Mississippi Econometric Model Forecast*, Mississippi Research and Development Center, January 1977.
3. *Energy Sources: A Guide for Mississippi Companies*, Mississippi Research and Development Center, October 1976.
4. *R&D Economic Comment*, Mississippi Research and Development Center, September 1975.
5. *Mississippi's Changing Economy, 1973*, Mississippi Research and Development Center, July 1974.
6. *Handbook of Selected Data for Mississippi*, Mississippi Research and Development Center, January 1976.
7. *Meeting the Energy Crisis — A Challenge to Mississippi*, Mississippi Economic Council, April 1975.
8. *Coal Slurry Pipelines: A Cost We Can't Afford*, Association of American Railroads, Washington, D.C.

DOCUMENTS FROM NORTH CAROLINA APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

Energy Division

1. *North Carolina Fuel Consumption for 1975 & 1976 and Fuel Projections through 1990, by Economic Sector, by Fuel Type*, N.C. Utilities Commission; Energy Division, March 1977.
2. *Annual Report: North Carolina Energy Policy Council, Vol. I and Vol. II*, Energy Division, January 1977.

Southern Growth Policies Board

1. *The Future of the South's Economy*, SGPB, December 1976.
2. *Financing the South's Economic Expansion*, SGPB, December 1976.
3. *Energy for the Growing South*, Russell Howard, Phillips Petroleum Co.
4. *Income Distribution in the South*, Madelyn Lockhart, SGPB, December 1975.
5. *The Causes and Quality of Southern Growth*, Mancur Olson.
6. *The Changing Structure of the Southern Economy*, Wm. Miernyk, SGPB, December 1976.
7. *Growth Trends in the South, 1970-1976*, SGPB, March 1976.
8. *A Myth in the Making: The Southern Economic Challenge and Northern Economic Decline*, U.S. Dept. of Commerce, November 1976.
9. *The Future of the South*, SGPB, 1974.
10. *Human Resources and Public Services in the South*, SGPB, December 1974.
11. *Transportation Policies for the South*, SGPB, December 1974.
12. *Growth Management Policies for the South*, SGPB, December 1974.

DOCUMENTS FROM SOUTH CAROLINA APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *South Carolina Land Resources Conservation Commission 1975-76
Annual Report.*
2. *South Carolina Economic Development Plan, 1975-76, Division of
Administration, Office of Community Development, May 31, 1976.*

January 19, 1977

DOCUMENTS FROM TENNESSEE APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *Site Selection Procedure for Future Power Generating Facilities*, Tennessee Valley Authority Division of Power Resource Planning, March 5, 1974.
2. *A Study of Unmet Housing Needs of Low and Moderate Income Households in Tennessee*, prepared by The Tennessee State Planning Office State Planning Division, December 1972.
3. *Sanitary Services in Tennessee 1975*, James L. Murphy, Jr. and Company, TN-STAE-75-1030, July 1975.
4. *Tennessee Migration, Population, Families, Income, and Manpower Demand Projections to 1990 for Development Districts and Counties*, TN-STAC-7-1017-4, July 1974.
5. *Environmental Problems in Tennessee: Radiation*, State Planning Division, Tennessee State Planning Commission, TN-STAE-6-71-129-2, March 1971.
6. *Housing Needs Analysis*, TN-STAE-76-1038, July 1, 1976.
7. *A Final Report to The Appalachian Regional Commission*, prepared by The Tennessee State Planning Office, Natural Resource Section, July 1975.
8. *An Economic Report to the Governor of the State of Tennessee on the State's Economic Outlook and Revenue Prospects*, Center for Business and Economic Research, TN-STAE-76-1038, January 1976.
9. *Coal in Tennessee*, June 1975.
10. *Land Use Mapping in Tennessee*, TN-STAE-74-1232, October 1974.
11. *Automatic Data Processing System for Surface Mining in Tennessee*, Tennessee Department of Conservation, Division of Geology, TN-STAE-74-1017, September 1974.
12. *Oil and Gas Data System*, Tennessee Division of Geology, TN-STAE-75-1030, June 1975.
13. *Goals and Objectives of State Government in Tennessee*, Ray Blanton, Governor 1976-1977.
14. *Certified Population of Tennessee Incorporated Municipalities*, compiled by Local Planning Division, Tennessee State Planning Office, 1976.

15. Coal Severance Tax by Counties, July 1, 1974, thru June 30, 1975.
16. *Estimates of the Population of Tennessee Counties and Metropolitan Areas: July 1, 1974 and 1975*, Federal-State Cooperative Program for Population Estimates, August 1976.
17. Tennessee Coal Severance Tax Legislation.
18. Tennessee Development Districts (map), compiled by Tennessee State Planning Office.
19. Population Changes for Tennessee Counties 1950-1960 (map), State Planning Division, May 1971.
20. Population Changes for Tennessee Counties 1960-1970 (map), State Planning Division, May 1971.
21. State of Tennessee Population Distribution 1970 (map), State Planning Division, March 1970.

DOCUMENTS FROM TEXAS APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *Coal and Lignite in Texas: A Brief Review*, Center for Energy Studies, Univ. of Texas, July 1975.
2. *Publications of the Center for Energy Studies*, Univ. of Texas.
3. *Texas Energy Outlook: The Next Quarter Century*, Governor's Energy Advisory Council, January 1977.
4. *Policy Position on Selected Energy Issues of the Governor's Energy Advisory Council*, Feb. 21, 1977.
5. *Energy Research Inventory*, Center for Energy and Mineral Resources, Texas A&M University, Sept. 30, 1975.

February 2, 1977

DOCUMENTS FROM VIRGINIA APPLICABLE TO THE NATIONAL COAL UTILIZATION ASSESSMENT

1. *Energy and Virginia's Future*, prepared by the Virginia Energy Resource Advisory Commission, October 26, 1976.
2. *Energy Management and Conservation Program for the Commonwealth of Virginia*, prepared by the Virginia Energy Office, January 4, 1977 (draft copy).
3. *Annual Report for Year 1974*, Virginia Department of Labor and Industry, June 30, 1975.
4. *Annual Report for Year 1975*, Virginia Department of Labor and Industry, June 30, 1976.
5. *Labor Laws and Mining Laws of Virginia*, Department of Labor and Industry, 1976.
6. *Trends in Employment, Hours, and Earnings: Virginia and Standard Metropolitan Areas*, Virginia Department of Labor and Industry, December 1976.
7. *Data Summary: Tazewell County*, Division of State Planning and Community Affairs, February 1976.
8. *Data Summary: Buchanan County*, Division of State Planning and Community Affairs, February 1976.
9. *Data Summary: Russell County*, Division of State Planning and Community Affairs, March 1976.
10. *Data Summary: Dickenson County*, Division of State Planning and Community Affairs, March 1976.
11. *Data Summary: Scott County*, Division of State Planning and Community Affairs, September 1972.
12. *Data Summary: Lee County*, Division of State Planning and Community Affairs, December 1972.
13. *Projections and Economic Base Analysis: Highland County*, Department of Planning and Budget, September 1976.
14. *Projections and Economic Base Analysis: Buchanan County*, Division of State Planning and Community Affairs, September 1973.

15. *Projections and Economic Base Analysis: Dickenson County*, Division of State Planning and Community Affairs, September 1973.
16. *Projections and Economic Base Analysis: Russell County*, Division of State Planning and Community Affairs, September 1973.
17. *Projections and Economic Base Analysis: Wise County, City of Norton*, Division of State Planning and Community Affairs, February 1971.
18. *Projections and Economic Base Analysis: Scott County*, Division of State Planning and Community Affairs, February 1971.
19. *Projections and Economic Base Analysis: Lee County*, Division of State Planning and Community Affairs, February 1971.
20. *Data Summary: Wise County and Norton City*, Division of State Planning and Community Affairs, July 1972.
21. *Population Projections, Virginia Counties and Cities, 1980-2000*, Division of State Planning and Community Affairs, March 1975.
22. *Population Profile, Virginia*, Division of State Planning and Community Affairs, June 1976.

DOCUMENTS FROM WEST VIRGINIA APPLICABLE TO THE NATIONAL COAL UTILIZATION
ASSESSMENT

1. *West Virginia Energy Handbook*, West Virginia Commission on Energy,
Economy and Environment, January 1977.
2. *West Virginia Statewide Traffic Assignment Model*, West Virginia
Dept. of Highways, Advanced Planning Division, February 1977.
3. *West Virginia Coal*, West Virginia Coal Association.
4. *West Virginia Coal Facts, 1976*, West Virginia Coal Association.
5. *Coal Geology Bulletin No. 1 and No. 2*, West Virginia Geological
and Economic Survey.

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APPENDIX A-5

ORNL DWG. 77-2504

NATIONAL COAL UTILIZATION ASSESSMENT (NCUA)

sponsored by

**DIVISION OF TECHNOLOGY OVERVIEW (DTO)
ADMINISTRATOR FOR ENVIRONMENT AND SAFETY (AES)
ERDA**

A-28

OAK RIDGE NATIONAL LABORATORY ORGANIZATION CHART

CONTRACTOR: UNION CARBIDE CORPORATION
NUCLEAR DIVISION

CONTRACT NO. W-7405-ENG-26

APPROVED: *[Signature]* DATE: 11/77

*EVAL CAPACITY.

**REPORTS TO C. R. RICHMOND FOR INFORMATION CENTER COMPLEX PROGRAMMATIC WORK.

***REPORTS TO F. R. BRUCE FOR APPLIED HEALTH PHYSICS AND INDUSTRIAL SAFETY.

ORNL DWG. 77-2505

ASSESSMENT OBJECTIVE

**TO ASSESS THE POTENTIAL ENVIRONMENTAL, SOCIAL,
AND ECONOMIC EFFECTS FROM INCREASED COAL
DEVELOPMENT AND USE AND RELATED COAL TECH-
NOLOGIES AT THE REGIONAL AND NATIONAL LEVEL.**

C. R. RICHMOND, ASSOCIATE DIRECTOR
BIOMEDICAL AND ENVIRONMENTAL SCIENCES

ENVIRONMENTAL SCIENCES DIVISION
S. I. AUERBACH

REGIONAL RESOURCES ANALYSIS AND PLANNING PROGRAM
D. C. PARZYCK

ATMOSPHERIC
TRANSPORT

- LONG-RANGE
- SHORT-RANGE

WATER
RESOURCES

- REGULATED
- UNREGULATED

LAND-USE
PLANNING

- CONVENTIONAL
- ENERGETICS

ECOLOGICAL
EFFECTS

- FORESTS
- MINED AREAS

SENSITIVE
HABITATS

- MAMMALS
- BIRDS

COMPONENTS OF COAL FUEL CYCLE ANALYSIS

- 1. EXTRACTION**
- 2. REFINING AND/OR CONVERSION**
- 3. TRANSPORT OF PRIMARY ENERGY SOURCE**
- 4. CENTRALIZED CONVERSION (e.g., ELECTRICITY GENERATION)**
- 5. TRANSPORT OR TRANSMISSION AND STORAGE OF SECONDARY ENERGY FORM**
- 6. DECENTRALIZED CONVERSION**
- 7. UTILIZATION IN AN END USE DEVICE**

REGIONAL BOUNDARIES FOR LABORATORY ASSESSMENTS

ORNL DWG. 77-2513

NCUA PROGRAM MANAGEMENT STRUCTURE

ORNL DWG. 77-2506

ASSESSMENT SCOPE

TIME: 1975, 1985, 2000, 2020

GEOGRAPHIC: NATIONAL AND REGIONAL

TECHNICAL: FOUR SCENARIOS

- RECENT TRENDS — BASE CASE
- HIGH COAL ELECTRIC
- ACCELERATED SYNTHETIC FUELS
- HIGH COAL ELECTRIC AND
ACCELERATED SYNTHETIC FUELS

SCENARIO RATIONALE

- **HIGHLIGHT ESSENTIAL FEATURES OF COAL DEVELOPMENT OPTIONS**
- **BOUND THE RANGE OF COAL DEVELOPMENT AND UTILIZATION**
- **PROVIDE MECHANISM AND COMMON FRAMEWORK FOR COMPARING IMPACTS OF ALTERNATIVE COAL TECHNOLOGIES**

DEFINITION OF SCENARIOS

RECENT TRENDS – BASE CASE

BASED ON PROJECTIONS OF RECENT TRENDS OF COAL USE AND USE OF EXISTING TECHNOLOGIES AND TECHNOLOGIES IN DEMONSTRATION PHASE.

HIGH COAL ELECTRIC

REFLECTING APPROXIMATELY 25% INCREASED USE OF COAL IN ELECTRICITY GENERATION FOR 2000 AND 2020. ADVANCED COMBUSTION AND ENVIRONMENTAL CONTROL WILL BE CONSIDERED.

ACCELERATED SYNTHETIC FUELS

CONTINUED DEMAND FOR GASEOUS AND LIQUID FUELS AND INCREASED USE OF COAL-DERIVED SYNTHETIC FUELS.

HIGH COAL ELECTRIC AND ACCELERATED SYNTHETIC FUELS

UPPER LEVEL OF COAL UTILIZATION THROUGH INCREASED USE OF COAL FOR ELECTRICITY GENERATION AND SYNTHETIC FUEL PRODUCTION.

Coal fields of the conterminous United States. Source: Averitt, P. 1975. *Coal resources of the United States, January 1, 1974*. U. S. Geol. Surv. Bull. 1412. Fig. 1, p. 5.

REGIONAL COAL EXTRACTION BY SCENARIO^a
(MILLIONS OF TONS PER YEAR)

YEAR	TOTAL U.S. PRODUCTION	APPALACHIA	INTERIOR	GULF	N. G. PLAINS	MOUNTAIN
1975		389	148	12	59	32
(RECENT TRENDS)						
1985	1,144	612	150	52	234	96
2000	1,634	815	185	82	388	164
2020	3,299	1,372	366	188	1,038	335
(HIGH COAL ELECTRIC)						
1985	1,139	598	154	52	235	100
2000	1,843	893	225	100	438	187
2020	3,645	1,483	435	217	1,159	351
(ACCELERATED SYNFUELS)						
1985	1,194	603	167	57	254	113
2000	2,104	859	274	165	625	181
2020	3,900	1,494	549	296	1,238	323
(ACCELERATED COAL ELECTRIC AND SYNFUELS)						
1985	1,171	598	159	57	248	109
2000	2,250	937	300	169	645	199
2020	4,112	1,586	571	307	1,304	344

^aINCLUDES IN SITU CONVERSION AND FOREIGN EXPORTS.

ORNL APPROACH TO REGIONAL INTEGRATED ASSESSMENTS

**WORK STATEMENT CATEGORY: COORDINATION WITH STATE AND
REGIONAL AGENCIES (TASK 1)**

TASK DESCRIPTION:

- (1) REVIEW THE PURPOSE AND SCOPE OF THE COAL UTILIZATION ASSESSMENT.
- (2) ESTABLISH A SYSTEM FOR CONTINUOUSLY COMMUNICATING WITH STATE AND REGIONAL AGENCIES.
- (3) MEET WITH REPRESENTATIVES OF GOVERNORS' OFFICES, STATE ENERGY OFFICES, AND OTHER KEY STATE OFFICIALS TO:
 - (A) IDENTIFY IMPORTANT COAL DEVELOPMENT AND CONVERSION PROBLEMS.
 - (B) IDENTIFY ISSUES AND MANAGEMENT OPTIONS AVAILABLE.
 - (C) IDENTIFY CURRENT AND FUTURE STATE PLANS FOR MANAGING COAL DEVELOPMENT.

OUTPUTS AND MILESTONES:

- (1) REGIONAL CHARACTERIZATION REPORT – DRAFT MARCH 30, FINAL REPORT MAY 30, 1977.

**WORK STATEMENT CATEGORY: TECHNOLOGY CHARACTERIZATION
(TASK 2)**

TASK DESCRIPTION:

- (1) DESCRIBE AND CHARACTERIZE ALTERNATIVE COAL TECHNOLOGIES INCLUDING MAJOR TECHNICAL, SOCIAL, ECONOMIC AND ENVIRONMENTAL CHARACTERISTICS.
- (2) TWO STEP CHARACTERIZATION — INTERIM TO INITIATE ASSESSMENT; ADD DETAIL AS IT IS AVAILABLE.

OUTPUTS AND MILESTONES:

- (1) INTERIM CHARACTERIZATION — NOVEMBER 30, 1976.
- (2) FIRST YEAR CHARACTERIZATION — JUNE 30, 1977.

WORK STATEMENT CATEGORY: ECONOMIC (TASK 3.1)

TASK DESCRIPTION:

- (1) ALLOCATE REGIONAL ELECTRICITY DEMAND TO EACH BEA IN SOUTH AS A BASIS FOR A PRELIMINARY SITING PATTERN FOR FUTURE GENERATING UNITS IN REGION.
- (2) ALLOCATE BASELINE POPULATION AND EMPLOYMENT FOR EACH BEA IN SOUTH FROM 1975–2020.
- (3) ANALYZE SHIFTS IN POPULATION AND EMPLOYMENT PATTERNS IN BEA's ASSOCIATED WITH ALTERNATIVE STRATEGIES OF COAL DEVELOPMENT.

OUTPUTS AND MILESTONES:

- (1) ALLOCATE ELECTRICITY DEMAND – NOVEMBER 30, 1976
- (2) ALLOCATE BASELINE POPULATION AND EMPLOYMENT – JAN. 31, 1977
- (3) ASSESS POPULATION AND EMPLOYMENT SHIFTS – MAY 30, 1977

WORK STATEMENT CATEGORY: SOCIAL (TASK 3.2)

TASK DESCRIPTION:

- (1) ASSESS SOCIAL IMPACTS OF DIFFERENT STAGES OF COAL FUEL CYCLE.
- (2) IDENTIFY INITIAL SOCIAL CRITERIA FOR EVALUATING POTENTIAL SITES FOR LOCATING COAL TECHNOLOGIES.
- (3) IDENTIFY FISCAL, SOCIAL AND INSTITUTIONAL CONSTRAINTS TO COAL DEVELOPMENT.
- (4) CONDUCT SOCIAL ASSESSMENTS AT SITES SELECTED TO ILLUSTRATE IMPACTS FROM COAL EXTRACTION, CONVERSION, AND COMBUSTION.

OUTPUTS AND MILESTONES:

- (1) INITIAL SITING CRITERIA – JAN. 31, 1977.
- (2) REPORT ON SOCIAL IMPACTS OF COAL FUEL CYCLE – APRIL 30, 1977.
- (3) REPORT ON CONSTRAINTS – MAY 31, 1977.
- (4) CONDUCT INITIAL SOCIAL ASSESSMENTS – MAY 31, 1977.

WORK STATEMENT CATEGORY: SITING (TASK 4)

TASK DESCRIPTION:

- (1) SCREEN AND SELECT CANDIDATE AREAS SUITABLE FOR FOSSIL AND NUCLEAR POWER PLANTS AND COAL CONVERSION PLANTS IN SOUTH.
- (2) COUNTY SITING PATTERNS WILL BE DEVELOPED FOR EACH SCENARIO BY YEAR (1985, 2000, 2020).
- (3) SITING APPROACH TO BE USED BY ORNL (FIGURE 1).

OUTPUTS AND MILESTONES:

- (1) INITIAL SITING FOR FOUR SCENARIOS – JAN. 30, 1977.
- (2) REVISED FIRST YEAR SITING PATTERN – JUNE 30, 1977.

WORK STATEMENT CATEGORY: AIR QUALITY (TASK 5)

TASK DESCRIPTION:

- (1) ANALYZE THE TRANSPORT OF AIRBORNE POLLUTANTS FROM COAL CONVERSION AND COMBUSTION FACILITIES SITED IN REGION.
- (2) ESTIMATE GROUND LEVEL POLLUTANT CONCENTRATIONS FOR EACH SITING PATTERN DEVELOPED.

OUTPUTS AND MILESTONES:

- (1) EVALUATION OF INITIAL SUITABILITY OF SITES – JAN. 31, 1977.
- (2) EVALUATION OF ALTERNATIVE SITING PATTERNS – FEB. 28, 1977.

WORK STATEMENT CATEGORY: WATER RESOURCES (TASK 6)

TASK DESCRIPTION:

- (1) ANALYZE WATER AVAILABILITY FOR SITING FUTURE ENERGY FACILITIES.**
- (2) IDENTIFY SUBREGIONS WITH POTENTIAL WATER SHORTAGES.**
- (3) EVALUATE THE RELATIVE IMPORTANCE OF WATER AVAILABILITY TO THE FOUR MAJOR SCENARIOS.**

OUTPUTS AND MILESTONES:

- (1) COMPLETE LOW FLOW ANALYSIS NOV. 30, 1976.**
- (2) CONSTRUCT INDICES OF WATER AVAILABILITY DEC. 30, 1976.**
- (3) REPORT ON LOW FLOW ANALYSIS JUNE 30, 1977.**
- (4) REPORT OF WATER/SCENARIO RELATIONSHIP JAN. 31, 1978.**

WORK STATEMENT CATEGORY: ECOSYSTEM (TASK 7)

TASK DESCRIPTION:

- (1) AIR POLLUTION IMPACT ANALYSIS.
- (2) ECOLOGICAL IMPACT ANALYSIS.
- (3) POLLUTANT IMPACTS ON FOREST ECOSYSTEMS.
- (4) ANALYSIS OF IMPACTS ON ANIMAL SPECIES.
- (5) IMPACT ANALYSIS OF CO₂ LEVELS.

OUTPUTS AND MILESTONES:

- (1) FIRST YEAR IMPACT ASSESSMENTS — JUNE 30, 1977.

WORK STATEMENT CATEGORY: HEALTH IMPACT (TASK 8)

TASK DESCRIPTION:

- (1) EVALUATE DIRECT AND INDIRECT EFFECTS OF INCREASED COAL UTILIZATION ON PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY IN SOUTH.**
- (2) EVALUATE EFFECTS FOR FOUR SCENARIOS AND ALTERNATIVE COAL TECHNOLOGIES.**

OUTPUTS AND MILESTONES:

- (1) FIRST YEAR HEALTH AND SAFETY ASSESSMENT – MAY 30, 1977.**

**WORK STATEMENT CATEGORY: REGIONAL INTEGRATION
AND ASSESSMENT (TASK 9)**

TASK DESCRIPTION:

- (1) COMPILE INDIVIDUAL TASK OUTPUTS.
- (2) SYNTHESIZE TASK OUTPUTS INTO REGIONAL INTEGRATION
AND ASSESSMENT.

OUTPUTS AND MILESTONES:

- (1) DEVELOP REPORT FORMAT JAN. 30, 1977.
- (2) FIRST YEAR ASSESSMENT REPORT JUNE 30, 1977.

National Coal Utilization Assessment Task Interactions

PROVIDES INPUTS TO TASK:

	1.0	2.0	3.1	3.2	4.0	5.0	6.0	7.1	7.2	7.3	7.4	7.5	8.0	9.0
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9.0

= INDICATES INTERACTION

Schedule for National Coal Utilization Assessment (NCUA)

(Δ = END OF MONTH DEADLINES)

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