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State Policies and Requirements for Management of Uranium Mining and Milling in New Mexico

MASTER

Volume IV — The Supply of Electric Power and Natural Gas Fuel as
Possible Constraints on Uranium Production

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STATE POLICIES AND REQUIREMENTS FOR MANAGEMENT
OF URANIUM MINING AND MILLING IN NEW MEXICO

VOLUME IV

THE SUPPLY OF ELECTRIC POWER AND NATURAL GAS
FUEL AS POSSIBLE CONSTRAINTS ON URANIUM PRODUCTION

Prepared for the
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ABSTRACT

The report contained in this volume considers the availability of electric power to supply uranium mines and mills. The report, submitted to Sandia Laboratories by the New Mexico Department of Energy and Minerals (EMD), is reproduced without modification. The state concludes that the supply of power, including natural gas-fueled production, will not constrain uranium production.

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FOREWORD

In 1977, the Sandia Laboratories' Office of Environmental Policy Analysis and the State of New Mexico agreed upon a cooperative analysis of environmental, health, resource use, socioeconomic and institutional (EHRSI) problems resulting from uranium mining and milling in the state. Four issues were identified by state agencies as potentially significant constraints to increasing uranium production in New Mexico. Sandia had initiated the cooperative analysis by organizing a conference on the coordination of environmental analysis activities. The conference, held in Grants, New Mexico, in May, 1977, was cosponsored by the ERDA Office of Environmental Policy Analysis and the New Mexico Environmental Improvement Agency. A tour of the Kerr-McGee uranium mine and mill was included.

The objectives of the conference were: 1) to develop a mutual understanding of the issues, 2) to explore a mechanism by which to include local and state officials in national energy planning regarding New Mexico, and 3) to determine what actions were needed to facilitate analysis of the most critical issues. The conferees agreed that four major uranium production issues must be resolved to avoid potential conflicts between federal and state interests. As a result of the conference, Sandia Laboratories entered into negotiations with three agencies of the State of New Mexico for an assessment of the issues from the State point of view. Four contracts were signed in September

of 1977. Each contract provided for consideration of one of the four issues which had been identified in May.

The studies conducted by the State agencies were to have these five common features:

1. Identification of all governmental activities and associated decision makers that influence the issue under consideration.
2. Description of the policy options that are most relevant from the State's point of view for coordination with federal, state, and local government activities.
3. An outline and cost estimate of technical, scientific, and engineering support services required for development of the prospective options.
4. Operational and organizational recommendations for a cooperative policy-option analysis program.
5. An estimate of the resources required to provide the technical, scientific and engineering information and services which DOE would be asked to contribute to the proposed policy option analysis.

The issues and the State agencies contracted to explore them were as follows:

1. The New Mexico State Engineer agreed to a study of water availability and the related issues associated with uranium mining and milling in the San Juan Structural Basin. The State Engineer was expected to define the need for and the requirements of a

program to provide necessary information for management of the water resources in the Basin.

2. The New Mexico Energy Resources Board agreed to consider community impact assistance requirements in the Grants Mineral Belt. The Energy Resources Board was expected to define the problem and identify a program which would allow avoidance of socio-economic constraints on uranium production.
3. The New Mexico Environmental Improvement Agency, Radiation Section, agreed to provide a comprehensive description of its regulatory authority and planned regulatory developments. The agency was to describe the data and analysis needed to support regulatory development.
4. The New Mexico Energy Resources Board agreed to assess the electric power allocation for uranium development and the effects of competing power demands by the various energy industries, other industrial users, and communities in New Mexico.

These program planning studies were designed to provide DOE a basis for understanding the issues, the decision points, and the State's preferred alternatives for programs to solve EHRSI problems while increasing uranium production. Upon receipt of the studies, this office examined the issue analyses and recommendations of the State. The State, in turn, was invited to provide comments on the Sandia companion papers.

For two of the contracted studies, the Sandia analysis and the State's paper* comprise one volume (in two parts) of State Policies and Requirements for Management of Uranium Mining and Milling Impacts in New Mexico, prepared for publication by Sandia Laboratories. The third study stands alone as Volume IV. The fourth study did not provide an analysis of the issue; it proposed a management program, which comprises Volume V. The documents were prepared for the Office of Technology Impacts, the Department of Energy successor to the ERDA Office of Environmental Policy Analysis.

The five volumes of the study are as follows:

Volume I - Executive Summary, SAND 79-0973;

Volume II - Water Availability in the San Juan Structural Basin, SAND 78-1331;

Volume III - Adverse Effects of Uranium Mining and Milling on the Physical Environment,
SAND 78-1332;

Volume IV - The Supply of Electric Power and Natural Gas Fuel as Possible Constraints on Uranium Production, SAND 79-7105

Volume V - State Policy Needs for Community Impact Assistance, SAND 79-7093.

*The State's issue paper in each volume is reproduced exactly as presented to Sandia, without modification.

ENERGY AND MINERALS DEPARTMENT

STATE OF NEW MEXICO

Santa Fe

THE SUPPLY OF ELECTRIC POWER AND NATURAL GAS FUEL

AS POSSIBLE CONSTRAINTS ON URANIUM PRODUCTION

IN NEW MEXICO

Submitted to

Sandia Laboratories
Environmental Research Division
Albuquerque, New Mexico

MARCH 1978

Updated December 1979

NORTHWEST QUADRANT URANIUM, COAL, GAS AND OIL DEVELOPMENT

RELATIONSHIP OF URANIUM BELT TO COAL AND GAS AND OIL FIELDS

G. P. '77

ELECTRIC POWER AND NATURAL GAS ENERGY
AS POSSIBLE CONSTRAINTS ON NEW MEXICO
URANIUM PRODUCTION

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I. INTRODUCTION

Background and Rationale for Preliminary Investigation

President Carter's April 7, 1977 statement on the Nuclear Non-Proliferation Policy Act of 1977 called for an indefinite deferral of commercial reprocessing and recycling of plutonium produced in the U.S. Nuclear Power Program. Among the seven major issues raised in the statement was the need to increase the capacity to produce enriched uranium.

Appreciating the impact of a possible increase of production on New Mexico, which now supplies 46% of U.S. production, the Office of Environmental Policy of the Energy, Research and Development Administration (ERDA), and Sandia Laboratories hosted a conference of State, Federal and Sandia Laboratory representatives to explore possible impacts of the non-proliferation policy on New Mexico. The conference, held in Grants, New Mexico on May 4 and 5, 1977, explored various issues that might be involved in determining the maximum rate of uranium production in the Grants Mineral Belt (GMB) that could be accepted as economically and environmentally sound.

A frame of reference was adopted by conference leaders which involved a tripling of U_3O_8 production of the GMB by 1985 and a doubling again by 2000. The general objective of the conference were (i) to develop a mutual understanding of environmental and economic issues that are associated with the rapid depletion of domestic uranium resources, (ii) to recognize the role of state officials in national energy

planning, and (iii) to determine which actions are needed to initiate a cooperative analysis of the most critical issues.

Questionnaires were distributed outlining various areas of potential interest. Opinions were solicited on the relative importance of selected issues and the availability of data required for their analysis.

Four general issue areas were identified out of the conference and analysis of returned questionnaires. They were:

1. impact of uranium mining and milling on water resources;
2. impact of radioactivity and trace element transport into the environment;
3. power and fuel requirements for uranium development in New Mexico;
4. coordination of uranium and community development.

As agreement was reached between State agencies and Sandia Laboratories which initiated a joint program for developing policy options as a first step toward a realization of the problems associated with a stepped up uranium ore production program. The Energy and Minerals Department, the Environmental Improvement Division and the State Engineer accepted DOE/Sandia requests to begin preliminary studies on water, energy, community development and environmental as-

pects of expanded ore production.

Purpose

This paper examines the third of the four general issue areas. Its purpose is (1) to determine whether electric power and natural gas are potential constraints on expanded U_3O_8 production and, if so, (2) to suggest areas which might be examined for future policy option development.

Methodology

Although the preparation of this report included a survey of literature and statistics, much of the content was derived from direct contact with the relevant parties. Interviews and correspondence were initiated with utility companies, uranium producers and Federal and State agencies involved with the energy and uranium production sectors in an attempt to identify issues affecting electrical and natural gas use in New Mexico and in the Uranium Belt in particular.

II. BACKGROUND ON NEW MEXICO URANIUM ORE PRODUCTION

Importance of New Mexico as a Uranium Producer

New Mexico has been the nation's leading uranium producer for many years. Through 1974, the State had contri-

buted 40% of the cumulative production of U_3O_8 in the United States. Current production is approximately 46% of the national total. New Mexico also has the largest reserves among the 50 states. A total of 302,700 tons of U_3O_8 (forward cost reserves of \$30 or better) or 47% of nationwide reserves has been identified.

Milling capacity of 18,160 tons of ore per day represents more than 63% of the nation's present capacity. New Mexico, without question, is the nation's leading producer of U_3O_8 and should continue to be so for the foreseeable future.

Areas Affected by Increased Uranium Production

The term "Grants uranium region (or belt)" has been used by the uranium industry to describe the area encompassing all the known large uranium deposits in the northwestern part of the State. The area or belt is approximately 100 miles long from east to west, commencing in the vicinity of the Rio Puerco about 20 miles west of Albuquerque and extending northwestward to a point a few miles north of Gallup. Maximum width of the belt, from southwest to northwest, is about 20 miles.¹ Located in three counties, McKinley, Valencia and Sandoval, the region has been divided into three mining districts, the Laguna District on the east, the Ambrosia Lake District in the middle and the Church Rock or Gallup District on the west. The two most productive dis-

tricts have been the Laguna and Ambrosia Lake Districts. About 98 mines of the inclined, shaft and open pit types have produced in the Grants uranium region from 1951 to the present.

Exploration and drilling have extended beyond the present belt, with interest shown in the northwest corner of New Mexico on Navajo Tribal lands, in the area 20 miles northwest of Albuquerque, and in the southern portion of the San Juan Basin where the Morrison formation occurs, particularly north of Seven Lakes. These activities indicate that the belt may broaden in the future, becoming 45 or 50 miles wide rather than the general width now of 20 miles. The possibility exists that very large resources of uranium ore may be found north of the present belt in the future.

The existence of six billion tons of strippable low sulfur coal, in a zone just north and parallelling the uranium belt compounds the energy requirement picture. Plans for development of this coal are well advanced with activity expected in the 1980's. Active coal mines are already located at the western end and north of the Grants Mineral Belt.

(i) Regional

Northwest of the uranium belt is located the electrical generation "park" consisting of the giant Four Corners and

San Juan plants which provide energy to several western states including New Mexico. Most of the northwest quadrant in New Mexico, including the Grants Mineral Belt, is supplied electrical power from these plants. Because of this close relationship, impacts stemming from electrical supply to the Grants Mineral Belt and San Juan Basin will tend to be felt both in the surrounding regional areas and in the rest of New Mexico.

(ii) Northwest Growth

There are obvious growth areas in the northwest quadrant of New Mexico. They include, in particular, the principal cities in the uranium/coal region as shown in Table 1. Farmington is obvious because of its location near the San Juan gas and oil field; and, in the future, because of its geographical position north of the proposed coal gasification plants. Gallup will grow because of the location of coal and uranium on and under its borders. Coal from the McKinley mines fuels the Cholla generating plant in Arizona. Grants and Milan must be included, of course, because they are presently the active uranium boom towns. Thus, the northwest quadrant of the state, consisting of McKinley, San Juan and Valencia Counties, must be considered essentially an "energy producing province."

The Governor's Energy Impact Task Force preliminary report estimates that there are 154,000 people within this region who will be directly affected by energy mining efforts.² By 1985, the report estimates there will be a population of 229,000. These population estimates, shown in Table 1a, assume that construction of one coal gasification plant will be underway in 1981 and one more plant started by 1985.

Table 1

Principal Cities in the Uranium/Coal Region

	<u>Population</u>
Farmington	29,700
Gallup	17,600
Grants-Milan area	15,000
Shiprock	8,000 (±)
Aztec	4,327
Bloomfield	2,030
	<u>76,657 (±)</u>

Table 1a

Directly Impacted Areas²

(Population)

	<u>1976</u>	<u>1985</u>
San Juan County Area	65,000	92,746
McKinley County Area	51,600	67,345
West Valencia and Sandoval County Area (47% Valencia)	40,134	69,279
	<u>156,734</u>	<u>229,370</u>

Table 2

Population of Impacted Counties³

	<u>1970</u>	<u>1976</u>	<u>Percent Change</u>
McKinley	43,208	56,000	29
San Juan	52,517	67,700	29
Valencia	40,476	48,400	19
Total	137,201	172,100	Average change 24%

(iii) Peripheral Growth

On the periphery of the uranium/coal belt are two growth areas, Bernalillo County, containing Albuquerque, and Sandoval County which are and will continue to be impacted by mineral development. Albuquerque will be affected because it is a major supply center and Sandoval County because of its location on the eastern edge of the uranium belt. These peripheral areas have also experienced recent high growth rates as shown in Table 3, although the impact of the energy sector on this growth is unquantified. Adding the estimated population of the Northwest quadrant of 169,000 to the periphery area population of 388,000 suggests that approximately 50% of New Mexico's population is directly or indirectly affected by energy development in the northwest quadrant.

Table 3

Expanded Affected Area

(Population)

	<u>1970</u>	<u>1976</u>	<u>Percent Change</u>
Bernalillo	315,775	364,300	15.5
Sandoval	14,492	23,400	33.7
Total	<u>330,267</u>	<u>387,700</u>	

III. NEW MEXICO'S ELECTRICAL POWER SECTOR

Public Utility Systems

Commercial electric power was first installed in New Mexico in 1891.⁴ By 1977 the New Mexico electrical system was owned and operated by nine private companies, 21 cooperatives, seven municipalities, three government agencies and two industrial firms.⁵ Table 4 shows the ownership of the state electrical systems. Figures 1 and 3 show the principal transmission lines.

Of the nine private companies, two have their entire systems inside New Mexico and seven have interstate ties. Of the 21 Rural Electrical Cooperatives all but four are entirely within the State.⁶ The municipal systems include the Navajo Tribal Utility Authority which serves the reservation in Arizona and New Mexico but wheels power from the Four Corners Plant through New Mexico transmission systems.

FIGURE 1.

NEW MEXICO URANIUM BELT AND ELECTRIC TRANSMISSION LINES 1977

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FIGURE 2

NEW MEXICO ELECTRICAL POWER CAPACITY

SOURCE OF 1957-1972 DATA, KLEINE AND FORD,
JULY 1973. UPDATED 1977. G. P. 12/ '77

G. P. '77

FIGURE 3

PRINCIPAL ELECTRICAL FACILITIES IN NEW MEXICO

TABLE 4
Ownership of the State Electrical System
1977

Private

1. Arizona Public Service Co.
2. Community Public Service Co.
3. El Paso Electric Co.
4. New Mexico Electric Service Co.
5. Public Service Co. of New Mexico
6. Southern California Edison Co.
7. Southwestern Public Service Co.
8. Tucson Gas & Electric Co.
9. Utah Power & Light Co.

Municipal

1. Clayton
2. Farmington
3. Gallup
4. Navajo Tribal Utility Authority
5. Raton
6. Truth or Consequences
7. Tucumcari

Governmental

1. Atomic Energy Commission
2. Bureau of Reclamation
3. Salt River Valley Project

Industrial (Major)

1. Hurley (Kennecott)
2. Tyrone (Phelps-Dodge)

Source: Kleine and Ford 1973

TABLE 4 (cont'd)

Ownership of the State Electrical System
1977

Rural Electric Cooperatives

1. Central New Mexico
2. Central Valley
3. Continental Divide
4. Columbus
5. Duncan Valley (Arizona)
6. Farmers
7. Jemez Mountain
8. Kit Carson
9. La Plata (Colorado)
10. Lea County
11. Mora-San Miguel
12. Navopache (Arizona)
13. Northern Rio Arriba
14. Otero County
15. Plains Electric Generation and Transmission
16. Rio Grande (Texas)
17. Roosevelt County
18. Sierra County
19. Socorro
20. Southwestern
21. Springer

Source: Kleine and Ford 1973

(i) Generating Capacity

By 1977, 23 power plants were located in New Mexico with a combined generating capacity of 3981.5 megawatts. This represented almost a tripling of generation capacity over a period of 12 years, largely due to the Four Corners Project (see Figure 2). Table 5 provides details on the 23 power plants plus an additional plant located in El Paso, Texas but serving southern New Mexico. Figure 3 shows their geographical location.

Analysis of Table 5 indicates that of the twenty-four generating plants, twenty are dependent on natural gas for primary fuel and all but four are relying on oil as a standby fuel. The exceptions are the hydroelectric plant at Elephant Butte and the coal burning plants at Four Corners, San Juan and Raton. The three coal burning plants account for over 56 percent of total generating capacity, however. On the other hand, of the eight plants in the State having 100 MW or more capacity, six are using natural gas and are relying on oil for standby fuel.

(ii) PNM and Plains

Public Service of New Mexico (PNM) and Plains Electric-Generation and Transmission Cooperative (Plains) are the two major companies serving in-state customers of the western two thirds of the state. PNM has generating plants in San Juan and Bernalillo Counties. Figures 3 shows locations of

Table 5

NEW MEXICO POWER PLANTS, 1977

No.	Names	MW Cap.	Type	Stand-by		Owned by
				Fuel	Fuel	
1.	Algodones	51.0	ST	NG	Oil	Plains Electric Gen. & Trans.
2.	Carlsbad	61.0	ST,GT	NG	Oil	Southwestern Public Service
3.	Clayton	6.9	IC, Wind	NG	Oil	City of Clayton
4.	Cunningham	265.4	ST	NG	Oil	Southwest Public Service
5.	Elephant Butte	24.3	HY			U.S. Bureau of Reclamation
6.	Farmington	30.0	ST	NG	Oil	Town of Farmington
7.	Four Corners	2170.0	ST	Coal		Arizona Public Service, El Paso Electric Public Service of New Mexico Tucson Gas & Electric, Southern California Edison Salt River Project
8.	Hobbs	180.0	ST	NG	Oil	New Mexico Electric Service
9.	Lordsburg	55.0	ST	NG	Oil	Community Public Service Co.
10.	Lovington	69.5	ST,IC	NG	Oil	Lea County Elec. Coop., Inc.
11.	Newman*	(289.9)	ST	NG	Oil	El Paso Electric Co.
12.	Person	96.0	ST	NG	Oil	Public Service Co. of N.M.
13.	Prager	26.0	ST	NG	Oil	Public Service Co. of N.M.
14.	Raton	12.0	ST	Coal	Oil	Town of Raton
15.	Reeves	175.0	ST	NG	Oil	Public Service Co. of N.M.
16.	Rio Grande	396.0	ST	NG	Oil	El Paso Electric Co.
17.	Roswell	34.0	ST	NG	Oil	Southwestern Public Serv. Co.
			GT	NG	Oil	
18.	Santa Fe	12.0	ST	NG	Oil	Public Service Co. of N.M.
19.	Tucumcari	16.2	IC	NG	Oil	City of Tucumcari
20.	Hurley	65.0	ST	NG	Oil	Kennecott Copper Corp.

Table 5 (cont'd)

<u>No.</u>	<u>Names</u>	<u>MW Cap.</u>	<u>Type</u>	<u>Stand-by</u>		<u>Owned by</u>
				<u>Fuel</u>	<u>Fuel</u>	
21.	San Juan	676.0	ST	Coal		Public Service Co. of New Mexico
22.	Las Vegas	21.0	GT	NG	Oil	Tucson Gas & Electric
23.	Los Alamos	16.0	ST	NG	Oil	Public Service Co. of N.M.
24.	Tyrone	50.0	IC	NG	Oil	U.S. Govt., Atomic Energy Comm.
						Phelps Dodge Corporation

Note: Number of Plant corresponds to number on Principal Electrical Facility Map.
(Figure 3.)

* Newman Power Plant is located in El Paso County Texas.

ST - Steam

IC - Internal Combustion

HY - Hydroelectric

NG - Natural Gas

GT - Gas Turbine

Source: Kleine and Ford
Legislative Energy Committee
Utility Report 1976
Public Service of New Mexico
December 1977

Public Service Commission 1978
Energy and Minerals Department,
Mining and Minerals Division 1979

each company's plants and distribution systems. The larger of the two systems, Public Service of New Mexico, has 789 MW of capacity as indicated in Table 6.

Table 6

Public Service of New Mexico
Plants in Service

<u>Plant</u>	<u>Capacity in MW</u>	<u>Generation (1000 MWH)</u>
Person	96	504
Reeves	175	1,122
San Juan	310	4,882
Four Corners (PNM only) (Arizona Public Service #4,#5)	208	
Total	<u>789</u>	

Stand-by plants not included

The Plains Electric Generation and Transmission Cooperative, Inc. serves the systems of eleven affiliated members. These cooperatives provide distribution systems for electric power purchased from Plains Electric, their sole source of power. The eleven members serve approximately two thirds of the geographical area of the State and approximately 25% of the State's population. Figure 4 indicates the service areas.

FIGURE 4

G. B. P.

The company has a single 49.5 MW plant at Algodones but purchases additional power from the Bureau of Reclamation and Public Service of New Mexico. Wheeling and interconnecting agreements with these two producers are also in force.

Regional Grid Relationships

The U.S. electrical generation and distribution system is divided into nine regions and is known as the National Reliability Council (NERC). The State of New Mexico is located on the edge of three of these regional councils, the WSCC, ERCOT and the SPP, although for practical purposes most of the State's land area and population is served by the WSCC. Figure 5 shows the location of the regional councils.

The WSCC or Western Systems Coordinating Council is the largest of the nine regional councils in land area and second largest in generating resources and peak load.⁷ It is composed of 46 members located in California, Arizona, Washington, Utah, Montana, Nevada, Idaho, Colorado, Oregon, Wyoming and parts of Nebraska, South Dakota, Texas and British Columbia, Canada. Both of the two major electric generating and distribution companies in New Mexico, Public Service Company of New Mexico and Plains Electric Generation and Transmission Cooperative, Inc., are members of the WSCC. Figure 6 shows transmission lines 230 KV or above for the system.

FIGURE 5

NATIONAL ELECTRIC RELIABILITY COUNCIL REGIONS

SOURCE : WSSC 1975

FIGURE 6

**WESTERN HIGH VOLTAGE
TRANSMISSION LOOP**

NOTE : TRANSMISSION LINES ARE 230,000 VOLTS OR OVER.

SOURCE : ADAPTED FROM WESTERN INTERSTATE NUCLEAR BOARD,
WESTERN STATES ENERGY RESOURCE DEVELOPMENT
UPDATE 1976

G. D. P.

The WSCC membership is composed of separate bulk power producers and subregional networks formed into so-called "power pools." The sub-regional networks belonging to the WSCC are The Northwest Power Pool (Washington, Oregon, Utah, Idaho, Montana), The Rocky Mountain Power Area (Colorado, Wyoming and parts of western South Dakota and Nebraska), the Pacific Southwest Power Area (California, Nevada, Arizona) and the New Mexico Power Pool (New Mexico and El Paso area).

Two implications of New Mexico's regional memberships are clear. First, there is a separation of major electrical systems in the State with all but an eastern strip of New Mexico being tied to the WSCC. This is well illustrated in Figure 1. Second, any electrical demand impact resulting from increased uranium production in the Northwest quadrant of the State potentially affects all of the State with the exception of the eastern strip.

A possible third implication of New Mexico's regional ties that is not clear is its potential vulnerability to abnormal electrical demands because of its essential lack of interties with systems other than the WSCC. This lack of additional interties combined with New Mexico's peripheral location on the southeastern edge of the WSCC might conceivably pose problems under certain sets of adverse conditions. An industry representative states, however, that there is an advantage to being on the edge, in that there might be a demand for power transfer to pools eastward if

additional interties existed.

(i) Regional Demand

Peak demand forecasts developed by the WSCC indicate that, based on an average annual compound growth rate of 7.41 percent, peak demand for the New Mexico Power Pool (New Mexico and El Paso Area) will rise from 1,507 MW in 1975 to 2,868 MW in 1984 and to 6,300 MW in 1995.⁸ This implies a fourfold increase in electrical power demand in the New Mexico Power Pool by 1995.

(ii) Net Import - Export

New Mexico is a net exporter of electrical energy, due primarily to the sales of the Four Corners Plant to consumers in Arizona and California. The routes of export transmission lines are shown in Figure 1. Table 7 indicates that 2085 MW capacity presently exists at the Four Corner Plant for the five out-of-state electric companies. Thus, of the 3981.5 megawatts capacity of installed plants in New Mexico, almost 50% is committed to export (all coal-fired).

The seven electric cooperatives and municipal systems located along the eastern edge of the State have a total generating capacity of 553 MW. Several of the systems are interconnected with Texas generating stations. Data compiled by the Federal Power Commission indicates no imports of electric energy. Exports in 1974 were 10,428 MWH of a

17,498 MWH total or 59.6% of the total net production.

Information furnished December 21, 1977 by representatives of Southwestern Electric and El Paso Electric clarifies the import-export situation for the eastern and southern electric systems of the State. Although the two large stations and systems exchange power transfer between New Mexico and Texas, the exports from New Mexico far exceed the power received from Texas and Oklahoma.⁹

A Los Alamos Scientific Laboratory flow study supports the earlier conclusion on electrical exports, that less than half of production is being consumed domestically. The study notes that considering all energy produced from gas, oil, natural gas liquids and coal in New Mexico, a total of 2110 trillion BTU's, only 556 trillion BTUs are consumed in the State.⁴¹

Consumption Patterns

Although strictly comparable data were not immediately available, some sense of New Mexico electrical consumption can be derived from Table 8. In the period 1973-1974 the nine municipal electric companies sold 445,134 MWH;¹¹ in 1976, the New Mexico Rural Electric Cooperatives purchased and distributed 1,359,816 MWH.¹³ Thus, a rough estimate of electrical power consumed in New Mexico in 1975 would be approximately 7 million MWH.

Table 7
The Four Corners Generation Complex

<u>Ownership</u>	<u>Units</u>	<u>Capacity</u>	<u>Date Installed</u> ¹⁰
Arizona Public Service	1	565,000 KW	1963-1964
Arizona Public Service	2	"	"
Arizona Public Service	3	"	"
Southern California Edison Co. (48%)	4	755,000 KW	1969
Arizona Public Service (15%)		<u>755,000</u> KW	1970
		2,085,000	
Public Service of New Mexico (13%)	5		1970
Salt River Project (10%)			"
Tucson Gas & Electric (7%)			"
El Paso Electric Co. (7%)	21		

Table 8

New Mexico Electric Utility Sales 1974 - 1976

Ultimate Consumer

	<u>Customers</u>	<u>Sales MWH</u>	<u>Data Year</u>
Municipal	37,118	445,134	1974
Rural Electric	96,199	1,359,816	1976
Cooperatives			
Investor Owned	288,000	5,209,529	1975

A breakdown by consumer category for Rural Electrical Cooperatives and Investor Owned Utilities is presented in Table 9. Residential and rural customers consume approximately 25% of total power. Most of the rest is used by commercial and industrial customers.

Power in the Northwest

Three plants are located in the northwest quadrant of the State, San Juan, Farmington and Four Corners, all in San Juan County. Customers in the northwest quadrant, including the uranium mills and mines, obtain their power from these stations, supplemented by Plains Electric Station at Algodones and other PNM stations also outside the area. Table 11 shows the principal generating facilities in the northwest and adjacent areas.

Table 9
Electrical Consumer Categories - 1975¹⁴

Type of Services Furnished

	<u>No. of Customers</u>	<u>Sales in MWH</u>	<u>Avg Annual KWH Used Per Customer</u>
<u>Investor-Owned</u>			
Residential and Rural	251,726	1,488,109	5,912
Commercial and Industrial	35,472	3,293,039	92,835
Public Street, Highway and Lighting	66	46,894	710,515
Sales to Public Authorities	<u>736</u>	<u>381,487</u>	518,325
	288,000	5,209,529	
<u>Rural Electric Cooperatives</u>			
Residential	70,738	340,598	4,815
Commercial and Industrial	15,786	796,684	50,468
Public Street, Highway and Lighting	110	8,183	74,391
Sales to Public Authorities	1,391	19,160	13,774
Irrigation and Sales	<u>3,488</u>	<u>124,958</u>	35,825
	91,513	1,289,582	

Table 11

Electric Supply to the Northwest Quadrant*

	<u>Generating Stations</u> <u>(Capacity in Megawatts)</u>	<u>Generation</u> <u>(1000 MWH)</u>
San Juan (PNM)	310.0	4,882
Person (PNM)	96.0	504
Four Corners (#4, #5 of Arizona Public Service) PNM	208.0	
Reeves (PNM)	175.0	1,122
Farmington (Municipal)	32.8	
Algodones	49.5	
	<u>871.3</u>	

* Standby Plants not included

The distribution of power to the existing uranium facilities in McKinley and Valencia Counties, however, is through two utilities: PNM and Continental Divide Cooperative. It is estimated that PNM is furnishing 70% of the power used by uranium facilities in the Grants Mineral Belt, (66% of this from coal-fired plants) and 30% furnished from Continental Divide Cooperative from power furnished by Plains Electric.¹⁴ The Farmington plant is a municipal plant serving the city and surrounding small towns.

(i) Northwest Consumption

Inquiries sent to Continental Divide Electric Cooperative and Jemez Electric Cooperative seeking latest data on consumption patterns in their respective franchise areas provided the following information:

Table 12
1976 and 1977 Sales - Continental Divide
and Jemez Electric Cooperatives

MWH

<u>Sales Classification</u>	<u>Continental</u>		<u>Jemez</u>		<u>Combined</u>	
	<u>1976</u>	<u>1977</u>	<u>1976</u>	<u>1977</u>	<u>1976</u>	<u>1977</u>
Residential	55,039	64,291	55,488	60,025	110,526	124,316
Irrigation	150	1,105	331			
Commercial- Industrial						
50 KVA or less	31,348	34,707	16,831	18,858	49,176	53,565
Commercial- Industrial						
50 KVA or greater	127,010	158,027	34,143	43,901	161,153	201,192
Sales to Public Bldgs.	3,217	3,920	3,364	3,650	6,580	7,570
Street/Flood Lighting	-	-	1,908	2,087	1,908	2,087
	<u>216,764</u>	<u>262,050</u>	<u>112,065</u>	<u>128,521</u>	<u>329,824</u>	<u>390,160</u>

As expected Continental Divide which is presently, with PNM, the other source of power to the GMB, had sales nearly four times that of Jemez in the 50 KVA or greater industrial category reflecting the heavier consumption in the Belt.

Public Service Company of New Mexico sold 338,079 MWH to major uranium mills and mine facilities and the City of Gallup in 1976. This total consisted of 84,358 MWH to large commercial, 3,982 MWH to small industrial (50 KW - 500 KW) 118,739 MWH to large industrial and 131,000 MWH to the City of Gallup.

IV. NEW MEXICO POWER SUPPLY AND DEMAND OUTLOOK

Supply Outlook

Public Service Company of New Mexico presently has existing generating capacity of 789.0 MW, not including standby stations. Planned additions to the system shown in Table 14, will provide additional capacity of 3,176 MW or a total of 3965 MW capacity for the Public Service system by 1992.¹⁶ These calculations assume that gas-fueled plants now operational will be phased out of the system after 1985.

According to Public Service Company of New Mexico, they are involved in some way in all new public generating projects presently planned for New Mexico. Therefore, Table 14 can be considered a comprehensive listing of all presently planned additions to in-state generating capacity.

Initial increased demand in New Mexico will be met by the completion of the #3 and #4 units of the San Juan station in 1979 and 1981. Later increases in demand will be met primarily by construction of a new generating plant, the New Mexico Station, which will probably use coal as a fuel. Output of this plant will be shared with Plains Electric. Ultimate generation capability could be 2000 MW if required. New high voltage lines will be required to integrate the plant into the present transmission network and to Albuquerque. The first unit of the New Mexico Station may be needed by early 1980's, but the total complex will probably not be completed until the early 1990's. The company may be required to purchase energy in the period 1977 on until #3 San Juan unit comes on line in May 1979 and #4 unit in May 1981.¹⁷ Thereafter, power requirements will be met from the Palo Verde plant in Arizona, a new pumped storage plant, and the New Mexico Station.

Plains Electric will continue to provide energy to the two cooperatives, who are now or will in the future, distribute to uranium and coal consumers located in their franchise service areas. Continental Divide Cooperative is now serving uranium facilities and Jemez Cooperative may have coal stripping demands if the Star Lake area is developed.¹⁸

If present plans to phase out the Algodones gas-fueled plant are carried out the generation load will fall partially on PNM and continued purchases from Bureau of Reclamation

Table 14

Public Service of New Mexico
Future Generation Capability
1979-1992

<u>Year</u>	<u>Unit on Line</u>	<u>Stations</u>	<u>Capacity (MW)</u>
1979	#3	San Juan	243 (out of 486)
1981	#4	San Juan	243 (out of 486)
1982	#1	Palo Verde (Phoenix, AZ)	130 (10.2% of total)
1983	#1	New Mexico Station	500 (beginning 5)
1984	#2	Palo Verde (Phoenix, AZ)	130*
1985	#1	Pumped Storage Station	300
1986	#3	Palo Verde (Phoenix, AZ)	130
1987	#2	New Mexico Station	500*
1988			
1989			
1990	#3	New Mexico Station	500*
1992	#4	New Mexico Station	<u>500</u>
Total			3,176

* Other Electrical Utilities may take some of this output.

Source: Public Service Company of New Mexico,
December 1977

facilities.

The balance of New Mexico's demands other than the energy furnished by PNM and Plains will continue to be furnished by the existing cooperatives or existing sources. It would appear that the rural and municipal requirements not served by Plains will continue to be met by existing gas-fueled units although rising natural gas costs will undoubtedly cause rates to increase.

Of New Mexico's current total generating capacity of 3981.5 MW, only 2105 MW are available to the New Mexico market. The balance is committed to other western states. Potential generating capacity available to New Mexico from existing and planned units is shown in Table 14a. Potential capacity rises from 2105 MW to 3651 MW by 1985.

Table 14a

Potential Electrical Generating Capacity²⁰

	<u>Additions</u>	<u>Total</u>
Domestically available capacity in 1977		2105 MW
New Capacity thru 1980	243 MW	2348 MW
New Capacity 1981-85	1303 MW	3651 MW
New Capacity 1986-92	1630 MW	5281 MW

Table 14a, undoubtedly, overstates potential generating capacity, however. Plains Electric has indicated it will phase out the 49.5 MW Algodones plant after its gas supply contracts expire in 1984, and PNM assumes that its gas-powered generating plants will be phased out sometime over the forecasting period of Table 14a. In addition, other gas-powered plants would seem susceptible to the same pressures operating on Plains and PNM. Three-fourths or 1532.2 MW out of the existing 2105 MW available to the domestic market are now operating on natural gas.

(i) Potential Power Development

Power development in the future from pumped storage geothermal, solar, wind and hydroelectric sources in the Southwest has been investigated by a Bureau of Reclamation study team. Of the five projects recommended for study, only a pumped storage project generating 200 MW appears practical at this time. The five study projects are shown in Table 15.

The Rio Grande pumped storage project study will investigate possible development near Elephant Butte Reservoir. Mescal Canyon is a potential site for the lower reservoir about two miles downstream from the existing dam. The upper reservoirs would have a capacity of 4,500 acre feet. The power plant would generate 200 MW and transmit power over a new twenty mile 345 KV line.

Table 15
Bureau of Reclamation Study Projects

<u>Project</u>	<u>Description</u>	<u>Head</u>	<u>Inst. Cap.</u> (MW)	<u>Cost</u> (\$1000)	<u>On Line Date</u>	<u>State</u>
SW 02	Rio Grande/Pumped Storage	418'	200	188	1993	New Mexico
SW 03	Rio Grande Rift/Geothermal	NA	NA	NA	NA	New Mexico
SW 04	Solar Thermal Gen	NA	NA	NA	NA	TX, OK, New Mexico
SW 05	Wind Energy Gen.	NA	NA	NA	NA	TX, OK, KA
SW 06	Middle Rio Grande Hydroelectric Study	NA	NA	NA	NA	New Mexico

Statewide Demand Outlook

New Mexico consumed approximately 7.0 million MWH in 1975. Based on WSCC expected growth rates for the New Mexico Power Pool, 1985 demand for New Mexico has been estimated at 14.9 million MWH.²¹ Operating at 65% of rated capacity would require 2617 MW of generating capacity. Table 28 shows estimated demand and required generating capacity derived therefrom.

Table 20

New Mexico Electrical Demand

	<u>(Million MWH)</u>	<u>Req'd Capacity</u> <u>@ 65% MW</u>
1975	6.94 estimated actual	1212
1976	7.5	1335
1977	8.4	1475
1978	9.0	1581
1979	9.7	1704
1980	10.4	1826
1981	11.2	1967
1982	12.0	2107
1983	12.9	2266
1984	13.8	2424
1985	14.9	2617

Northwest Demand Outlook

Anticipated new demand in the northwest quadrant by known uranium, coal and irrigation projects has been estimated to be 526 MW by 1987.

Table 16 indicates known uranium, coal and major agricultural projects under construction or planned. The degree of certainty for a given project may be judged in part by the presence of an initial service date. Some projects such as coal gasification for example, are highly uncertain at this time. According to utility officials, growth areas such as Farmington, Gallup, Grants and Milan have been included in the expansion plans of PNM and Plains although specific forecasts were not provided.

(i) Alternative Uranium Demand

A formula, devised by Mr. William Hicks, PNM Western Manager, and Mr. Keith Van Ausdale of the PNM Planning Staff allows the computation of electrical energy demands for mining and milling if yearly production of U_3O_8 is known. Using this formula, which is explained in the Appendix, and using ERDA's latest demand projections adjusted to New Mexico's share of national production (Table 18) electrical energy demand for the the uranium industry is projected in Table 17.

(ii) Comments on Northwest Demand

(a) Uranium

Uranium appears to require a relatively small amount of New Mexico generating capacity at present. PNM's 1977 estimate of sales to the uranium industry was 217,076 MWH or 38

Table 16
Uranium, Coal and Irrigation Projects 17
in Northwest Quadrant 1980-87

<u>Year Ultimate Load</u>	<u>Initial Service Required</u>		<u>MW Demand</u> <u>Year Ultimate</u> <u>Load Required</u>
<u>Uranium</u>			
1980	'77	2 Uranium Mines	10.5
1981	'78	3 Uranium Mines	12.0
1982	'79	2 Uranium Mines	16.0
		1 Uranium Mill	4.0
1983	'80	1 Uranium Mine	7.5
		1 Uranium Mill	3.0
1985	?	Unknown No. of Mines	25.0
1987	'84	1 Uranium Mine	7.5
1987	?	3 Mills (proposed) 4 MW each	<u>97.15</u>
<u>Coal</u>			
1982	'79	2 Coal Mines	36.0
1985	'81	1 Coal Mine	12.0
Unknown	?	Star Lake-Gallo	35.0
		Wash Strip Mine	
Unknown	?	1 Coal Mine (Carbon Coal)	<u>2.5</u>
			<u>85.5</u>
<u>Coal Gasification</u>			
Unknown	?	Coal Gasification Plant	280.0
<u>Irrigation</u>			
?		Navajo Irrigation Project	75.0
			<u>538.0</u> MW

Source: Public Service Company of New Mexico
December 1977

Table 17
Annual Energy Production For Uranium Mining and Milling

1977-1990
Annual KWH

<u>Year</u>	<u>Annual Production for New Mexico (1000 tons)</u>	<u>lbs U₃O₈ x49 KWH (millions)</u>	<u>Total Year Demand (MW)</u>
			(Col. 3 figures x 10 ³ MWH divided by .90 Load Factor (8760 hrs or 7884))
1977	5.7	558.6	70.85
1978	9.1	891.8	113.12
1979	11.2	1097.5	139.22
1980	13.2	1293.6	164.08
1981	14.0	1372.0	174.00
1982	16.6	1626.8	206.34
1983	16.3	1596.4	202.61
1984	19.0	1862.0	236.17
1985	18.4	1803.2	228.71
1986	19.0	1862.0	235.17
1987	20.5	2009.0	254.80
1988	20.0	1960.0	248.60
1989	20.3	1989.4	252.33
1990	20.7	2028.6	257.30

* U₃O₈ demand from Table 18

Table 18
National and New Mexico U₃O₈ Demand Projections
(No Plutonium Recycle)
1977-1990

<u>End Year</u>	<u>U.S. U₃O₈ Demand²² (thousand tons)</u>		<u>New Mexico Demand to Maintain 46% of U.S. Production (thousand tons)</u>	
	<u>Annual</u>	<u>Cumulative</u>	<u>Annual</u>	<u>Cumulative</u>
1977	12.3	12.3	5.7	5.7
1978	19.8	32.1	9.1	14.8
1979	24.4	56.5	11.2	26.0
1980	28.6	85.1	13.2	39.1
1981	32.3	117.4	14.9	54.0
1982	36.1	153.5	16.6	70.6
1983	35.5	189.0	16.3	86.9
1984	41.3	230.3	19.0	105.9
1985	39.9	270.2	18.5	124.3
1986	44.5	355.9	20.5	163.7
1988	43.4	399.3	20.0	183.7
1989	44.2	443.5	20.3	204.0
1990	45.1	488.6	20.7	224.8

Source: New Mexico State
Geologist Annual
Report 1977

MW or generating capacity @ 65% potential. At 85% capacity this consumption level would require 29.2 MW. Since PNM estimates that it supplies 70% of the power used by uranium facilities, it follows that total generating capacity devoted to the uranium industry was between 42 MW and 54 MW in 1977.

If U_3O_8 production triples by 1985 (3.2 times greater) this implies that electrical consumption will at a minimum triple. This implies capacity of 132 MW to 173 MW. Since mines will be deeper on average and ore grade content will fall on average this means that electrical consumption per lb of U_3O_8 will increase. Therefore, required capacity will need to be something greater than 134-173 MW. The PNM formula used in Table 17 attempts to take some of these factors into account and the resultant estimate of 229 MW capacity for 1985 is probably more accurate than simple linear extrapolation.

(b) PNM's U_3O_8 Formula

However, the PNM formula for estimating uranium electrical requirements is open to the following questions. (i) It makes no allowance for decreasing ore grade on either its mining or milling component. This may not be terribly significant, however, since a 20% decrease in ore grade requires only 3 KWH/lb U_3O_8 additional power or an increase of only 4.3% when inserted into the PNM formula.

(ii) A more serious question may involve the depth of new mines. PNM indicates in its formula that a doubling of depth increases pumping requirements by a factor of eight. Based on uranium industry testimony before legislative committees in 1976 and 1977, some deep mines may be substantially greater than the 2000 feet assumption of PNM. Gulf, for example, repeatedly made claims of a major new mine over 3400 feet deep. Since electrical requirements for pumping are so sensitive to mine depth, demand forecasting could be substantially improved by a more precise breakdown on new mine depths.²³

(c) Uranium, Other

Electrical requirements for specific new uranium projects shown in Table 16 are almost 2½ times smaller than requirements estimated by the formula in Table 17. Although the PNM formula may overestimate requirements, it seems more likely that new projects listed in Table 16 are insufficient to either mine or mill the uranium ore required to triple current U_3O_8 production.

This is suggested both by present milling capacity which is roughly one half the capacity required to triple U_3O_8 production,²⁴ and simple arithmetic which suggests that, even at unchanged ore grades and mine depths, additional power requirements in 1985 would probably not be met by the 97.5 MW shown in Table 16.

(d) Coal

Coal production in New Mexico is expected to increase even more rapidly than uranium, possible quadrupling between 1975 and 1985.²⁵ This would suggest, based on current consumption estimates of 40-50 MW, that 1985 power requirements would be at least four times greater or 160 - 200 MW. The shift from diesel-powered equipment to electric-powered drag lines should noticeably increase this requirement even further.

In the event coal gasification were to take place, coal production would expand even more with corresponding increases in electrical demand. By one estimate coal production would more than double again by 1985 if coal gasification were to proceed according to construction schedules submitted in environmental impact statements.²⁶ This, obviously, would dramatically affect coal industry electrical demand.

In conclusion, coal production in 1977 probably consumes about as much power as the uranium industry. By 1985 this should still hold true unless coal gasification takes place. In that event, coal production electrical power demand should dramatically surpass uranium sector demand.

(e) Coal Gasification

Coal gasification plants require immense amounts of electrical power. Two such plants have been considered for

New Mexico, although their potential existence is highly tentative based on current natural gas prices. Undoubtedly, the coal gasification technology will eventually become competitive with natural gas, it being more a question of when rather than if.

Of the two plants, El Paso plans to produce its own power but WESCO would require power from PNM. Assuming the WESCO plant were to be constructed this would require an estimated 280 MW of capacity. Although El Paso would generate its own power, its plant would probably be located in the Northwest Quadrant and thus contribute to the overall air and water quality problems.

It is important to realize that coal gasification would more than double estimated coal production by 1985. This would, of course, more than double electrical requirements, shown earlier under coal production for 1985. Thus, coal gasification has the double effect of requiring power for processing coal and power to mine the additional coal.

(f) Northwest Quadrant in Summary

An extremely rough estimate of generating capacity to meet Northwest electrical demand in 1985 is set out in Table 29. From this table it would appear that coal gasification possesses greater potential impact than increased uranium production although the certainty of impact is much greater for uranium.

Table 29

Northwest Quadrant Electrical Demand

1985

Uranium Industry	230 MW
Coal Industry	200 MW
Residential/Commercial Industrial ²⁸	<u>260 MW</u>
Total without gasification	690 MW
Coal Gasification	280MW
Additional Coal	200 MW
Additional Residential/Other	<u>?</u>
	<u>480 MW</u>
Total with gasification	1170 MW

Statewide Demand and Supply Compared

Table 30 summarizes the statewide demand and supply estimates made earlier. From this it can be seen that New Mexico starts from a position of excess generating capacity and would apparently maintain this position. However, there are considerable caveats to this conclusion including those in the table notes. Demand estimates may not adequately reflect energy sector requirements. Required capacity can be smaller if load requirements are greater than 65%. Existing plus planned capacity may be smaller than estimated because plans fail to materialize on schedule or because gas-powered capacity is phased out. Thus, it would appear that any outcome is possible.

Table 30
New Mexico Electrical Demand
Compared With Generating Capacity

<u>Year</u>	<u>Demand MWH (million)</u>	<u>Req'd Capacity MW @ 65%</u>	<u>WSCC Peak Demand for NM Power Pool MW Capacity</u>	<u>Actual/ Planned NM MW Capacity</u>
1975	7.0 estimated	1212	1507	2105
1980	10.4 projected	1826	2154	2348
1985	14.9 projected	2617	3003	3651

Table Notes: Demand - Assumes 10% growth 1976 & 1977 and 7.4% growth thereafter.

Required Capacity - Assumes that plants operate at 65% of technical capacity. This leaves a range between 65% and 85% to meet peak demand and to act as a cushion in case of forecasting errors.

WSCC - Assumes growth rate of 7.41% based on Western States forecasts. However, forecast is for the New Mexico Power Pool which is not identical with New Mexico.

Actual/Planned Capacity - Assumes planned units come on line and that no older units are retired. In actuality, 1532 MW of capacity are vulnerable to natural gas curtailments and it is known that PNM and Plains have plans to phase out their gas units. Thus, the cushion between required capacity and planned capacity may be non-existent when phase out plans are considered.

However, it would appear most likely, on the basis of current information, that electrical capacity will be sufficient in 1985 to meet demand. This is also the overwhelming opinion of officials in the electrical industry.

(i) Rationale for Utility Industry Optimism

The electrical utility industry seems to have no major concern about meeting future electrical demand in New Mexico. They are possibly better informed on energy sector expansion plans than anyone else in the state. Basically, their optimism is based on the following chain of thought:

- (a) Present generating capacity is in excess of current demand.
- (b) Planned capacity together with existing capacity is more than adequate to meet known future requirements.
- (c) No particularly difficult problems are expected in putting planned capacity on line. Environmental requirements can be met and adequate finance and construction lead times have been provided.

Underlying utility industry confidence are two other important points. First, the most likely source of important demand increase are the energy sectors. Yet energy sector industry must consult years in advance with electrical utilities to insure that power is on hand. Second, gestation periods for bringing new generating capacity on line are not much different from bringing new uranium facilities on line. Thus, even if there were dramatic new in-

creases in U_3O_8 production plans, the electric utility industry would have adequate reaction time to meet these new demands. Since transmission and distribution lines have a shorter gestation period than generating plants they can be no constraint if the plant is not a constraint.

(ii) Tentative Assessment of Industry Optimism

The basic argument seems sound. Industry starts in a position of excess generating capacity, has planned additions coming on line more rapidly than expected demand, and has the ability to react to new demand approximately as fast as it can be realized.

The major weak point in this rationale may be the overwhelming dependence of domestically committed capacity on natural gas and the unknown surrounding federal gas supply curtailments. However, even in the event of serious gas supply curtailments it implies, probably at worst, a switch of natural gas-fueled stations to higher cost petroleum back-up fuels rather than to initiate electrical power shortages.

V. NATURAL GAS SUPPLY AND CONSUMPTION IN NEW MEXICO

Supply Factors

The natural gas industry in New Mexico is basically in a position of no growth. The Federal Power Commission Order

72-6 has placed a ceiling on gas supply entitlements which cannot be exceeded. Effectively, this action, among other things, prevents installation of new electric generating facilities and uranium mills that would use natural gas as a fuel.

Interviews with representatives of the natural gas industry indicate that no new curtailments of Priority 1 and 2 categories are foreseen until possibly the early 1990's. The period during which priority 1 and 2 users will not be curtailed may be extended if gas suppliers are allowed to purchase Algerian and Mexican gas. Curtailment of deliveries to lower Priorities of 3, 4 and 5 is quite possible, however, and includes existing electrical generating plants, uranium mines and uranium mills.

The heavy dependence of New Mexico users on intra-state gas²⁹ may be altered if recent Administration moves insisting on federal control in intra-state gas are incorporated into new energy legislation. Secretary of Energy Schlesinger is quoted as stating relative to federal control of in-state gas "that he doesn't think that there is any grounds to retreat on that particular issue," and further, the only way to have an adequate national supply is for the federal government to assume control of intra-state gas and make it available to needy states.³⁰

New Mexico finds itself, as a gas producing state, in an awkward position in that the bulk of its natural gas is

shipped out of state, yet, because gas was also plentiful and cheap outside of the state, industries using gas were not attracted to the state in large numbers. Eugene Ward writing in the Albuquerque Journal, noted that 90% of the state's production goes into the interstate pipeline and the shift to a higher price for interstate gas could "undoubtedly cut into the 10% that remains ..."³¹

The low fraction of in-state use allowed gas production, reserves, and unexplored but favorable locations, to be committed to outside markets.³² This condition has been further complicated by the declining volume of gas production anticipated for the future.

The State Geologist estimates that future production from the Permian and San Juan Basins, the two major producing areas in the State, will decline from 1,203 billion cubic feet to 590 billion cubic feet in 1990.³³ Total production for the period 1976 through 1985 is projected at 916 trillion cubic feet and through 2000 at 17.4 trillion cubic feet. An additional 4 trillion cubic feet may be added to known reserves in the Permian Basin while 5 trillion cubic feet of gas may be added to Cretaceous reserves in the San Juan Basin.³⁴

Consumption Patterns

New Mexico is served by eight pipeline (Figure 7) and five major suppliers listed in Table 21.

FIGURE 7

GAS SYSTEMS

G.B.P.
'77

Table 22 emphasizes the role that natural gas plays in the New Mexico economy. The importance of natural gas as an energy input to New Mexico is declining, however. Its contribution of 74% in 1960 fell to slightly over 52% in 1972.³⁵ Nationally, electrical utilities declining use of gas is due to pipeline curtailments, price increases and problems connected with contracting for long term leases.³⁶

Table 21

Major Gas Suppliers

<u>Company</u>	<u>Gas Sales</u>	
	<u>August 1976 to July 1977</u>	
	<u>(MCF)</u>	
Gas Company of New Mexico	113,449,123	
El Paso Gas Company	48,932,873	
Llano Inc. (Hobbs area)	27,000,000	
Colorado Interstate	1,563,000	
Transwestern	763,500	
Total	191,707,996	MCF

Source: Energy and Minerals Department

Table 23 showing consumption of gas by New Mexico customers for the period 1926-1975, emphasizes the rising importance of gas as a fuel for electric utilities and its decline in industrial use. The table shows that gas consumption peaked in 1972 and has declined since.

Table 22
Percentage Contribution of Energy Resources to Total*
Energy Consumption, 1960-1972, New Mexico

<u>Category</u>	<u>Coal</u>	<u>Natural Gas</u>	<u>Petroleum</u>	<u>Hydro</u>	<u>Nuclear</u>	<u>Total Gross Energy Consumption (Trillion BTU's)</u>
Household/ Commercial	0.1%	68.5%	31.1%	-	-	807
Transportation		24.0%	76.0%	-	-	1,430
Electric Power	49.9%	48.8%	0.1%	0.1%	-	1,281
Industrial	.4%	95.4%	4.2%	-	-	2,328
Miscellaneous			100.0%	-	-	32
Total Percent	10.3%	63.6%	25.2%	-	-	5,877

* Source: U.S. Bureau of Mines, Fuel and Energy Consumption Data I.C. 8705, 1976.

Table 23

Total Consumption of Natural Gas and Deliveries to Consumers

By Consumption Class in Selected Years 1926-1975

(10⁹ Cubic Feet)

Delivered to Consumers

<u>Year</u>	<u>Residential</u>	<u>Commercial</u>	<u>Electric Utility</u>	<u>Industrial</u>	<u>Other</u>	<u>Total</u>	<u>Total</u>
1926	-	-	-	-	-	-	0.9
1930	-	-	-	-	-	-	3.0
1935	-	-	-	-	-	-	18.4
1940	2.2	1.4	-	-	-	-	40.2
1945	3.6	3.4	-	-	-	-	71.5
1950	8.8	4.7	-	-	-	-	147.5
1955	12.6	5.8	-	-	-	-	215.3
1960	20.4	9.0	-	-	-	-	256.4
1965	24.2	12.5	-	-	-	-	263.8
1970	30.7	16.6	54.9	73.1	16.4	191.8	322.8
1971	32.4	17.0	49.2	78.8	16.7	194.2	323.2
1972	34.6	17.2	59.1	76.8	15.1	202.9	342.2
1973	23.7	11.9	65.1	60.3	13.6	147.7	312.6
1974	25.3	13.3	66.7	64.4	11.9	181.6	312.4
1975	27.8	12.5	64.2	57.7	0.3	172.6	296.4

Source: U.S. Bureau of Mines, Minerals Year Book and "Minerals Industries Surveys,"
various issues

Shortle, James, G., Natural Gas Industry, New Mexico Energy Institute,
Report No. 76-100 C, University of New Mexico, September 1977.

Dependency of the Electric Industry on Natural Gas

A significant number of New Mexico municipal, urban and rural electrification systems are totally dependent on natural gas and oil fuels (see Table 5). This condition is particularly true in the eastern and southeastern portions of the state. Domestic systems in these areas are serviced by generating plants which are dependent on gas. Eastern New Mexico is connected to Texas electric plants which are members of the Southwest Power Pool (SWPP). This pool, as well as the adjacent pool, the Electric Reliability Council of Texas pool (ERCOT), are now deriving 75% of their electrical output from gas. It is predicted that this will decline to 24% by 1984. These two pools were fueled 95% by gas in 1972 compared to the national average of 33% in 1974.³⁷ Since 1972 the Southwest pools have begun a shift to oil and coal.³⁸

The oil embargo of 1973-1974 caused a re-thinking of alternatives available to those Texas stations because of the rising costs of oil. Coal and nuclear fuels appear to be the only alternative fuels having an attractive economic potential. A Federal Power Commission study stated:

"Natural gas is rapidly being withdrawn as a power plant fuel. The Federal Power Commission discourages the use of natural gas for electric power generation due to its growing shortage and since other fuels can be substituted for gas to save the gas for other uses. Natural gas consumption has outpaced new discoveries and additions to gas reserves since 1967. Reserve inventories are currently disappearing rapidly. The cur-

tailment level in the interstate gas supply system may reach such a degree purposes may be greatly reduced and service to residential and commercial users may be difficult to maintain on some systems. This disruptive impact could result in some redirection of intrastate gas supplies to the interstate market to make the best possible national use of this dwindling resource."³⁹

In New Mexico, Plains Electric is the supplier of electric power to the eleven members shown on the map on Figure 4. Because Plains is partially dependent on gas and oil until 1989, the members of its system may be vulnerable to substantial price rises if Plains should be ordered, in the future, to switch to coal prior to that year. Contrary to the belief held by many, a conversion of a gas-fired and/or oil-fired plant to coal means a complete new design and construction of the boiler portion of a plant. Two to four years would be required for the changeover by Plains. Purchase of hydroelectric power by Plains from the U.S. Bureau of Reclamation generation sources will continue to be of assistance in lessening the impact of rising fuel prices. PNM still depends on five stations fueled by gas but is moving towards greater use of coal.

New Mexico has made several internal adjustments to improve the supply of gas to areas potentially subject to future critical shortages. The State encouraged Gas Company of New Mexico (GASCO) to build a spur pipeline to Grants-Milan in the Uranium Belt to offset possible future curtailments by El Paso Natural Gas Company. Communities in the

Southwest part of the state will receive fuel this winter by means of an arrangement whereby gas derived from state lands will be purchased by the Energy and Minerals Department for priority 1 and 2 use, and the Land Office will be reimbursed from payments made by the consumers. The Federal Power Commission (now FERC) issued an order allowing temporary use of an interstate pipeline to carry the gas during the winter of 1977-1978.

The Northwest Quadrant

The Northwest quadrant, including the uranium and coal development areas, is served by El Paso Natural Gas Company and GASCO. Sales to consumers are tabulated below:

Table 24

Natural Gas Supply and Consumption in the Uranium Belt - 1976

<u>User</u>	<u>Period</u>		<u>Season</u>	<u>Year Total</u>
	<u>Winter</u>	<u>Summer</u>	<u>Totals (MCF)</u>	<u>(MCF)</u>
<u>El Paso</u>				
Suburban Propane (San Juan Co.)	X	X	23,705 8,345	42,050
Shell Oil (McKinley Co.)	X	X	562,395 391,802	954,197
Navajo Tribal Utility Authority	X	X	1,896,030 1,319,883	3,215,713

Table 24 (cont'd)

Natural Gas Supply and Consumption
in the Uranium Belt - 1976

<u>User</u>	<u>Period</u>		<u>Season Totals (MCF)</u>	<u>Year Total (MCF)</u>
	<u>Winter</u>	<u>Summer</u>		
Gamerco Assoc. Ltd (Gallup)	X	X	27,036 6,647	33,683
Energy Reserves Group	X	X	23,463 26,632	49,135
Aztec Oil	X	X	1,495 711	<u>2,206</u>
			Total	4,296,984

GASCO

GASCO's supply demand forecast for the GMB is shown in Table 25.

In view of uranium mills being allocated to gas user categories of P-4 it is possible that they may become vulnerable to curtailment if gas supplies should diminish. This condition is worsened by the apparent trend in federal policy to take intrastate gas from producing states.

GASCO estimates that gas requirements in the Gallup-Grants-Milan-Thoreau area will total 3,788 MMCF a year. Of this amount, Industrial Non-Boiler (200-1500 MCFD peak group) use, which is the category in which uranium mills fall, is only 369 MMCF or 9.7% of the total amount used in

the area. This would imply that making an exception for uranium mill supply curtailment would impose a relatively small hardship on other sectors. Mills can switch to petroleum or other fuels.

Table 25

Consumption in Gallup-Grants Area

1977

MMCF

1.	Residential	1,066
2.	Small Commercial	574
3.	Small Industrial	94
4.	Public Auth)50 MCFD	96
5.	Company Use	227
6.	Irrigation	2
7.	50-1500 MCFD Commercial	168
	Non-Boiler and Boiler	
8.	Public Auth)50-1500	306
9.	200-1500 MCFD Peak	369
	Industrial Non Boiler	
10.	200-1500 MCFD Peak	546
	Industrial Boiler	
11.	1500-3000 MCFD Peak	340
	Industrial Non Boiler	
	TOTAL REQUIRED	3,788

Potential Gas Shortage

An analysis of GASCO's 1976 annual gas requirements forecast for New Mexico and the Gallup-Grants-Milan-Thoreau area indicates a decline in natural gas supply beginning 1981. Coupled with a gradual rise in priorities 1-3 demand,

this indicates that there will be very little in the supply line for priorities 4-9 by 1990. Uranium mills in the priority 4 category are obviously vulnerable. Figure 8 illustrates the situation. The forecast predicts a gradual rise in demand from natural gas during the period 1977-1990 but a declining supply curve cutting into priority 4 use by 1990.

EXECUTIVE SUMMARY

New Mexico uranium production, presently 46% of the national supply, can be expected to triple by 1985 under President Carter's nuclear non-proliferation strategy. This poses the question of whether electrical power and natural gas will be sufficient to meet this demand without impinging upon the requirements of the rest of the New Mexico economy.

A preliminary review indicates that neither uranium sector demand for electrical power nor demand for natural gas is likely to pose hardship for the rest of the New Mexico economy by 1985. Although electrical power demand in New Mexico can be expected to double by 1985, the uranium sector itself may account for less than 10% of the total. Coal production will probably account for as much increased demand as uranium, and significantly more should coal gasification plants be constructed. Indeed, a single coal gasification plant could use more power than the uranium sector

FIGURE 8

**GALLUP, GRANTS, MILAN, THOREAU AND ENVIRONS
ANNUAL GAS REQUIREMENTS FORECAST**

GASCO STATES "NO ESTIMATES ARE INCLUDED FOR THE CONNECTION OF NEW SOURCES OF SUPPLY WHICH WILL BE ATTACHED AND MARKET REQUIREMENTS ARE BASED SOLELY ON HISTORIC TRENDS."

SOURCE : GASCO TABLES FOR 1977 TO 1990

G. B. P.

as a whole by 1985.

Planned generating capacity coupled with capacity currently available to the New Mexico market should be sufficient to meet anticipated demand in 1985. However, this is a very preliminary conclusion based on tentative assumptions of both demand and supply. In particular, existing generating capacity dedicated to the New Mexico market seems vulnerable to natural gas supply curtailments.

Natural gas consumption by the uranium industry itself appears relatively insignificant. In the Gallup-Grants area, for example, it would appear to constitute less than 10% of total gas consumed. Since new uranium mills are effectively prohibited from using natural gas, this source of demand will not significantly rise. Existing uranium mills would appear vulnerable to natural gas supply curtailments, given their relatively low priority category. However, there appears to be no particular problem in switching to diesel fuel.

Policy Issues Development

A surprising lack of policy issues seemed to emerge from this preliminary review. In part, this is probably because no major conflicts appear imminent or are immediately evident. This appears to be supported by opinion in the utility industry, the uranium industry and interested government agencies. In response to questions raised on wheth-

FIGURE 9

COMPARISON OF FUELS USED IN NEW MEXICO GENERATING PLANTS

□ COAL

▨ NATURAL GAS

* " PHASE - OUT " STAGE OF GAS FUELED PLANTS BEGINS

G. B. P.

er electric power or natural gas might pose a constraint to increased uranium production, there seemed to be an almost unanimous opinion that they would not.

The writers, in initiating this review, has assumed that any of a number of potential institutional, regulatory or economic obstacles would be cited as constraints to rapid expansion of the electrical power sector. Environmental problems associated with coal-fired generating plants were thought likely to be raised, for example. Instead, neither the utility industry nor the Environmental Improvement Division foresaw any major problems.

It would appear the apparent lack of obstacles is more a function of the utility industry having adequately planned for energy sector expansion than simply a lack of obstacles. Problems do exist. They are simply easier to handle with adequate lead times and become, in effect, normal or routine. Thus, if planning has indeed been adequate, problems with new generating capacity will probably be routine, as expected. However, should generating capacity fall short of demand requirements, for whatever reason, installing new capacity will undoubtedly transform routine problems into major constraints simply because of inadequate lead time. Nevertheless, it is difficult to see how uranium sector electrical demand, in view of its small size relative to statewide demand and its closely watched status, could be the precipitating factor behind any generating capacity

shortfalls. Rather, it would seem that the cause would have to lie elsewhere, in natural gas supply curtailments, new federal energy regulations or other sudden or unexpected events.

APPENDIX - C

Table 13

REA Electric Cooperatives in New Mexico - 1976*

<u>Cooperative Member</u>	<u>MWH Generated</u>	<u>MWH Purchased</u>	<u>Transmission Miles</u>	<u>Consumers Served</u>
1. Plains Electric G.T.	204,159	(941,114)	609	(67,992)
2(P) Central Valley		167,840	87	5,975
3. Roosevelt Co.		86,884	142	4,878
4. Farmers		82,805	191	7,627
5(P) Kit Carson		131,552	101	10,529
6(P) Otero Co.		61,898	84	6,392
7(P) Mora-San Miguel		23,736	40	4,516
8(P) Northern Rio Arriba		15,415	46	2,229
9(P) Sierra		16,525	-	1,807
10(P) Springer		47,486	177	2,236
11(P) Socorro		70,639	32	5,314
12. Central N. Mexico		44,777	115	4,994
*13(P) Continental Divide		234,000	60	13,348
14. Lea County	377,013	52,162	257	8,631
15(P) Columbus		189,563	119	2,299
16. Southwestern		10,764	9	1,028
*17(P) Jemez		123,427	161	14,326
	<u>581,172</u>	<u>1,359,816</u>	<u>2,230</u>	<u>96,129</u>

* U.S. Department of Agriculture, Rural Electrification Administration
1976 Annual Statistical Report REA Borrowers, REA Bulletin 1.1, USDA,
Wash., D.C., 1977, pp. 148-150 and p. 242.

Table 13 tabulates data compiled from the most recent Rural Electricification Administration report. The eleven cooperatives with the label (P) before the name are members of the Plains Electric System. The two starred members, Continental Divide and Jemez, are located physically in or adjacent to the Belt. It should be noted that only Plains and the Lovington stations are generation units. The other six purchase from Southwestern Public Service Company or other sources.

APPENDIX - D

Table 27

Methodology for Energy Requirements

to Produce 1 lb. of U_3O_8 in 1985*

(27 KWH is average energy consumption for mining
and milling one pound of U_3O_8)

	Fans 40% of 27	=	10.8 KWH
<u>Shallow</u>	Pumping - Msc.	15% of 27 KWH	= 4.0 KWH
<u>Mine</u>	Mining	15% of 27 KWH	= 4.0 KWH
(800'- 1000')	Milling	30% of 27 KWH	= <u>8.1 KWH</u>
			26.9 KWH
<u>Deep</u>	Fans 10.8 x 1.3	=	14.0 KWH
<u>Mine</u>	Pumps 4.0 x 4 x 2	=	32.0 KWH
(2000')	Mining 4.0 x 1	=	4.0 KWH
	Milling 8.1 x 1	=	<u>8.1 KWH</u>
			58.0 KWH

Average Requirement .30 (27 KWH) + .70 (58 KWH) based on estimate that 70% of mines will be deep mines in 1985.

$$\begin{aligned} \text{Average Requirement} &= 49 \text{ KWH per 1 lb. of } U_3O_8 \quad ** \\ \text{Total Uranium Production Demand} &= \frac{\text{KWH}}{\text{L.F. (8760) hrs/yr}} \end{aligned}$$

$$\text{Total Uranium Production Demand} = \frac{1803.2 \times 10^6 \text{ KWH}}{.90 (8760) \text{ KWH}} \quad ***$$

Total = 228.7 MW

Table 27 (cont'd)

Since Public Service estimates that they will supply 70% of the Electric demand for the G.U.B. $228.7 \times 70\% = 160$ MW as PSNM's share of uranium sector electrical demand in 1985. Presumably the other 30% or 68.7 MW will be supplied by Continental Divide Cooperative.

Source: Mr. William Hicks, Western Field Manager (PNM) also see page 32 of text.

* Approximately

** L.F. = Load Factor

*** The load factor relative to coincident peaks (mines, mills, systems was determined from actual data to be 90%.)

APPENDIX E

SUPPLY OF LIQUID PETROLEUM GAS TO THE
URANIUM AND COAL MINING AREAS OF THE NORTHWEST
QUADRANT OF NEW MEXICO

In an attempt to gather data on use of liquid petroleum gas in the Northwest quadrant of New Mexico and its use in industry and mobile homes, a conference was arranged with the regional manager of the largest LPG company serving that area. Data on total quantities supplies are given in Table A. An attempt was made to obtain a breakdown by use in residences, uranium mines, mills and coal facilities, but that data is not readily available. Using State Planning Office housing projections and LPG industry factors, I have calculated mobile home LPG use projections to 1985.

SUPPLY (Data given represents 60% of total annual supply to San Juan, McKinley and west Sandoval Counties)

TABLE A

<u>Area</u>	<u>Quantity</u> (gallons per year)	<u>Type</u>
Farmington	1,800,000	Retail
	1,000,000	Wholesale
Cuba	800,000	
Budville	1,000,000	Wholesale/ Retail
Grants	725,000	
Gallup	1,800,000	Wholesale
Gallup-Grants	500,000	Retail
Rio Puerco	400,000	
Old Laguna Housing (Project)	1,000,000	
<hr/>		
Total	9,020,000 gallons/year	

Since this company supplies approximately 60% of the total demand in the study area and two smaller suppliers, the remaining 40% and estimate was made that the remainder of 40% equals six million gallons a year or a total of 15 million gallons supplied in 1977.

DEMAND (For LPG Use in Mobile Homes)

The State Planning Office estimates that by 1985 there will be, at the lowest range, 1957 additional mobile homes in place in the Grants Mineral Belt and, at the highest range, 5,646 units. Assuming that 50% of these units will not be served by natural gas systems, an added requirement for LPG could be:

Low estimate - 978×850 gallons/year = 831,300 gallons/year
High estimate - $2,823 \times 850$ gallons/yr = 2,399,550 gallons/yr

TOTAL DEMAND

Using present supply figures and applying a 5% yearly increase in demand, the following projection is made:

<u>Year</u>	<u>Gallons/Year</u>		<u>Annual Total</u>
1978	$15,000,000 \times 5\%$	=	15,750,000 gallons/year
1979	$15,750,000 \times 5\%$	=	16,537,000
1980	$16,537,000 \times 5\%$	=	17,364,375
1981	$17,364,375 \times 5\%$	=	18,232,513
1982	$18,232,513 \times 5\%$	=	19,144,221
1983	$19,144,221 \times 5\%$	=	20,101,432
1984	$20,101,432 \times 5\%$	=	21,106,503
1985	$21,106,503 \times 5\%$	=	22,159,828

In order to obtain realistic data, a survey of trailer-mobile parks and isolated units would have to be made to determine type of mobile unit (single width or double width) and dependence on natural gas pipes systems or LPG.

The industry estimates that a single 12 x 60 foot unit uses 800 to 900 gallons of LPG annually, and a double (24 x 60) consumes 1200 to 1500 gallons a year for cooking and heating.

SUPPLY PICTURE

Nationwide supply of LPG appears adequate and suppliers do not believe that it will be a problem in the future. Inventories on November 1977 were 85.9 million barrels, and expected demand was estimated to be 48 million barrels (Williams Energy Digest, January 20, 1978).

Policy Options on Constraints of Electrical and Natural Gas
Production on Uranium Production in New Mexico

Land Use

The complex ownership of mineral and surface rights in the uranium and coal belt presents a problem in jurisdiction for state agencies. Approximately 62% of the land in the Grants Uranium Belt is owned or controlled through lease arrangements by other than state or private ownership. Indian land ownership accounts for 47% of the total, about 15% is federal land, 18.5% is private, 15.8% is included in private land grants and only 4% is state land (State Planning Office - The Grants Uranium Belt, 1976, p.15).

An estimate has been made that 40% of the "yellowcake" produced comes from Indian lands with a large amount of this fraction coming from the Jackpile Mine on the Laguna Indian reservation. Of the balance, about half comes from federal lands and the rest private; very little comes from state lands. (ERB Annual Report 1976-1977 p. 11).

To better clarify the complex ownership situations the state has undertaken two projects. Chapter 268 of the New Mexico Laws of 1977 provided for creation of Federal Lands Action Group to study the impact of federal land ownership and policies on future development of energy resources in New Mexico. This group will study intensively land ownership in the Northwest quadrant.

To better understand the impact of development activities in the state, the State Planning Office, Division of Natural Resources, began a systematic survey of critical areas in the state involving land use, slope, erosion, earthquake and fault zones and unstable soil, among some of the twenty-three variables studied.

Plotting of the evaluations on transparent overlays of a given area provides recognition of cumulative factors which taken as a whole indicate that limited or no development should take place. The San Juan Basin portion of this study is still underway; the completion of this sector should be expedited.

The study, to date, indicates that a great deal of uranium mining activity is being carried out on lands possessing 30% or greater slope. Measures should be taken by industry to heal scars left by secondary road construction and drill pad activities. Work areas should be re-contoured, if necessary, and re-seeded to restore disturbed vegetative cover to alleviate excessive erosion of the soil. It has been estimated that 2,070 acres of highly disturbed soil resulted from the 1976 drilling program in New Mexico (Perkins, Betty, The Uranium Industry in New Mexico, Draft MSS, EMD, Santa Fe, 1978).

The low rainfall in the San Juan Basin precludes rapid restoration of ground cover once it is disturbed, unlike areas in the eastern portions of the United States where

35 inches of rainfall a year hastens healing of soil scars.

An aerial survey of the areas north of the present active uranium mining area indicates an extensive "pock marked" pattern of drilling activity where reconnaissance exploration is taking place. In 1976 over 11 million feet of drilling took place and the amount is increasing.

Other energy activities underway or proposed which will significantly alter the existing landscape and soil surface are:

- * Strip mining of coal in the Farmington Four Corners area, Burnham-Bisti and along the Fruitland coal formation outcrop.
- * extension of 345 and 500 KV transmission towers and lines from the Four Corners San Juan generating stations to coal stripping operations along the Fruitland formation. Transmission lines from the proposed "New Mexico Station" will add to this form of surface change.
- * extensive spoil piles adjacent to uranium mines. A trend toward deeper uranium mines will generate large amounts of spoil. Perkins (1978) has estimated that 5.5 million tons of waste exist near active and inactive mines or used as backfill in abandoned portions of mines.

Mine Water Discharge

Approximately 14,000 gpm of discharge water will possibly be produced by mines now being developed and 24,000 gpm additional may be produced by mines now in the planning stage. The resulting 200 million gallons per year or 66,000 plus or minus acre feet of water per year may be being discharged in the early 1980's (Perkins 1978).

The impact of this extensive mining of water may be a drop in the level of the Westwater aquifer in the vicinity of the mining areas being pumped. After exhaustion of the economic ore and abandonment of the works, several decades may pass before the original aquifer level is regained (Perkins, 1978).

The state should carry out studies of this activity and determine the possible impact on communities adjacent to and dependent on the aquifer. As mines go deeper and water is encountered, more pumps are required, more energy is needed to power the pumps and disposal of the water becomes a greater problem.

Creation of industrial facilities such as major electrical generators require cooling and service water. Mines producing discharge water the the vicinity will be attractive sources of water and may be used after the State Engineer issues a permit.

Litigation

Stripping of coal, essential to efforts to produce gas by coal gasification process and to fuel new and existing electric generating plants, may be affected by recent law-suits.

The National Indian Youth Council (NIYC) has filed a law suit in U.S. District Court in Washington, D.C. to halt proposed mining on the Navajo Reservation by Consolidation Coal Company and El Paso Natural Gas Company (Albuquerque Journal, February 16, 1978, D-6).

The suit, aimed at principals in several federal agencies, stipulates that federal laws have been violated and that insufficient surveys were made of paleontological and archeological sites. The plaintiff asserts that strip mining "will cause irreversible damage to the Navajo life-style, land, air and water."

Future Data Requirements

There is an urgent need for more detailed data relative to energy requirements of the uranium and coal industry. The first warning that state agencies have is usually the filing of an Environmental Impact Statement, where it is required to meet federal requirements, a request for a mining permit, or an application to operate a uranium mill. Operating data, including sometimes an estimate of energy requirements, is included in data furnished to the U.S.

Geological Survey in the case of mining and milling planned for Indian lands. An industry wide survey of energy needs, confined to actual annual and five-year future forecasts for electricity, natural gas, diesel fuel and liquid petroleum gas would greatly aid in implementing a state energy plan.

State agencies in the permit business are:

The New Mexico Coal Surface Mining Commission reviews all plans for strip mining and reclamation measures and issues permits.

The State Mine Inspector, charged with monitoring safety in mine operations receives applications where underground mining is proposed.

The State Engineer reviews applications and issues permits for use of water by industry and municipalities of surface and ground water. Application for a permit is one of the earliest indications of a proposal activity.

The Environmental Improvement Division approves plans for the control of water and air, solid and liquid waste disposal, radiation and noise. The agency issues permits authorizing acceptable levels of pollution dis-

charges in water and air. It also certifies solid and liquid waste disposal and licenses activity involving radioactive materials (Resource Communities, Inc., Report to Energy Resources Board, Facility Siting and Managing Energy).

Rights of Way

Future requirements for extensions of electric power transmission lines and water lines to serve new coal burning electric generating and coal gasification plants and gas transmission lines in the San Juan Basin may require additional energy corridors now existing or additional widening of existing corridors.

In 1974 it was estimated that the following miles of energy corridors were in existence in the state.

Type Transmission Lines	Miles
115 KV	1,863
230 KV	336
340 KV	931
Petroleum Products	997
Natural Gas Major Net	1,768
Minor Net	2,240
Oil Major Pipelines	597
Minor Pipelines	850

The possible creation of a nuclear electric generating park in the Tularosa Basin (now under study), the building of the New Mexico Station in the San Juan Basin, and the possible coal gasification plants near Burnham will all add additional miles of electric and gas transmission lines and pipelines to the existing major network (Page G Study of Energy Corridors - New Mexico Governor's Energy Task Force, Santa Fe, 1974).

If, in the future, slurry pipelines are used to transmit coal through or out of state, their construction will add additional miles to the network.

The only inhibitions now on construction of major electric transmission towers and corridors are granting of permission by surface owners of rights of way affected by the construction, or a finding by the New Mexico Public Service Commission that the location of the proposed facilities line will unduly impair important environmental values.

The question of state authority to deny a proposed energy facility is complicated by the lack of control by a county or state agency over 62% of the G.U.B. land area. Indian ownership of 47% of the total area places jurisdiction of these lands in the hands of the Navajo Tribal Council, Chapter Officers or individual Indians. In addition, much of the subsurface rights for mining were retained by the federal government irrespective of current surface right owners.

Future use of the "checkerboard" area east and south-east of the Navajo Reservation will be predicated in large part on the willingness of private companies and federal agencies holding mining rights to lease to interested energy parties. Research to establish current ownership is badly needed. A study made for ERDA a few years ago needs updating and an extension of geographical parameters, because of rapid expansion of the uranium and coal reconnaissance areas.

APPENDIX - C

POLICY OPTIONS - ESTIMATED BUDGET - Annual

I. LAND USE

Preliminary Data Survey	\$ 5,000	1 Full Time Researcher
Comprehensive Data Coll.	\$20,000	3 Graduate Assistants
Data Analysis	\$20,000	
Travel/Per Diem	\$ 1,500	
	<u>\$46,500</u>	

II. MINE/WATER DISCHARGE

No cost estimate due to overlap with separate contract	na	na
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III. LITIGATION

Preliminary Data Survey	\$ 2,500	1 Full Time Lawyer
Comprehensive Data Coll.	\$20,000	1 Legal Assistant
Data Analysis	\$30,000	
Travel/Per Diem	\$ 4,000	
	<u>\$56,000</u>	

IV. FUTURE DATA REQUIREMENTS

Preliminary Data Survey	\$ 2,000	1 Full Time Researcher
Comprehensive Data Coll.	\$18,000	
	<u>\$20,000</u>	

V. RIGHTS OF WAY

Comprehensive Data Coll.	\$ 4,000	1 Parttime Researcher
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TOTAL \$ 126,500

APPENDIX H

Possible Inhibitions on Uranium and Coal Mining Development Due to Environmental Factors

Major electric generating facilities installed and proposed for the San Juan Basin (the Northwest Quadrant of New Mexico) pose an environmental problem of increasing complexity.

In the late 1960's the "Four Corners" area of New Mexico was given widespread notoriety in the national media for the display of widespread smoke plumes coming from the first three generating units of the complex. To these three were added into four and five in 1969 and 1970.

Dr Stark in 1975 estimated the effluents from this source as indicated in the table below:

Table 1

<u>Four Corners</u>	<u>Generating Cap. (megawatts)</u>	<u>Effluents (tons/day)</u>		<u>Particulates</u>
		<u>SO₂</u>	<u>NO_x</u>	
Units 1-3 total	575	65	66	198
Units 4 and 5	1510	172	174	52
TOTALS	2085	237	240	250

<u>Coal Gasification</u>	<u>Emissions</u>		<u>Hydrocarbons</u>
El Paso	<u>SO₂</u>	<u>NO_x</u>	<u>CO</u> .5 tons/day
	20 t/d	24 t/d	2.5 t/d

Stark (1975) states, "If all planned electric power plants and coal gasification plants are operating by 1983 and barely meet all present performance standards, that total effluent in the area (New Mexico) only would include 412 tons/day SO₂ and 374 tons/day NO_x. If these pollutants disperse 1000 feet vertically, the SO₂ air standard would require a complete dilution over an area of 10,000 square miles.

... This may pose a problem if the effluent from this region drifts down the Rio Grande Valley, since it would likely exceed the standards of "no significant deterioration in the Santa Fe-Espanola-Los Alamos region." ^{1/}

A conference with personnel of the Air Quality Division of the New Mexico Environmental Improvement Division (EID) provided current data on emissions expected in the period of the late 1980's. (Conference with Kenneth Hargis and Bruce R. Nicholson, EID, Air Quality Section, March 6, 1978).

Table 2 sets forth the daily emissions that could be expected if all the facilities outlined in the main body of the report were in place. It is assumed that two coal gasification plants and the New Mexico Station are operational in the post 1985 period.

^{1/} Stark, Eugene A., Environmental Issues Related to Energy Resources Development in New Mexico. A Report of the Task Force Committee on the Environment, Governor's Energy Task Force, Santa Fe, New Mexico, p. 36, 38, May 1975.

The consensus of the State experts is that emissions from existing and proposed facilities in the Basin will not inhibit mining activities provided that planned equipment is installed and maintained. Two warnings were given however:

- a. Location of facilities is very important. If the proposed coal gasification complexes and the New Mexico Station should be relocated geographically so that existing generating stations and proposed facilities were in a north-south "straightline" orientation, the concentration of emitters would be too great. Proposed locations do not pose this problem as they are south and east of the Four Corners area.
- b. Emissions of NO_x could, in the future, present a problem. It is understood that regulations relative to this emission will be received from EPA in a few months. After evaluation by the State EID, more specific information will be forthcoming. It is anticipated that during the next five years needs for control for NO_x may be more specific.

Table 2

Daily Emissions Anticipated in the Post 1985
Period in the San Juan Basin 1/

FOUR CORNERS

Total - all units

daily maximum

SO₂ - 135 tons per day (short tons) based upon 67½% control

TSP - 13 tons per day based upon 0.05 lb/MBTU

NO_x - 183 tons per day based upon 0.7 lb/MBTU

gross - total generating capacity (MW) = 2240 MW

SAN JUAN

Total plant (4 units)

daily maximum

SO₂ - 78 tons per day

NO_x - 102 tons per day based upon state reg. limits

TSP - 10.3 tons per day

SO₂ - 0.34 lb/MBTU new units
67½% existing units (applies to unit 2)

TSP - 0.05 lb/MBTU

NO_x - 0.45 lb/MBTU new units
0.79 lb/MBTU existing (unit 2)

New Mexico Station (at Bisti)

daily maximum

SO₂ - 26 tons/day 0.34 lb/MBTU

NO_x - 114 tons/day based upon 0.45 lb/MBTU

TSP - 13 tons/day 0.05 lb/MBTU

1/ Bruce Nicholson
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Section, Air Quality Division

FOOTNOTES

1. Melvin, James W. Geologic Map #31, Geology of Grants Uranium Region, 1973 Text accompanying map, New Mexico Bureau of Mines Mineral Resources, Socorro.
2. Governor's Energy Impact Task Force, Santa Fe, February 1977, p.71.
3. Specht, David, City, "State Growth Rate Triple U.S." Albuquerque Journal, August 6, 1977, p. A-1, A-2.
4. New Mexico Business, October 1959.
5. Kleine, L.W. and Ford, C.O., Electric Utility Industry of New Mexico, New Mexico State University Engineering Experiment Station. Bulletin No. 47, College Station, New Mexico, July 1973, p. 5.
6. Op. Cit. p. 5.
7. Western Interstate Nuclear Board, Regional Factors in Planning and Siting Electrical Energy Facilities in the Western States, Vol. II, Lakewood, Colorado, April 1977, p.2.
8. U.S. Department of Interior, Bureau of Reclamation, Western Energy Expansion Study, 1976, p.14.
9. Telephone conversation, December 1977.
10. Kleine, L.W. and Ford, Electric Utility Industry of New Mexico, New Mexico State University Station Bulletin. Public Service of New Mexico 1977 No. 47, (1973) p. 11.
11. N.M. Legislative Energy Committee, Utility Report, Dec. 1976.
12. USDA, REA, 1976 Annual Statistical Report.
13. New Mexico Public Service Commission Thirty-Second Annual Report, July 1975-June 30, 1976.
14. Interview with Mr. William Hicks.
15. New Mexico Public Service Commission Thirty-Second Annual Report, July 1975-June 30, 1976, p. 10.

FOOTNOTES (cont'd)

16. Interview with Public Service personnel, December 1977.
17. Public Service Company of New Mexico, Phase 1 Report (Input to Bureau of Land Management's Regional Coal Environmental Impact Statement - 1976).
18. Public Service Company of New Mexico serves all industrial customers (using more than 2MW) north to the PNM's 115 transmission line from Gallup to Albuquerque. However, some of the uranium mining and milling customers are serviced by Continental Divide Electric Cooperative (CDEC) which distributes power purchased from Plains Electric. The SOHIO mill/mine complex and the Anaconda Mills and Mines are some served by CDEC.
19. Gallo Wash and Star Lake Coal/Uranium facilities if initiated will be served by Jemez Electric Cooperative (JEC) of Espanola also a customer of Plains Electric.
20. Assumes that no existing plants are phased out.
21. U.S. Department of Interior, Bureau of Reclamation, Western Energy Expansion Study, Feb. 1977, p. 14.
22. Enrichment feed contracts 208,000 megawatts electric; 0.20 percent tails to October 1980; 0.25 percent tails thereafter; ERDA 1977a.
23. However, much of the pumping requirements is for additional water as well as additional depth and it is not clear that the volume of water will vary strictly with mine depth.
24. Assumes feed grades can obtain current average levels of 3.6 lbs U_3O_8 /ton. Present capacity of 18,160 tons/day equals 5.4 million tons per year at 80% capacity. To process 36.8 million lbs U_3O_8 in 1985 would require 10.2 million tons per year capacity at minimum. The two mills scheduled in Table 16 will not be sufficient to make up this difference.
25. Balizer, K., The Economic Impact of Changes in Mineral Production in the State of New Mexico 1975-2000, BBER (UNM), Feb. 16, 1977, p.29.
26. Ibid, p. 29-35.

FOOTNOTES .(cont'd)

27. Demand is reflected in terms of megawatt capacity rather than megawatt hours.
28. Based on a population 229,000 and a per capita consumption for all categories of 6.4 MWH.
29. Gas produced and consumed within the state.
30. Albuquerque Journal, Tuesday, November 22, 1977, p. A-2.
31. Albuquerque Journal, September 18, 1977.
32. National Economics Research Associates (NERA), Maximizing the Benefits to New Mexico Economy of it's Gas Supply Potential, January 12, 1977, New York, p. 1.
33. State Geologist's Annual Report, New Mexico's Energy Resources 1976, Santa Fe, 1977.
34. Ibid, p. 11 and p. 15.
35. Shortle, James S., Natural Gas Industry in New Mexico, New Mexico Energy Institute, Report No. 76-1000, September 1977.
36. Ibid, p.47.
37. Federal Power Commission, Bureau of Power, The Phasing Out of Natural Gas and Oil for Electric Power Generation, Southwest Power Pool and Electric Reliability Council, Fort Worth Regional Office, September 1975.
38. Ibid, P. 1.
39. Ibid, p. 2.
40. State Geologist: Annual Report, New Mexico Energy Resources 1977, Santa Fe, New Mexico; Circular 167, 1978.
41. Kidman, Barrett, Koenig; Los Alamos Scientific Laboratory; Energy Flow Patterns 1975, June 1977.