Figure 6. One impact of coal development in the area around Hazen, North Dakota, is the increase in new housing units being built.

The Economic Impact of
Coal-Based Energy Development
in Western North Dakota

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The energy crisis has a special meaning for residents of the Northern Great Plains states. Not only are they subjected to the inconvenience imposed by lower speed limits, closed filling stations and uncertain fuel supplies, but also their states contain much of the nation's remaining energy reserves. The current energy situation provides considerable incentive for the development of the region's oil and oil shale, natural gas, uranium and coal — especially coal.

The coal reserves of the Fort Union Formation are expected to play a major role in supplying energy to meet growing national needs. These reserves account for more than 40 per cent of total United States coal reserves and as much as 90 per cent of the low-sulfur reserves which are well suited to large scale surface mining (9). Fort Union coal is expected to be developed to supply electric power and also to convert to gaseous and liquid fuels, with large scale developments occurring in western North Dakota, eastern Montana, and northeastern Wyoming.

Coal-based industrial development is likely to have a dramatic impact on the economic struc-

ture of western North Dakota. The purpose of this report is to describe probable changes in gross business volume, employment, population, and income associated with various levels of prospective coal development.

The Study Area

The coal mines, power plants, and coal conversion complexes which soon may be developed in North Dakota will be located primarily in the section of the state lying south and west of the Missouri river. Therefore, the study area was defined as North Dakota State Planning Regions 7 and 8, an 18-county area which contains more than 80 per cent of the state's strippable coal (lignite) reserves (2).

The economy of the study area presently is heavily oriented toward agriculture. Agriculture

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Figure 7. A trailer court is part of the impact development at Center, North Dakota.

is the dominant land use in the area, with more than 95 per cent of the land being included in farms (7). Dryland crops and range livestock are the primary enterprises. An important trend in recent years has been a decline in the number of farms and ranches, which in turn has resulted in a decline in agricultural employment. Between 1960 and 1970, agricultural employment decreased by 37 per cent in the study area (Table 1). The decline in agricultural employment has been the key factor leading to a general population decline. Between 1960 and 1970, the population of the study area declined 3.9 per cent (Table 2). Of the 18 counties in the study area, 16 experienced a population decrease during the decade of the 1960's.

As a result of declining employment opportunities, the area has experienced income levels considerably below the national average and a high rate of net out-migration. Per capita money income in the area in 1969 was only 74 per cent of the national average (6). During the decade of the 1960's, the area's net out-migration amounted to 26,651 persons, or 17.4 per cent of the 1960 population (10). Local and state leaders are interest-

ed in ways to halt these trends, but also are concerned that massive coal development may impose substantial social costs on area residents in the form of population congestion, air pollution and water pollution, as well as increased taxes to provide schools, streets and other public services for the expanded population.

Continuing the present mix of primary industries in the study area will likely result in the continuation of many of the trends observed in recent years. The economies of size present in small grain and range livestock production will prompt further decreases in farm numbers and agricultural employment. A decline in employment in agriculture without compensating employment increases in other basic economic sectors is not expected to permit significant growth in the area. Underemployment of human resources will, under these conditions, remain a problem in the area.

Projections of gross business volume, employment, population and income were developed for the years 1985 and 2000 under the assumption that there would be no energy development in the study area and that other industries would fol-

Table 1. Agricultural and Total Employment, North Dakota State Planning Regions 7 and 8, 1960 and 1970.

State Planning Region	Total Employment			Agricultural Employment		
	1960	1970	Per Cent Change, 1960-1970	1960	1970	Per Cent Change, 1960-1970
SR7	36,883	36,280	—1.6	13,424	8,234	—38.7
SR8	15,553	14,872	—4.4	7,010	4,614	—34.2
Total	52,436	51,152	—2.4	20,434	12,848	—37.1

Source: (5)

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Table 2. Population Change and Net Migration, North Dakota State Planning Regions 7 and 8, 1960 to 1970.

State Planning Region	Population 1960	Population 1970	Population Change, 1960 to 1970 Number	Per Cent[1]	Rate of Net Migration Per Cent[2]
SR7	106,561	104,207	—2,354	—2.2	—15.7
SR8	46,227	42,609	—3,618	—7.8	—21.4
Total	152,788	146,816	—5,972	—3.9	—17.4

[1] 1960-1970 population change, expressed as a per cent of 1960 population.
[2] 1960-1970 net migration, expressed as a per cent of 1960 population. A minus sign (-) indicates net out-migration.
Source: (10)

low past trends (Table 3). An input-output model of the area economy was used to develop the projections of gross business volume. One obvious implication of the continuation of the present industry mix is continued substantial out-migration from the area, primarily of young people. Another implication is that per capita costs of providing many public services will become increasingly expensive.

Table 3. Gross Business Volume, Employment and Population, North Dakota State Planning Regions 7 and 8, 1970, 1985 and 2000 (Assuming No Coal Development).

Item	1970	1985	2000
Gross business volume: (million dollars)			
SR7	$ 1,031	$ 1,648	$ 2,324
SR8	543	773	1,130
total	1,574	2,421	3,454
Employment: (number)			
SR7	39,036	37,750	42,343
SR8	14,447	15,649	17,350
total	53,483	53,399	59,693
Population: (number)			
SR7	104,207	100,038	107,975
SR8	42,609	41,470	44,243
total	146,816	141,508	152,218
Per capita money income: (dollars)			
SR7	$ 2,999	$ 5,020	$ 6,895
SR8	3,638	5,321	7,262

Analysis of Economic Impacts of Alternative Coal Development Policies

As a basis for a comprehensive analysis of the economic, social and environmental impacts of Northern Plains coal development, the U. S. Bureau of Mines outlined levels of coal development consistent with three alternative policies (1).

An input-output model of southwestern North Dakota was employed to analyze the impacts of these alternative coal development policies. Expenditure data for 1965 had been collected by personal interview with individual firms and households and incorporated into a 30-sector input-output (I-O) model to develop interdependence coefficients (3). These coefficients were subsequent-

ly tested for validity (4). Experience in application of the I-O model has indicated that the original 30-sector model contains more sectors than are needed and may lead to confusion regarding sector definition for users of the results. Accordingly, the original 30 sectors were consolidated into 13 sectors.[1]

In this study, the 13 sector I-O model was employed to project the gross business volume resulting from three alternative levels of coal development. Projections were made for the years 1985 and 2000. To project the economic impacts of development, local expenditures were estimated for each activity (e.g., surface coal mining, steam electric power generation, and conversion of coal to synthetic natural gas) in each alternative. The local expenditures for plant and mine construction and operation were assigned to the sectors from which inputs are purchased. Interdependence coefficients were applied to these direct expenditures to obtain estimates of the total (direct and indirect) effects on gross business volume in each of the economic sectors in the region.

Additional employment (by sector) was estimated by applying projected gross business volume per worker ratios to projected sector gross business volume resulting from plant construction and operation.[2] The summation of employment in the 13 sectors provided estimates of total employment attributable to energy development. Changes in population associated with each development level were estimated by applying projected participation rates (trend in population ÷ trend in total employment) to the total employment estimates. The results indicate the sum of direct and indirect or induced effects of each development alternative.

[1] The sectors include agriculture - livestock production; agriculture-crop production; mining; contract construction; transportation; communications and utilities; agricultural processing and wholesaling; retail trade; finance; insurance; and real estate; business and professional services; professional and social services; households; and government.

[2] Ratios were calculated relating historic gross business volume to historic employment for each of the planning regions. The ratios were extrapolated via multiple regression to obtain projected ratios for the target years. The ratios were in turn applied to projected gross business volume to obtain the additional employment resulting from energy development.

Farm Research

Development to Meet Regional Demand (Alternative I)

The first policy analyzed is a limitation of coal development to that level necessary to meet regional energy demand. This policy implies that coal production in the study area will be 19.3 million tons annually in 1985 (Table 4), compared to a production level of less than 6 million tons in calendar year 1972. The increased coal production will be used primarily to fuel steam-electric power generating plants. Generating plant capacity in the area is assumed to increase from 736 megawatts (MW) in 1972 to 2,533 MW in 1985. An additional 1,200 MW steam electric power generating complex is assumed to be built by the year 2000.

The projected change in final demand vectors resulting from these changes in energy development were used in the I-O model to estimate changes in gross business volume, employment, and population (Table 5). Employment in the area is projected to increase by 19 per cent between 1969 and the year 2000, and about one-third of this increase can be attributed to the expansion of coal mining and power generation.[3]

Development to Meet Regional and National Demand (Alternative II)

The second policy alternative is development of Northern Plains coal resources to meet both regional and national demands, but under an as-

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[3] *An increase in employment of about 5,400 is expected to occur by the year 2000 in the absence of any further energy development (Table 3). Employment resulting from energy development is added to this "baseline projection."*

sumption of substantial reliance on imports of foreign oil and gas. This policy implies that coal production in the study area would increase more than 20-fold between 1972 and the year 2000. The coal would be used both in electrical generating plants and for conversion to synthetic natural gas (Table 4). This scenario assumes that seven gasification plants are to be built in the area between 1980 and 2000.

Development of this magnitude will result in substantial employment and population increases (Table 5). Employment is expected to increase by 96 per cent between 1969 and 2000, and thus area employment in the year 2000 is 82 per cent greater than projected with no further coal development. Furthermore, it should be emphasized that this growth will not be distributed uniformly over the study area. Rather, the plants and mines will be concentrated in those areas where large strippable coal deposits are located in proximity to water supplies. Of the 18 counties of the study area, only six are likely to be sites of new plant or mine facilities, and two of these six counties will likely experience a doubling of their population by 1980.

Development to Contribute to National Energy Self-Sufficiency (Alternative III)

The third policy alternative involves extensive development of coal resources to meet growing demands in the face of assumed major reductions in oil imports, assumed major restrictions in natural gas imports from Canada, and an assumed major lag in nuclear generating capacity. Energy activity associated with this policy is summarized in Table 4. Under this policy, the

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Table 4. Coal Production and Related Energy Activity Associated with Three Development Alternatives, Southwestern North Dakota.

Item	1972 Region 7	1972 Region 8	Total	1985 Region 7	1985 Region 8	Total	2000 Region 7	2000 Region 8	Total
Alternative I									
Coal production (MMTPY)[1]	5.2	.4	5.6	16.5	2.8	19.3	23.8	4.8	28.6
Electrical generation (MW)[2]	735.8	—	735.8	2,533.0	—	2,533.0	3,733.0	—	3,733.0
Alternative II									
Coal production (MMTPY)	5.2	.4	5.6	26.6	15.9	42.5	61.9	73.8	135.7
Electric generation (MW)	735.8	—	735.8	2,533.0	—	2,533.0	5,033.0	5,000	10,033.0
Coal gasification (MMCFD)[3]	—	—	—	250	250	500	1,000	750	1,750
Alternative III									
Coal production (MMTPY)	5.2	.4	5.6	56.4	26.8	83.2	107.7	142.0	249.7
Electrical generation (MW)	735.8	—	735.0	2,533.0	—	2,533.0	5,033.0	5,000	10,033.0
Coal gasification (MMCFD)	—	—	—	1,000	500	1,500	2,000	2,250	4,250

[1] *Million tons per year.*
[2] *Megawatts, one megawatt = 1,000 kilowatts.*
[3] *Million cubic feet per day.*

Table 5. Gross Business Volume, Employment and Population, North Dakota State Planning Regions 7 and 8 (Combined), 1970, 1985 and 2000.

Item	1970[1] Region 7	8	Total	1985 Region 7	8	Total	2000 Region 7	8	Total
Alternative I									
Gross business volume (million dollars)	$ 1,032	$ 543	$ 1,575	$ 1,692	$ 773	$ 2,465	$ 2,605	$ 1,140	$ 3,745
Employment	39,036	14,447	53,483	38,878	15,685	55,563	45,243	17,578	62,821
Population	104,207	42,609	146,816	103,019	41,589	144,608	115,370	44,825	160,195
Alternative II									
Gross business volume (million dollars)	1,032	543	1,575	1,937	1,063	3,000	3,530	2,274	5,804
Employment	39,036	14,447	53,483	44,302	22,055	66,357	60,895	36,957	97,852
Population	104,207	42,609	146,816	117,401	58,446	175,847	155,027	94,241	249,268
Alternative III									
Gross business volume (million dollars)	1,032	543	1,575	2,216	950	3,166	4,066	3,233	7,299
Employment	39,036	14,447	53,483	51,145	20,075	71,220	71,148	54,014	125,162
Population	104,207	42,609	146,816	135,535	53,199	188,734	181,427	137,736	319,163

[1] *Employment is for 1969. Source: (8).*

economic impacts are massive. For example, population in the area is estimated to increase 47 per cent between 1970 and 1985 and 150 per cent by 2000 (Table 5). Development of this magnitude will pose serious challenges of state and local leaders. Providing adequate levels of public services in areas affected by the "coal rush" will certainly be one of the major problems.

Summary and Policy Implications

The estimates presented indicate that coal development is likely to cause major economic changes in areas with extensive and readily recoverable coal reserves. Modest levels of coal development may assist some areas in reversing a trend of economic decline. However, higher levels of development will place considerable pressure on public service delivery systems and may impose substantial social costs on present residents. Public officials and planners should give serious attention to alternative ways to provide and finance public services in such impacted areas. At the national level, attention should be given to developing alternative energy sources.

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