

Socioeconomic Impacts of Lignite Coal Resource Development

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Future coal resource development projects in western North Dakota could have significant socioeconomic impacts, especially for the towns and cities near the project sites. Some of the cities could have relatively rapid and large increases in employment and population, especially during the construction phase of the projects. The likely result is for local units to have increases in public costs that exceed the increases in their public revenues. The reverse is true for state costs and revenues associated with the projects, and the state's fiscal surplus is projected to exceed the deficits of local units of government.

Introduction

The socioeconomic impacts of North Dakota's lignite coal resource development have become an issue of concern to many in the state. The impacts of previous coal conversion developments generally have been accommodated by the local communities that were affected. However, future development could present more serious adjustment problems for the communities involved, because most of the excess capacities in the trade and service systems in those areas already have been absorbed by previous development.

Mercer county is an example of the case in which future development will likely result in stress on many of the public and private components of the local and regional economy. Presently, two electrical generation units are operating near Stanton, and three mines in the county each produce more than one million tons per year. Proposed coal conversion projects for Mercer county include a coal gasification plant and two electrical generating plants near Beulah and the mines associated with these facilities.

The Department of Agricultural Economics at North Dakota State University has been involved in a number of research projects to estimate the economic impacts of the construction and operation of coal conversion facilities in western North Dakota. One such project was addressed to the socioeconomic impacts associated with an electric generating plant located in Mercer county, North Dakota. This article is a summary of a more detailed report of that work.¹ Procedures used in this

¹Leholm, Arlen G., et al, *Economic Impacts of Construction and Operation of Coyote Station No. 1 Electrical Generation Plant and Expansion of Coal Handling Facilities at the Beulah Mine of Knife River Coal Company*, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, May, 1976.

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study were similar to those employed in the other projects.

The study was an analysis of the socioeconomic impacts associated with the construction and operation of the Coyote Station facility² to be located southwest of Beulah, North Dakota. In the analysis, consideration was given to the cumulative impacts of present and proposed energy developments in Dunn, Mercer, McLean and Oliver counties. The proposed Coyote Station Project consists of a nominal 440-megawatt electrical generation plant, expansion of the present Beulah mine operated by Knife River Coal Mining Company to 2.5 million tons per year (MTPY) from the present production of approximately 1.75 MTPY, and 25 miles of water pipeline. The construction period is scheduled for the years 1977-1981, with a peak work force of 1,000 workers in 1980 (930 at the plant and 70 at the mine). The plant and mine will become fully operational in late 1981 with 70 operating employees.

Procedures

Procedures used in the study involved the use of an input-output model for North Dakota to estimate the level of gross business volumes in the respective sectors (industries) in the area economy without and with the Coyote Station facility. Input-output analysis is a technique for tabulating and describing the economic linkages of an economy. Input-output interdependence coefficients (multipliers) indicate the gross business volume that is generated in each sector of a region's economy per dollar of output of the "basic" sectors. A "basic" sector is defined as one that is part of the economic (or export) base of the region, and the other sectors are those that provide

²The Coyote Station facility is a joint project of a consortium of electrical utilities. The primary participants include Otter Tail Power Company, Montana-Dakota Utilities, Minnkota Power Cooperative and Northwest Public Service.

trade and service functions to other sectors. The dominant basic sector in North Dakota is crop production, followed by federal government outlays. Livestock production ranks third, and the other basic sectors are manufacturing, mining and tourism.

Economic baseline projections were made for the region, which were projections of the production of the basic sectors in Region 7 (Figure 1) for the years 1980, 1985 and 2000. These projections were made on the basis of trends in production of those sectors in the years 1958-1973. Input-output multipliers were applied to the production projections of the basic sectors to obtain estimates of gross business volumes of each of the sectors in the region's economy for the years 1980, 1985 and 2000. These estimates were translated to employment on the basis of projected gross business volume-per-worker ratios for those years. Employment estimates were translated to population estimates on the basis of assumed ratios of population to employment.

The economic impacts of construction and operation of the Coyote Station were made by applying the input-output multipliers to new expenditures in the area accruing from the project. During the construction phase of the project, these expenditures will consist of payments to local firms engaged in contract construction, to local retail trade firms, and payroll payments to construction workers. In the operation phase of the project, these expenditures will consist primarily of payroll payments to the operating work force and some expenditures to local retail trade firms. Estimates of gross business volume for the respective sectors were translated to estimated employment and population that would be associated with construction and operation of the plant.

Table 1. Baseline Total Employment and Population For 1960 and 1970, and Projected for 1980, 1985, and 2000, State Planning Region 7.

Year	Employment	Population
1960 ¹	37,300	106,600
1970 ¹	39,000	104,200
1980 ²	39,900	101,400
1985 ²	40,000	100,700
2000 ²	41,000	99,300

¹U.S. Census of Population, North Dakota, U.S. Department of Commerce, U.S. Government Printing Office, Washington, D.C., 1960 to 1970.

²Projected.

Baseline and Impact Projections

Baseline employment in the 10 counties of Region 7 is projected to increase in the future, but population is projected to decrease (Table 1). This represents a continuation of trends that were evident between 1960 and 1970, which involved a modest rate of economic growth for the region as a whole and a decrease in average family size. Population growth in the larger cities is more than offset by decreases in the rural areas.

Peak construction employment in the first year of construction (1977) is expected to be 632 workers, and will reach 1,000 in 1980 (Table 2). The additional operational work force in the plant and associated mine will be 70 people.

Table 2. Peak Construction Plant Operating Employment, By Year, Coyote Station, 1978 and Subsequent Years.

	Year ¹					
	1977	1978	1979	1980	1981	after 1981
Construction						
Plant	632	677	871	930	475	—
Mine	—	—	50	70	70	—
Total	632	677	921	1,000	545	—
Operation	—	—	—	—	70	70

¹Construction is scheduled to begin in March, 1977 and end by July, 1981.

The peak population associated with the plant and mine is estimated to be 2,053 in 1980 (Table 3). The population directly or indirectly associated with the facility is projected to stabilize at about 733 in 1982 and thereafter. These increases compare with a projected baseline population for Region 7 in 1980 of 101,400, so the regional impacts (relative to the total 10-county area) are not likely to be as significant as the local impacts in the site county and in towns near the plant.

The number of workers estimated to migrate to Beulah and Hazen because of the new facility, as well as the estimated new population associated with these workers, is presented in Table 4. The population of Beulah is estimated to almost double between 1970 and 1980, but the plant-related population in Beulah is projected to decrease from 1,235 in 1980 to 469 in 1983.

The estimated new population in Beulah and Hazen resulting from the new facility should be interpreted as general approximations rather than as precise predictions of the population increases for any community. Increases in population of the magnitude projected for Beulah and Hazen will require expansion and development of both private and public facilities in those cities.

Table 3. 1960 and 1970 Population, Projected Baseline Population for 1980, Population Associated with Plant and Mine and Total Population Projected for 1980, 1981, and 1982, State Planning Region 7.

	Years				
	1960	1970	1980	1981	1982
Baseline: ¹ SR 7	106,600	104,200	101,400		
Construction direct			1,320	720	—
Operation direct			231	231	231
Indirect			502	502	502
Subtotal			2,053	1,453	733 ²
SR 7 total			103,453	102,853 ³	102,133 ³

¹Assumes no additional lignite coal development.

²Indicates the stabilized population level when the plant and mine complex become operational which could occur in the latter part of 1981.

³1980 baseline projection is used to compute total population.

These settlement pattern projections considered to be "most likely" are based on information from other studies, past experience, size of the projected work force, and the size and location of cities in the area. A gravity model was

used to allocate percentages of the total migrants to selected cities.

Net Fiscal Impacts

Changes in the public sector costs and revenues associated with the Coyote Station facility were estimated on an annual basis for the years 1977-2012. The procedures are too involved to be described in detail here, but the projections are summarized in Table 5. The local units of government in Mercer county are projected to have a net fiscal deficit of about \$2.5 million at the end of the construction period. By the year 2012, cumulative public costs are projected to exceed cumulative public revenues by about \$1.9 million.

The deficit of local units of government could be offset by transfers from the state Coal Impact Fund, or other state and federal transfer payments. The state is projected to have a cumulative surplus of project-related tax revenues over project-related public costs of \$11.3 million after the construction period and \$182.7 million by the year 2012 (Table 6).

RED-1

The experience gained in conducting economic impact assessments for the Coyote 1 project and other similar projects has indicated that state and local decision makers have a need for precise impact estimates developed in a timely manner. This need has led to the development of an interactive computerized impact assessment model.

The REAP Economic-Demographic Model-1 (RED-1) has been developed for use in estimating the economic and population changes, as well as the changes in related public costs and revenues

Table 4. Estimated Number of Workers Moving to Beulah, Hazen, and Other Towns and Population Associated with These Workers, Coyote Station Plant, 1977-1983.

	Beulah	Hazen	Other towns	Total
1970				
Population	1,344	1,240	5,978	8,562
1977				
Migrating workers	232	107	65	404
New population	528	242	154	924
1978				
Migrating workers	259	122	77	458
New population	605	286	193	1,084
1979				
Migrating workers	365	170	111	646
New population	867	405	286	1,558
1980¹				
Migrating workers	476	193	131	800
New population	1,235	470	348	2,053
1981				
Migrating workers	318	119	90	527
New population	887	308	258	1,453
1982²				
Migrating workers	128	31	41	200
New population	469	114	150	733
1983³				
Migrating workers	128	31	41	200
New population	469	114	150	733

¹Year of peak construction employment.

²All construction activity has been completed by 1982.

³The work force and associated population are assumed stable during the operation phase (i.e. 1982 and thereafter).

associated with alternative levels of resource development in a region. This model was developed and computerized under contractual arrangements awarded by the North Dakota Regional Environmental Assessment Program (ND-REAP). One contract, primarily for conceptual development and data assembly, was with a team of economists and sociologists from North Dakota State University and the University of North Dakota. The other contract, primarily for implementation of the model for computer operation, was with a team from Arthur D. Little, Inc., but that team also made contributions in the area of model development.

RED-1 was developed to permit rapid and comprehensive analysis of economic and demographic impacts of the kinds of resource developments described earlier. It was also designed to allow convenient access by a wide range of users and to permit the user to specify the character-

istics of the project and the area in which the project may locate.

The RED-1 model consists of several sub-modules. These modules are an economic model, a demographic model, an economic-demographic interface, a gravity model, and a fiscal impact model. The modules are integrated within a computer program that operates on the state's Central Data Processing (CDP) computer and can be accessed with a computer terminal via telephone link to the CDP computer. Access to the model is coordinated by the REAP office.

The programming language for RED-1 is APL, and the model operates in an interactive mode; that is, the user communicates directly with the CDP computer via the computer terminal. The user is queried by the computer as to which project he wishes to consider and the values of selected variables he may wish to specify. He is also queried as to the types of projects for which he

Table 5. Net Fiscal Impacts on Local Government of Construction and Operation of an Electric Generating Station and Associated Mine, Mercer County (prices in year indicated).

Year	Increased revenue ¹	Increased operating costs	Capital improvements		Fiscal balance	
			Original cost	Repayment and debt service ²	Current	Cumulative
Construction phase						
1977	\$ 239,857	\$ 476,168	\$ —	\$ —	\$ -236,311	\$ -236,311
1978	291,718	550,994	5,496,839	—	-259,276	-495,587
1979	862,251	841,668	—	577,886	-557,303	-1,052,890
1980	1,065,258	1,289,301	—	577,886	-801,929	-1,854,819
1981	902,858	966,900	—	577,886	-641,928	-2,496,747
Subtotal	3,361,942	4,125,031		1,733,658		
Operation phase						
1982	1,222,502	561,205	—	577,886	83,411	-2,413,336
1983	1,256,904	600,490	—	577,886	78,528	-2,334,808
1984	1,293,705	642,524	—	577,886	73,295	-2,261,513
1985	1,333,065	687,501	—	577,886	67,678	-2,193,835
1986	1,375,168	735,626	—	577,886	61,656	-2,132,179
1987	1,420,199	787,120	—	577,886	55,193	-2,076,986
1992	1,718,859	1,103,976	—	577,886	36,997	-1,855,606
1997	2,106,381	1,548,384	—	577,886	-19,889	-1,841,276
2002	2,276,205	2,171,689	—	0	104,516	-1,538,381
2007	3,035,807	3,045,906	—	0	-10,099	-1,359,646
2012	4,099,144	4,272,041	—	0	-172,897	-1,898,526

¹Increased revenues initially include property taxes, school foundation program payments, user fees, and special assessments. During the operation phase, 5 percent of severance taxes, coal conversion taxes, and revenue sharing are added. The decrease in farm property tax revenues due to strip mining are subtracted from this total.

²The repayment and debt service was assumed to be paid by special assessments, excluding capital construction costs for schools and recreation. The special assessments from city expansion are included as an increased revenue.

SOURCE: Leholm, Arlen G., Norman L. Dalsted, Norman E. Toman, F. Larry Leistritz, Thor A. Hertsgaard and Randal C. Coon, *Economic Impacts of Construction and Operation of Coyote Station No. 1 Electrical Generation Plant and Expansion of Coal Handling Facilities at the Beulah Mine of Knife River Coal Company*, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, May, 1976, Table 20, page 36.

Table 6. Net Fiscal Impact on State Government of Construction and Operation of an Electric Generating Station by Year, North Dakota (prices in year indicated).

Year	Revenue ¹	Current Operating Cost ²	Fiscal Balance	
			Current	Cumulative
Construction phase				
1977	\$ 1,910,205	\$ 642,816	\$ 1,267,389	\$ 1,267,389
1978	2,361,064	795,898	1,565,166	2,832,555
1979	3,700,144	1,280,899	2,419,245	5,251,800
1980	5,210,130	1,805,657	3,404,473	8,656,273
1981	4,030,063	1,427,948	2,602,115	11,258,388
Subtotal	17,211,606	5,953,218		
Operation phase				
1982	2,716,102	786,271	1,929,831	13,188,219
1983	2,870,309	836,750	2,033,559	15,221,778
1984	3,035,213	890,763	2,144,450	17,366,228
1985	3,211,726	948,557	2,263,169	19,629,397
1986	3,400,577	1,010,398	2,390,179	22,019,576
1987	3,602,627	1,076,566	2,526,061	24,545,637
1992	4,845,022	1,483,721	3,361,301	39,681,662
1997	6,586,712	2,054,777	4,531,935	64,532,004
2002	9,027,894	2,790,581	6,237,313	92,307,813
2007	12,450,140	3,913,934	8,536,206	130,391,057
2012	17,246,820	5,489,495	11,757,325	182,735,444

¹Includes revenues from personal income tax, sales and use tax, corporate income tax, business and corporate privilege tax, highway revenues, cigarette and tobacco tax, liquor taxes, and revenues from business structures, public facilities, and residential construction during the construction and operation phase; as well as receipts for the state's share of coal conversion tax and severance taxes.

²Includes increased highway operating expenditures, school foundation program payments, and increased state government operating expenses on a per capita basis, and amortized state highway improvements of \$65,131 annually for 20 years, beginning in 1979.

SOURCE: Leholm, Arlen G., Norman L. Dalsted, Norman E. Toman, F. Larry Leistriz, Thor A. Hertsgaard and Randal C. Coon, **Economic Impacts of Construction and Operation of Coyote Station No. 1 Electrical Generation Plant and Expansion of Coal Handling Facilities at the Beulah Mine of Knife River Coal Company**, Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, May, 1976, Table 21, page 38.

would like results. After the user has typed in this information, the computations are performed and the results are typed on the user's terminal.

The model has been designed for use in a 15-county area in southwestern North Dakota. The counties included are all those below the Missouri river, except for McKenzie county, plus McLean and Burleigh counties. This corresponds to State Planning Regions 7 and 8, less Emmons, Kidder and Sheridan counties.

The computer model will perform the computation very rapidly and economically. In addition, the model has the flexibility of allowing the user to specify certain types of assumptions that he may wish to consider in alternative solutions.

The economic module uses an input-output framework to perform the computations of projected gross business volume and employment. The demographic module employs a cohort-survival procedure to compute age-sex distributions

of population. The economic and demographic modules jointly estimate migration rates within the region, and a gravity module computes the projected settlement patterns for immigrating population. The fiscal balance module performs the computations of changes in state and local public costs and revenues associated with the development projects specified by the user. The computer printout consists of a regional economic activity report that indicates the project-related, baseline and total business activity (gross business volumes) and personal income for the years requested by the user. Similar information is presented for population and project-related (construction, operating and indirect) and baseline employment. The user may request the same information as is printed for the 15-county region for any counties or for municipalities in those counties. Final printed results are the fiscal balance reports (project-related changes in public costs and revenues) for the state and for counties and municipalities selected by the user.