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Economic Contribution of the North Dakota Lignite Industry in 2017

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Lignite Energy Council

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NDSU NORTH DAKOTA STATE UNIVERSITY

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Dean A. Bangsund and Nancy M. Hodur*

Commercial use of lignite coal to produce energy in North Dakota precedes the 1970s. Since that time, technology has dramatically improved the industry's environmental effects, and over that same period, society has become more concerned with issues of pollution and global warming. This convergence of social concerns with technological advancement has kept the use of coal in the middle of the debate on the future mix of energy resources. These challenges to burning coal have diminished the use of coal for stationary power generation in some regions of the United States; however, the overall size of the lignite industry in North Dakota has remained consistent for nearly a half century.

Lignite in the state is used primarily to produce electricity, which utilizes nearly 80 percent of lignite mined in the state. Other uses include synthetic gas (13%), fertilizer (7%), and miscellaneous heating (1%). Lignite coal has lower energy densities and generally higher moisture content than other forms of coal (e.g., bituminous) which makes it difficult to compete economically when markets require inter-state transportation of coal. Fortunately for North Dakota, the location of lignite coal reserves is in close proximity to substantial water resources reducing the challenges of securing adequate resources for steam and cooling operations. These circumstances led to the creation of several coal conversion facilities in North Dakota.

The lignite coal industry in North Dakota primarily represents a 'mine-to-mouth' operating structure. This type of arrangement has the coal-fired power plants located near mining operations with output from the mines contracted and delivered to nearby plants. Advantages of this arrangement include lower coal transportation costs, capacity to secure long-term market contracts between plant and mine, and ability to optimize coal burning efficiencies to match specific coal characteristics associated with a dedicated supply. Having a consistent and stable supply of coal further assists private industry and utility managers in making long-term capital investments.

Coal-fired power plants are a key component of electricity supply in the United States. Other sources include hydroelectric, solar, wind, nuclear, and natural gas-fired plants. Coal continues to provide base-load electricity—a relatively constant amount of electricity needed to meet minimum electricity demands. The coal-fired plants in North Dakota were historically designed around base load-usage in the electricity grid. The growth of other electricity sources, combined with deregulation in some markets, have changed the electricity supply structure in the United States.

North Dakota has benefited from having a stable, long-term supply of electricity through the use of lignite coal in mine-to-mouth operations. This report represents an update to numerous economic assessments, which began not long after the industry was developed, estimating the economic footprint of the industry in North Dakota.

*The authors are, respectively, Research Scientist, Department of Agribusiness and Applied Economics, and Director, Center for Social Research, North Dakota State University.

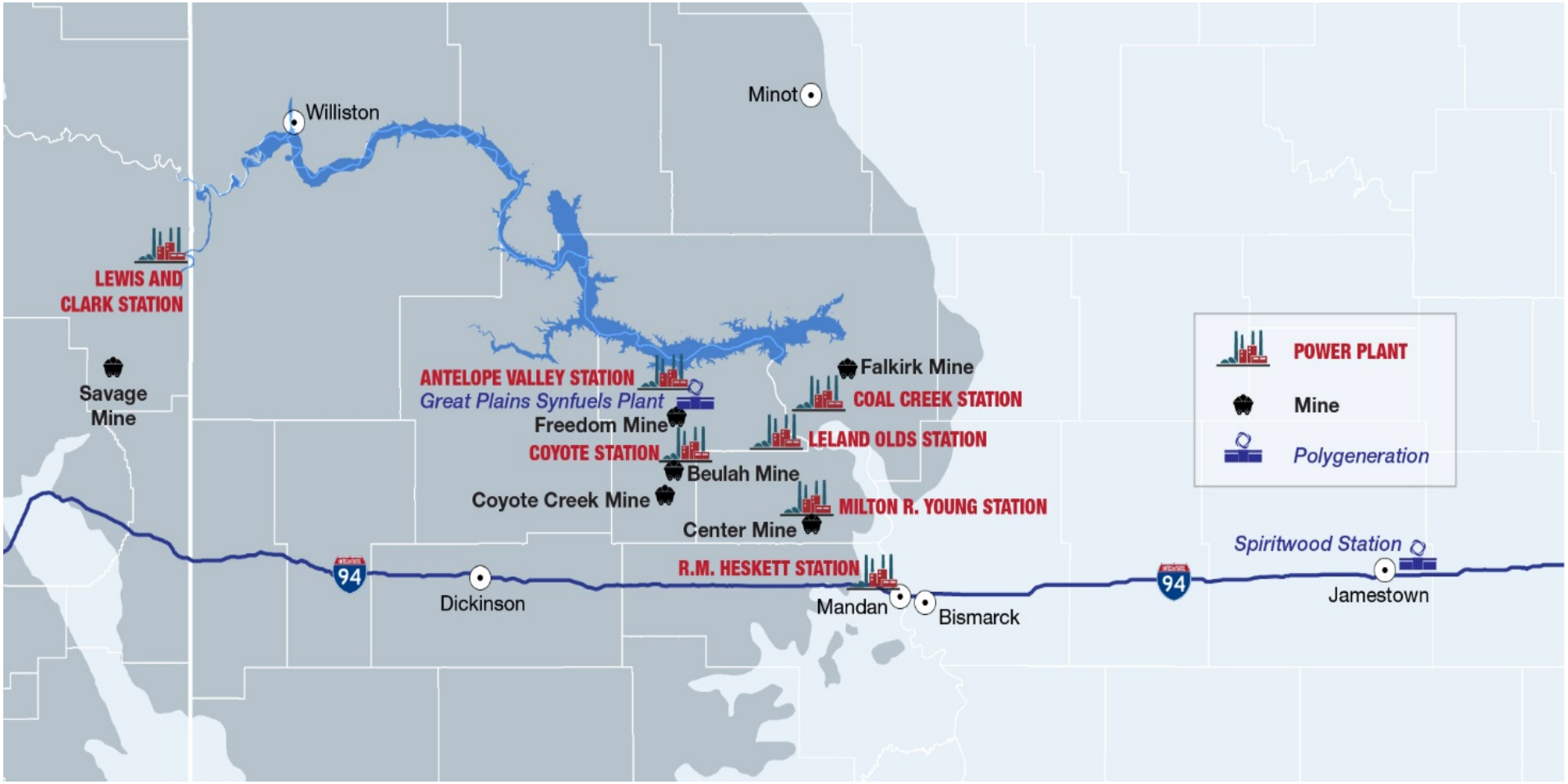

Figure 1. Distribution of Lignite Coal Mining, Conversion, and Generation Facilities, North Dakota and Eastern Montana, 2017

Source: Energy & Environmental Research Center, University of North Dakota.

Data Collection and Impact Methodology

The methods used for this analysis are similar to those used in previous lignite industry assessments (see Previous Research and Literature Cited section for listing of previous reports). Financial information of companies involved in lignite-related activities in North Dakota constitute much of the baseline data for the study, and were obtained by surveying the firms and companies comprising mining operations, electricity generation plants, coal conversion facilities, and electricity transmission (Appendix A contains sample questionnaires). The ND Lignite Energy Council provided assistance in contacting the firms. The industry survey had 100 percent participation by all firms involved in lignite-based mining, conversion, generation, and transmission. The following firms were identified by the ND Lignite Energy Council and participated in the study:

Basin Electric Power Cooperative
BNI Coal, Ltd.
Coteau Properties Company
Coyote Creek Mining Company, L.L.C.
Dakota Gasification Company
Great River Energy
Minnesota Power, Allete, Inc.
Minnkota Power Cooperative and Square Butte Electric Cooperative
Montana-Dakota Utilities Co.
NoDak Energy Services
Otter Tail Power Company
The Falkirk Mining Company

The survey collected information on sales, employment, employment compensation, total expenditures, in-state expenditures, and taxes paid in North Dakota (Tables 1 and 2). The general framework for analysis after obtaining industry data is to estimate the indirect and induced economic effects in the state's economy (Figure 2). (Appendix B contains a detailed discussion of the study's I-O methodology and terminology used in the analysis.)

The industry data, and in some cases, secondary information from other sources, represent the direct impacts of the industry. Those values are then structured for use in the IMPLAN modeling system (Table 3). (Appendix C discusses modifications to IMPLAN's social accounting matrix.)

Table 1. In-state Employment, Lignite Industry Survey, North Dakota, 2017

Employment	Coal Mining	Conversion, Generation, and Transmission	All Segments
Full-time	1,172	2,585	3,757
Part-time	96	30	126

Source: Industry Survey Data 2017.

Table 2. Summary Financial Data, North Dakota Lignite Industry Survey, North Dakota, 2017

	Coal Mining		Conversion, Generation, and Transmission		All Segments	
	Total	In-state	Total	In-state	Total	In-state
	000s 2017 $					
Revenue	519,558	519,558	2,870,065	2,870,065	3,389,623	3,389,623
Wages/Salaries	138,753	138,753	240,014	234,548	378,767	373,302
Benefits	32,460	29,186	75,566	26,562	108,026	55,748
Total Payroll	171,213	167,940	303,144	262,591	474,357	430,531
Expenditures[1]						
Advertising	497	458	771	411	1,268	869
Communication	272	265	644	248	916	512
Construction	3,308	2,633	289,101	46,801	292,409	49,434
Cost of goods sold	0	0	32,022	0	32,022	0
Depreciation/amortization	26,529	518	0	0	26,529	518
Engineering testing/controls	282	268	0	0	282	268
Equipment	49,899	19,877	58,290	23,847	108,189	43,724
Fees	1,201	465	8,440	1,393	9,641	1,857
Freight	0	0	42,915	11,458	42,915	11,458
Fuel	37,472	37,472	0	0	37,472	37,472
Insurance	4,251	0	9,232	681	13,483	681
Legal	2,238	334	523	177	2,760	511
Lime	0	0	13,649	0	13,649	0
Loan interest	13,641	5,289	181,575	13,514	195,216	18,802
Manufacturing	26,800	16,080	0	0	26,800	16,080
Materials	0	0	81,724	17,322	81,724	17,322
Meetings	836	309	1,660	317	2,496	626
Miscellaneous	0	0	1,040	590	1,040	590
Office supplies	16,118	11,940	189,865	25,836	56,367	36,695
Operations and maintenance	0	0	32,615	10,268	32,615	10,268
Rent	29,057	21,603	21,571	842	50,627	22,445
Repairs	81,904	66,457	165,304	84,218	247,209	150,675
Research	0	0	250	250	250	250
Road supplies	804	764	0	0	804	764
Royalty/easements	9,469	6,802	0	0	9,469	6,802
Security and janitorial	321	241	0	0	321	241
Training	1,900	1,309	2,479	962	4,380	2,271
Transmission/wheeling	0	0	242,773	0	242,773	0
Utilities	10,774	10,774	68,205	63,632	78,979	74,407
Total	317,573	203,856	2,414,199	979,750	2,731,773	1,271,299
Taxes Paid in ND	17,927	17,927	39,268	39,268	57,196	57,196

[1]Expenditures listed here exclude in-state purchases of electricity for resale and generation plant and conversion facilities purchases of lignite coal from in-state mines for confidentiality.
Source: Industry Survey Data 2017.

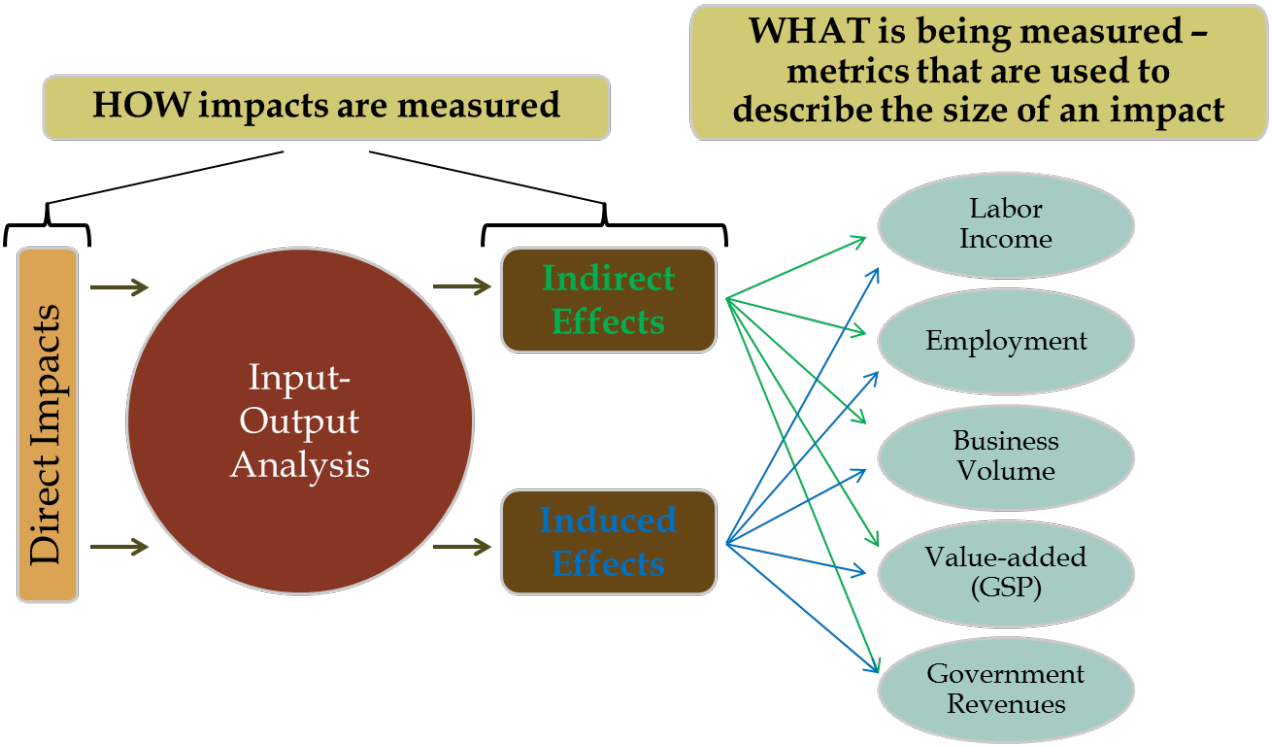

Figure 2. Impact Assessment Methodology
Source: DA Bangsund, Department of Agribusiness and Applied Economics NDSU

Table 3. Industry Profiles, by IMPLAN Economic Sector, Lignite Industry Survey Data, North Dakota, 2017

Sector Profile Components	IMPLAN Sector 22 Coal Mining	IMPLAN Sector 42 Electricity Generation	IMPLAN Sector 49 Electricity Transmission and Distribution
Output (sales)	$519,558,024	$1,813,256,877	$1,129,907,917
Employment[1]	1,268	2,102	513
Employment Compensation	$167,939,680	$264,189,707	$483,519,876
Sole Proprietor Income	$0	$0	$0
Property type income	$7,372,860	-$431,750,454	$10,641,314
Tax on Production and Inputs	$26,672,452	$50,393,816	$93,921,587
Total Value-added	$201,984,992	$-117,166,930	$93,921,587
Intermediate Inputs	$317,573,032	$1,930,423,807	$1,035,986,330

[1]Represents full-time equivalent (FTE) jobs converted to IMPLAN's estimate of total jobs.
Source: Industry Survey Data 2017.

Economic Effects

Direct impacts were run through the IMPLAN modeling system to estimate the indirect and induced economic impacts. Secondary impacts were estimated separately for coal mining, conversion and electricity generation, and electricity transmission and distribution (Table 4).

Coal mining was estimated to have nearly 1,300 direct jobs; business activity relating to coal mining operations supported another 1,100 jobs. Personal spending on goods and services by employees working in the coal mining sector and employees of businesses affected by coal mining supported an additional 1,100 jobs. The combined effects on statewide employment from coal mining was estimated at 3,500 jobs (Table 4). Other economic effects from coal mining included $290 million in labor income and $670 million in gross business volume.

Coal conversion and electricity generation from lignite was estimated to have nearly 2,100 direct jobs, and business activity relating to those lignite operations supported another 4,900 jobs. Personal spending on goods and services by employees working in the coal conversion and generation activities and employees of businesses affected by those activities supported an additional 2,300 jobs. The combined direct, indirect, and induced effects on statewide employment from coal conversion and electricity generation was estimated at 6,300 jobs (Table 4). Other economic effects from coal conversion and electricity generation included $690 million in labor income and $3.6 billion in gross business volume.

Electricity transmission and generation from lignite-based activities was estimated to have 500 direct jobs; business activity relating to those lignite operations supported another 370 jobs. Personal spending on goods and services by employees working in coal-related electricity transmission and distribution and employees of businesses affected by those activities supported an additional 330 jobs. The combined direct, indirect, and induced effects on statewide employment from coal-related electricity transmission and distribution was estimated at 1,200 jobs (Table 4). Other economic effects from transmission and distribution included $87 million in labor income and $1.3 billion in gross business volume.

The combination of coal mining, coal conversion, coal-fired electricity generation, and electricity transmission and distribution was estimated to have 3,880 direct jobs in North Dakota in 2017. These lignite coal activities supported about 6,400 jobs through business purchases of goods and services in the state. The combined personal spending of employees in the Lignite Industry, and employees of businesses involved with supplying goods and services to the industry supported another 3,800 jobs (Table 4). Collectively, the industry was estimated to support 14,000 jobs in the state.

The lignite industry also supports about $1 billion in labor income, which represents wages, salaries, benefits, and sole proprietor’s income. The industry also contributes $1.6 billion to the state’s gross domestic product, and the industry’s gross business volume was estimated at $5.7 billion (Table 5).

Table 4. Direct, Indirect, and Induced Economic Effects, Key Economic Metrics, North Dakota Lignite Industry by IMPLAN Economic Sectors, 2017				
IMPLAN Sector/Type of Economic Effect	**Employment[1]**	**Labor Income**	**Value-added**	**Output**
IMPLAN Sector 22 Coal Mining		---------- 000s 2017 $ ----------		
Direct effects	1,268	167,940	201,985	519,558
Indirect effects	1,099	86,182	125,003	172,293
Induced effects	1,095	47,759	68,324	105,550
Total economic effects	3,462	301,881	395,111	797,400
IMPLAN Sector 42 Electricity Generation				
Direct effects	2,102	264,190	137,408	1,813,257
Indirect effects	4,903	323,509	532,760	1,448,765
Induced effects	2,346	105,006	135,411	347,623
Total economic effects	9,351	692,705	805,579	3,609,645
IMPLAN Sector 49 Electricity Transmission and Distribution				
Direct effects	513	51,390	318,458	1,129,908
Indirect effects	366	21,470	40,158	114,036
Induced effects	332	13,995	23,901	50,181
Total economic effects	1,211	86,855	382,518	1,294,125
[1] Employment represents total jobs, and does not represent employment in FTE.				

Table 5. Direct, Indirect, and Induced Economic Effects, Key Economic Metrics, North Dakota Lignite Industry, 2017				
Type of Economic Effect	**Employment[1]**	**Labor Income**	**Value-added**	**Output**
ND Lignite Industry		---------- 000s 2017 $ ----------		
Direct[1] (3,820 fte)	3,883	483,520	657,850	3,462,723
Indirect	6,368	431,161	697,921	1,735,093
Induced	3,774	166,761	227,637	503,354
Total	14,024	1,081,442	1,583,408	5,701,170
[1] Employment represents total jobs, and does not represent employment in FTE. Direct employment in FTE was 3,820 jobs.				

Indirect and induced economic effects were combined, and have been estimated for 2-digit North American Industrial Classification System (NAICS) economic sectors (Figures 3 through 6). Key economic sectors affected by the industry include construction, professional and technical services, transportation, financial and real estate services, and wholesale trade.

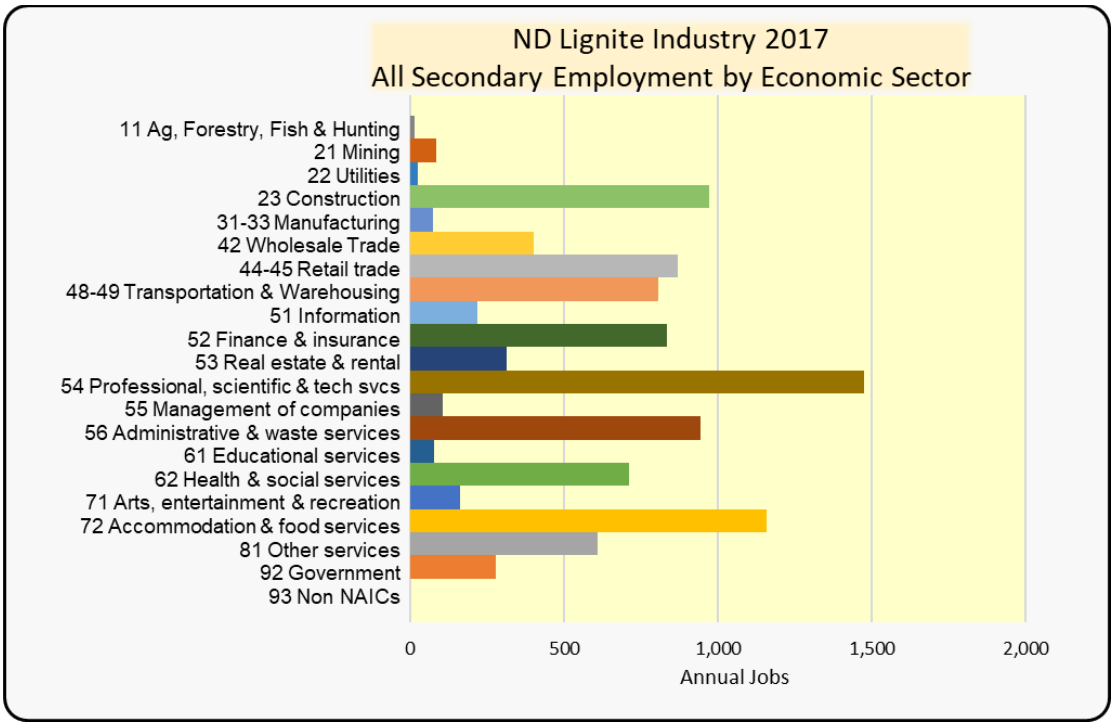

Figure 3. Secondary Employment (Indirect and Induced Effects), by Economic Sector, North Dakota Lignite Industry, 2017.

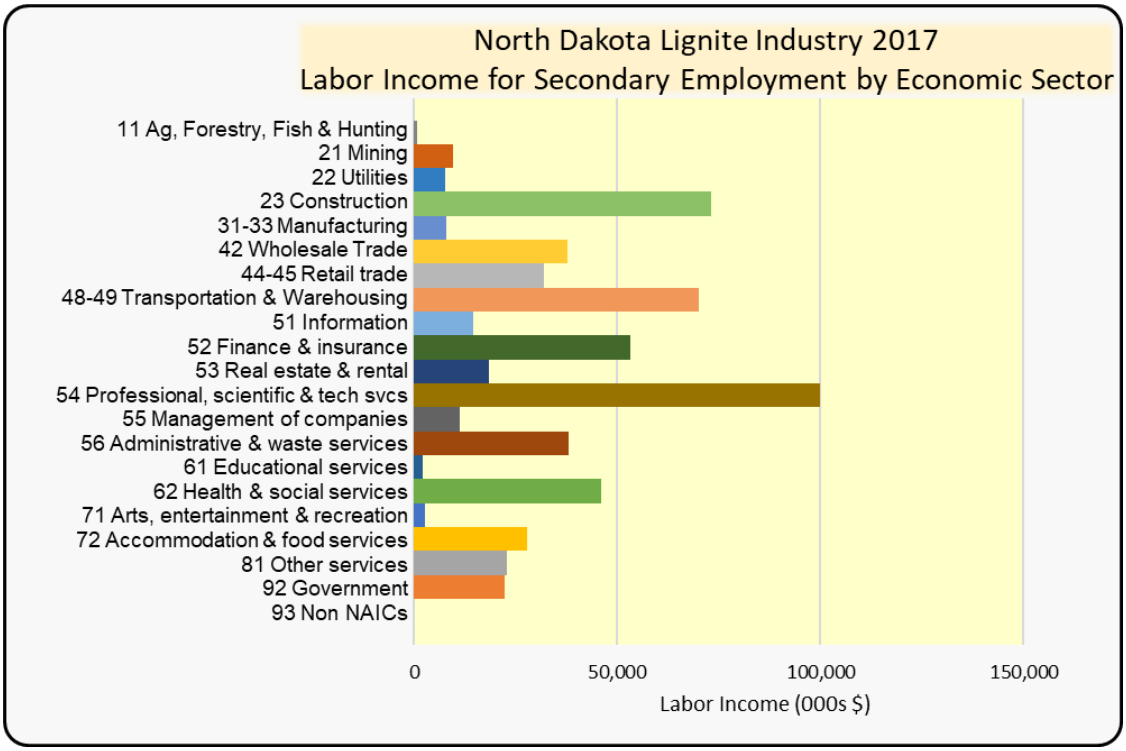

Figure 4. Labor Income from Secondary Employment (Indirect and Induced Effects), By Economic Sector, North Dakota Lignite Industry, 2017

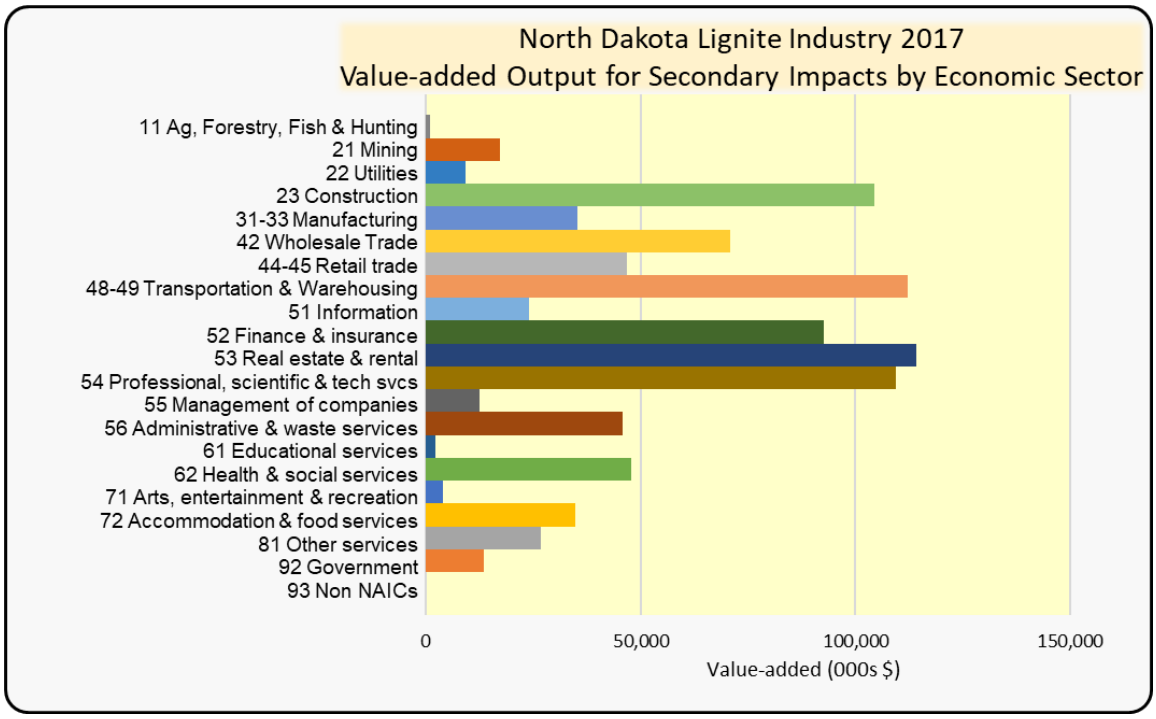

Figure 5. Value-added Economic Output from Secondary Economic Activity, by Economic Sector, North Dakota Lignite Industry, 2017

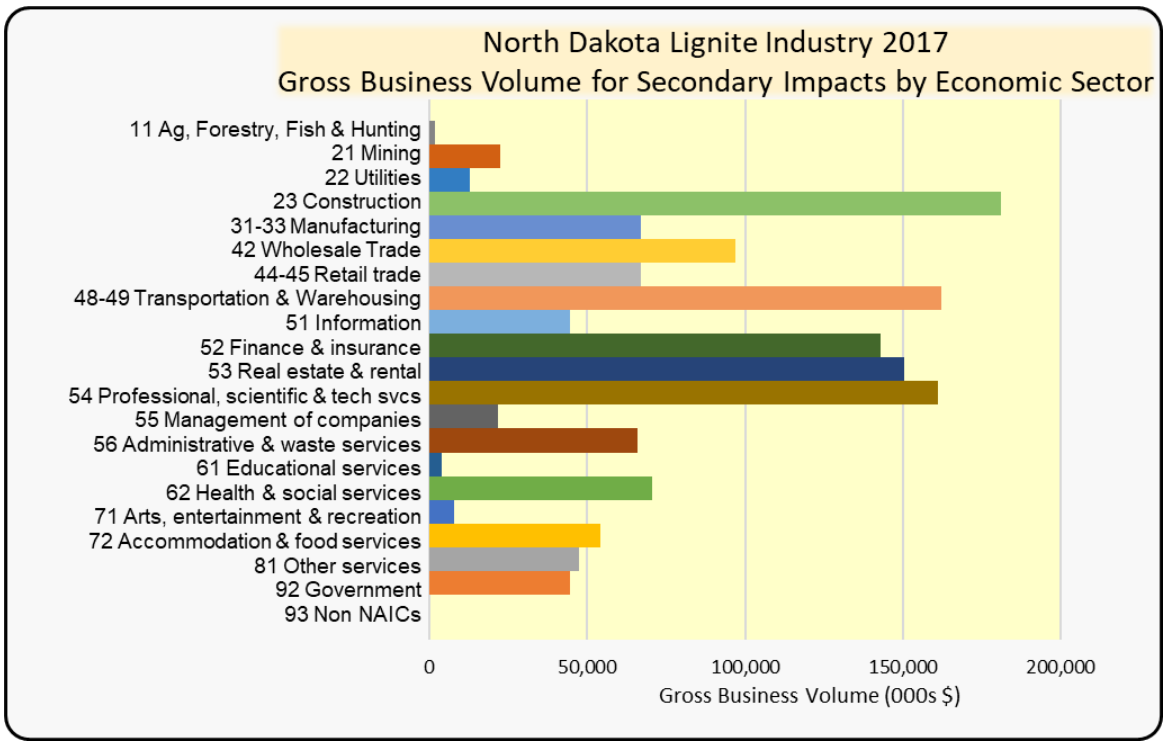

Figure 6. Gross Business Volume from Secondary Economic Activity, by Economic Sector, North Dakota Lignite Industry, 2017

Government Revenues

Government revenues are often used as a measure of how effectively an industry supports public services. In North Dakota, the most common sources of in-state public revenues are severance taxes, sales and use taxes, property taxes, and income taxes. A host of other taxes and revenue sources are often tracked in impact assessments, but have varying levels of contribution to government funds.

The lignite industry was estimated to contribute $70 million in government revenues directly from the firms in the industry. Additional tax revenues arising from secondary business activity was estimated to generate an additional $60 million in government revenues. A total of $130 million in state and local tax revenues were created by the Lignite Industry in North Dakota in 2017 (Table 6).

Coal conversion and coal severance taxes were estimated at $37 million (ND Office of State Tax Commissioner 2018). Other substantial contributions to state and local government revenues from secondary economic effects were from sales taxes ($34 million) and property taxes ($13 million).

Table 6. State and Local Government Revenues, Lignite Industry, North Dakota, 2017

Government Revenue	Paid Directly by the Industry	Collected from Indirect and Induced Economic Output	Total Collections
	---------- 000s 2017 $ ----------		
Coal Severance Tax	11,578	---	11,578
Coal Conversion Tax	25,709	---	25,709
Sales, Property, and Corporate Income taxes (reported in survey data)	20,661	---	20,661
Dividends	1,871	403	2,275
Social Insurance Tax	628	414	1,042
Personal Income	4,360	3,442	7,802
Sales Tax	see above	33,784	33,784
Property Tax	see above	12,830	12,830
Corporate Income	see above	2,325	2,325
Other Taxes	2,165	2,069	4,235
Non Taxes	3,508	4,319	7,827
Totals	70,481	59,586	130,067

Summary

The North Dakota Lignite Industry periodically assesses the industry's economic contribution, and this study is another installment in those ongoing efforts. The purpose of this study was to engage the industry to provide financial information on the industry's sales, employment, payroll, and expenditure profiles. Industry-based data were used with input-output analysis to estimate the additional economic activity related to business purchases and household spending.

The North Dakota Lignite Energy Council provided contacts for firms comprising the lignite industry in the state. The study had 100 percent cooperation as every firm identified for contact in the study provided financial information.

The vertically integrated industry acts to concentrate the economic footprint of mining, generation, and distribution because all the stages of electricity production are contained in the state. Unlike some coal-fired electricity plants in other regions of the country, lignite coal is mined in close proximity to generation plants. The primary export from the lignite industry is not the raw commodity of lignite, but rather electricity. North Dakota also has a coal conversion facility producing synthetic gas, fertilizer, and other chemical products from lignite coal.

The economic effects were nearly equally split among coal mining, coal conversion and electricity generation, and transmission and distribution. Coal mining supported 3,500 jobs, of which nearly 1,300 were directly employed by lignite mines. Coal conversion and electricity generation supported 7,200 jobs, of which 2,100 were directly employed by the industry. About 1,200 total jobs were supported in North Dakota through the operations of electricity transmission and distribution. The industry has a total of 3,880 jobs in all segments of the industry. Direct, indirect, and induced economic effects were estimated to support a total of 14,000 jobs in the state.

Other sources of economic output from the industry include total labor income of $1 billion, $1.6 billion in value-added economic activities (contribution to GSP), and a gross business volume of $5.7 billion. The industry was directly responsible for $70 million, and indirectly responsible for another $50 million in state and local government revenues.

The industry has remained stable in the state for several decades. Data from recent economic assessments were compiled showing recent job reductions in the state have been offset with growth in labor income (Figure 7). Over the past several years, the output of coal in the state also has been relatively stable (Figure 8).

The economic footprint of the industry is considerable, and this study confirms the magnitude of economic effects in the state are similar to previous years. The industry continues to be an important driver of employment, business activity, and tax revenues.

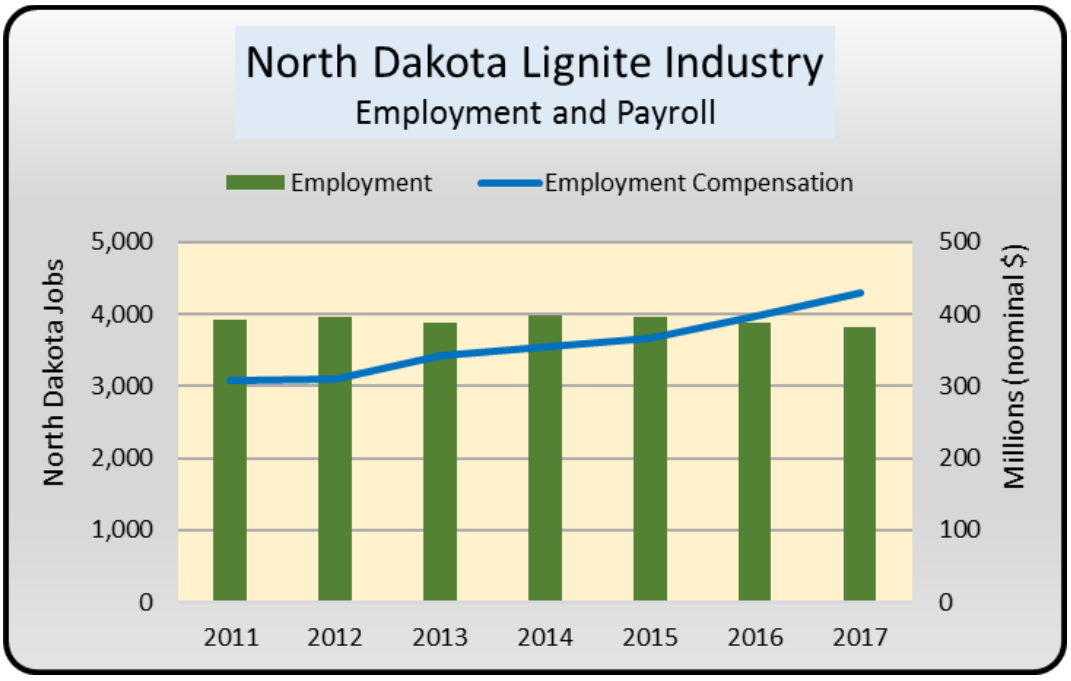

Figure 7. Employment and Employment Compensation, North Dakota Lignite Industry, 2011 through 2017

Source: Coon et al. (various years).

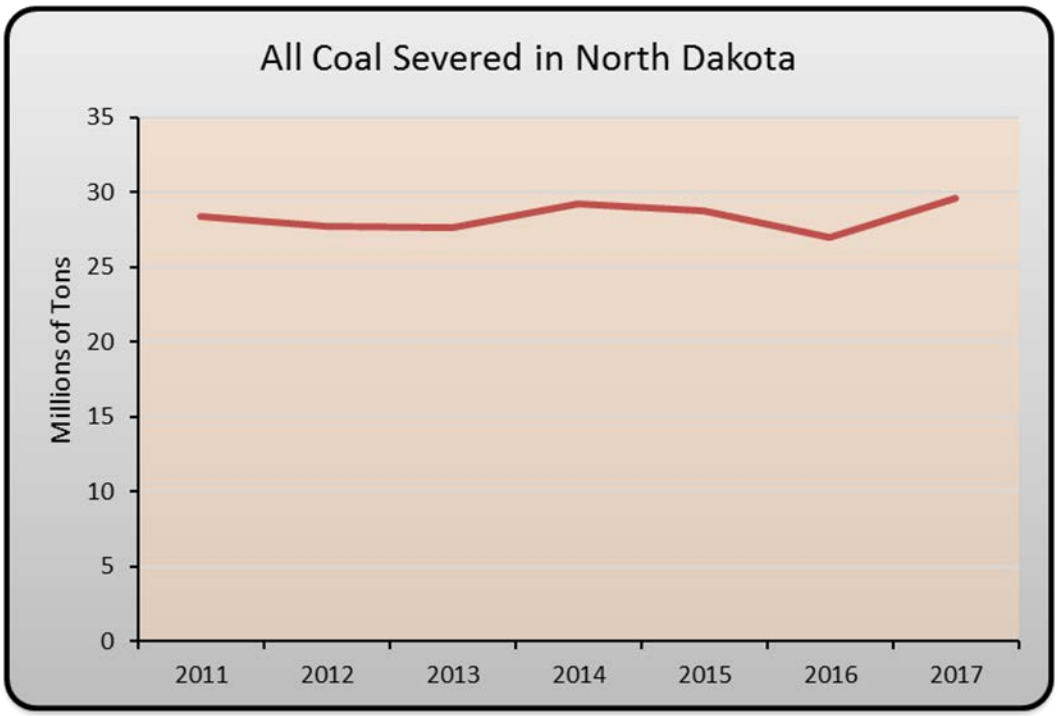

Figure 8. Coal Severed in North Dakota, 2011 through 2017

Source: North Dakota Office of State Tax Commissioner (2018).

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Appendix A

Industry Questionnaires

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Coal Conversion

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2017.

2. This questionnaire is specific to the ND Synfuels Plant.

3. When information is not available, please estimate.

4. Definitions for selected expenditure items are included to help determine allocation of expenditures.

5. Please complete the survey by July, 2018.
   You can mail the survey in the prepaid envelope or email the questionnaire to Dean Bangsund at the address below.

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry
ND Synfuels Plant

Company: _____

Contact Person: _____

Email: _____ Phone: _____

I. Revenues for 2017 for the Synfuels Plant in North Dakota (financial values can be rounded to thousands)

Sources of Revenue	Total Revenue for Operations in North Dakota
Chemicals and Fuels (such as dephenolized cresylic acid, naphtha, phenol, tar oil)	$
Fertilizers (such ammonium sulfate, anhydrous ammonia, urea)	$
NOx Emission Control (such anhydrous ammonia, diesel exhaust fluid, urea)	$
Gases (carbon dioxide, krypton and xenon, liquid nitrogen, synthetic natural gas)	$
Miscellaneous by-products	$
	$
	$

II. Employment for 2017 for the Synfuels Plant in North Dakota.

Employment	On-site Synfuels Plant Operations	Any off-site employment related to the plant
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2017 for the Synfuels Plant in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Example:	telecommunications	$35,000	80%
Employment Compensation			
	Wages, salaries, bonuses	$	%
	Employee Benefits	$	%
Expenditures			
	Purchases of lignite coal	$	%
	Purchases of plant equipment	$	
	Contract Construction	$	%
	Communications	$	%
	Utilities	$	%
	Repairs and Maintenance (facilities and infrastructure related to the Synfuels plant)	$	%
	Insurance	$	%
	Loan interest and finance charges	$	%
	Advertising and public relations	$	%
	Fees, permits, licenses, inspections, audits, tax preparations	$	%
	Office supplies, computers, software	$	%
	Meetings, Conventions, Travel	$	%
	Training, Safety, Employee Education	$	%
	Rent and Leases (exclude Federal coal leases)	$	%
	Legal and attorney fees	$	%
	Other Expenses (please list)	$	%
		$	%
		$	%

Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Taxes Paid in North Dakota (please exclude payroll taxes)		
Coal Conversion Tax	$	100%
Property Tax	$	100%
Sales and Use	$	100%
Corporate Income	$	100%
Others (please list)	$	100%
	$	100%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

Contract Construction: Includes expenses for new work, additions, alterations, and remodeling to residential, industrial, public, office, warehouse, and other buildings and structures.

Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Public Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

Feel free to add any supporting materials or comments that will help with the study.

Thank You for completing this questionnaire

Please return the questionnaire in the postpaid envelope or email an electronic copy to one of the study researchers.

Study results will be available in late 2018. Please contact Edie Nelson in the Department of Agribusiness and Applied Economics at North Dakota State University for more information on our departmental reports. Phone 701-231 7441, fax 701-231-7400, email: ndsu.agribusiness@ndsu.edu or visit our departmental listing of research reports on the internet at http://agecon.lib.umn.edu

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Coal Mining Operations

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2017.

2. For firms with multiple locations in North Dakota, please combine all locations into one questionnaire.

3. When information is not available, please estimate.

4. Please consider Coal Mining Operations to include all activities at the mine, such as removal of over burden, coal extraction, coal beneficiation, reclamation, and any expenses for delivery of coal to power plants.

5. Definitions for selected expenditure items are included to help in determine allocation of expenditures.

6. Please complete the survey by July 20, 2018.
   Please email the questionnaire to Dean Bangsund at the address below or return via prepaid envelope (if requested).

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry

Company: _____
Contact Person: _____
Email: _____
Phone: _____

I. Revenues for 2017 for mining facilities and operations in North Dakota (financial values can be rounded to thousands)

Sources of Revenue (definitions provided below)	Total Revenue
Sale of Coal	$
Sale of Other Mining Products	$
Other revenues associated with Mine Operations (please specify):	$
	$
	$
	$
	$

II. Employment for 2017 for mining facilities and operations in North Dakota.

Employment	Coal Mining Operations	
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2017 for mine facilities and operations located in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
	Example: Office supplies, computers, software	$35,000	80%
	Employment Compensation		
	Wages, salaries, bonuses	$	%
	Employee Benefits	$	%
	Expenditures		
	Purchases of coal mining equipment	$	%
	Purchases of fuel and lubrication	$	%
	Contract Construction	$	%
	Communications	$	%
	Utilities (electricity, natural gas, water)	$	%
	Repairs and Maintenance (facilities & equipment)	$	%
	Manufacturing	$	%
	Insurance	$	%
	Loan interest and finance charges	$	%
	Advertising and/or public relations	$	%
	Fees, permits, licenses, inspections, audits, tax preparations	$	%
	Office supplies, computers, software	$	%
	Meetings, Conventions, Travel	$	%
	Training, Safety, Employee Education	$	%
	Rent and Leases	$	%
	Legal and attorney fees	$	%
	Other Expenses (please list)	$	%
		$	%
		$	%

	Other Expenses (cont.)	$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
Taxes Paid in North Dakota (please exclude payroll taxes)			
	Property Tax	$	100%
	Sales and Use	$	100%
	Corporate Income	$	100%
	Others (please list)	$	100%
		$	%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

Contract Construction: Includes expenses for new work, additions, alterations, and remodeling to residential, industrial, public, office, warehouse, and other buildings and structures.

Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

Feel free to add any supporting materials or comments that will help with the study.

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Thank You for completing this questionnaire

Please return the questionnaire in the postpaid envelope or email an electronic copy to one of the study researchers.

Study results will be available in late 2018. Please contact Edie Nelson in the Department of Agribusiness and Applied Economics at North Dakota State University for more information on our departmental reports. Phone 701-231 7441, fax 701-231-7400, email: ndsu.agribusiness@ndsu.edu or visit our departmental listing of research reports on the internet at http://agecon.lib.umn.edu

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Electricity Generation, Transmission, and Distribution

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2017.

2. For firms with multiple locations in North Dakota, please combine all locations associated with lignite-power generation, transmission, and distribution into one questionnaire.

   Note: Please do not include mining operations in this questionnaire. Coal mining is being handled separately.

3. When information is not available, please estimate.

4. Definitions for selected expenditure items are included to help determine allocation of expenditures.

5. Please complete the survey by July, 2018.
   You can mail the survey in the prepaid envelope or email the questionnaire to Dean Bangsund at the address below.

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry

Company: _____

Contact Person: _____

Email: _____ Phone: _____

I. Revenues for 2017 for Lignite-power Generation and Transmission Operations in North Dakota (financial values can be rounded to thousands)

Sources of Revenue	Total Revenue for Operations in North Dakota
Sales of Electricity	$
Sales of Other Lignite-Energy Products (please specify)	$
	$
	$
	$
	$
	$

II. Employment for 2017 for Lignite-power Generation and Transmission Operations in North Dakota.

Employment	Electricity Generation	Electricity Distribution and Transmission
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2017 for Lignite-power Generation and Transmission Operations in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Example:	telecommunications	$35,000	80%
Employment Compensation			
	Wages, salaries, bonuses	$	%
	Employee Benefits	$	%
Expenditures			
	Purchases of lignite coal	$	%
	Purchases of electricity for distribution	$	%
	Purchases of plant equipment	$	%
	Contract Construction	$	%
	Communications	$	%
	Utilities	$	%
	Repairs and Maintenance (lignite-power plants, electricity distribution infrastructure, and all other general facilities)	$	%
	Insurance	$	%
	Loan interest and finance charges	$	%
	Advertising and public relations	$	%
	Fees, permits, licenses, inspections, audits, tax preparations	$	%
	Office supplies, computers, software	$	%
	Meetings, Conventions, Travel	$	%
	Training, Safety, Employee Education	$	%
	Rent and Leases (exclude Federal coal leases)	$	%
	Legal and attorney fees	$	%
	Other Expenses (please list)	$	%
		$	%

	Other Expenses (cont.)	$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
Taxes Paid in North Dakota (please exclude payroll taxes)			
	Property Tax	$	100%
	Sales and Use	$	100%
	Corporate Income	$	100%
	Others (please list)	$	100%
		$	100%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

Contract Construction: Includes expenses for new work, additions, alterations, and remodeling to residential, industrial, public, office, warehouse, and other buildings and structures.

Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Public Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

Feel free to add any supporting materials or comments that will help with the study.

Thank You for completing this questionnaire

Please return the questionnaire in the postpaid envelope or email an electronic copy to one of the study researchers.

Study results will be available in late 2018. Please contact Edie Nelson in the Department of Agribusiness and Applied Economics at North Dakota State University for more information on our departmental reports. Phone 701-231 7441, fax 701-231-7400, email: ndsu.agribusiness@ndsu.edu or visit our departmental listing of research reports on the internet at http://agecon.lib.umn.edu

Appendix B

Economic Impact Modeling

Overview

Economic impact assessments measure the economic activity from a project, program, policy, or activity. Economic activity is categorized into direct and secondary impacts. Direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of a project, program, or event. Secondary impacts result from subsequent rounds of spending and re-spending within an economy.

Direct economic impacts are usually measured as injections (or reductions) of money into a specified economy. Direct impacts therefore represent inputs into an economic model to trace linkages among sectors of an economy and calculate various forms of business activity resulting from a direct impact in an economic sector.

Input-Output Analysis

Input-output analysis is a mathematical representation of the production and consumption of goods and services within a given economy. The basic premise to input-output modeling can be traced to economic base theory, or the understanding that a given economy is comprised of both 1) economic sectors or industries which produce goods/services for export outside the economy (basic sectors) and 2) economic sectors which produce goods/services within the economy for use by those exporting industries (non-basic sector). However, most current I-O modeling platforms do not limit economic activity in non-basic sectors to be driven or determined entirely by basic sector output.

Input-output analysis is premised on the notion of inter-industry transactions, where industries use products/services from other industries to generate their output, and outputs from one industry usually represent inputs to another industry. The basis for the interdependence (linkages) within input-output analysis between consuming and producing industries forms the foundation for development of multiplier effects. Multiplier effects can then be used to estimate how initial changes in economic activity result in economy-wide changes in a given area and represent the core component of input-output analysis.

While input-output analysis is a popular methodology used by a host of different stakeholders, the methodology has a number of fundamental assumptions or limitations. Key assumptions in input-output methodologies include 1) the economy is in equilibrium, 2) any expansion or contraction is linear, constant, and fixed, 3) no price and substitution effects, and 4) no supply constraints. This means that I-O models are a static representation of an economy and do not provide for dynamic adjustments that are likely to occur in an economy, especially those relating to large, fundamental changes in the size or structure of an area's key industries.

Since I-O models are widely available and used, output from those models is often accepted without much scrutiny. Despite development and use of other modeling processes (e.g., general equilibrium models) to mitigate the limitations and shortcomings of I-O modeling, I-O analysis remains the most widely used approach to conducting economic impact and contribution assessments.

Types of Economic Evaluations

Input-Output analysis provides a tool for economists to perform ***economic impact*** and ***economic contribution*** analyses. These analyses can be applied to programs, projects, developments, industries, and other economic activities. Key macro-economic indicators such as retail trade activity, employment compensation, labor income, value-added output, total business activity, secondary economic business activity (indirect and induced), selected government tax collections, and secondary (indirect and induced) employment can be estimated using input-output analysis.

Economic impact analysis estimates the change in key economic indicators resulting from the 'new' dollars (either gained or lost) from a specific project or development within a given economy. An economic impact analysis measures the net effect of two possible situations–often these situations would be the presence or absence of some type of economic activity, development, or program. Measures of the business activity generated in secondary industries are included in economic impact figures.

Economic contribution analysis differs in that it includes all relevant revenues and expenditures in the generation of the amount of economic activity created in an economic unit. Economic contribution analyses attempt to capture all economic activity without regard to the net change or value of alternative economic activities; therefore, economic contribution assessments provide measures of the gross effects. Typically, an economic contribution analysis will show more economic activity than found in an economic impact study for the same industry or activity. Measures of the business activity generated in secondary industries are included in economic contribution figures.

Key Definitions

Direct Economic Effects: Direct economic impacts represent the first-round of payments for services, labor, and materials. Direct effects can be interpreted to represent jobs, labor income, and business activity that comprise the Agriculture Industry.

Indirect Economic Effects: Indirect economic effects arise from the additional consumption of goods and services triggered by businesses that supply inputs to firms in a given sector/industry. Indirect effects can be interpreted as the additional economic activity created through purchases by businesses.

Induced Economic Effects: Induced economic effects arise from the additional spending by households from changes in personal income associated with direct effects and indirect effects. Changes in personal income can come from payrolls of businesses that are directly impacted, changes in payroll from businesses that supply goods and services to an impacted sector (induced effects), and proprietor income resulting from a change in business volume. Induced effects measure the additional business activity that is triggered as changes in personal income are translated into the purchase of goods and services for personal consumption.

Value-added Effects: Value-added economic activity is a measure of the payment to labor and capital, and includes labor income, business taxes, and business/proprietor income

(profit). This economic effect is sometimes referred to a measure of the value that is added to purchased inputs by a business or industry, and is analogous to gross state product. The use or consumption of goods and services in the production of another good or service is not included in value-added measures.

Total Economic Output: Total output is a measure of the business activity created by summing direct economic effects, indirect economic effects, and induced economic effects. This economic measure is sometimes called gross business volume. Total output therefore represents the sum of gross receipts of all economic sectors.

Employment and Employment Compensation: Employment is perhaps one of the most important economic measures associated with impact assessments. Direct employment represents the jobs employed by the business or economic sector for which the activity or event is being modeled. I-O analysis also estimates employment associated with indirect and induced economic effects. Changes in employment compensation include wages, salaries, and employment benefits linked to changes in employment levels.

Government Revenue: Changes in revenues to state and local governments are another important measure in most contribution studies. I-O models estimate changes in selected government revenues such personal income, sales and use, corporate income, severance, and property taxes, and a variety of miscellaneous revenues such as permits, fees, licenses, and dividends. Government revenues are not generally additive to economic effects, as most government revenues are either imputed internally or directly comprise a component of an industry balance sheet.

Selection of Input-output Model

The Department of Agribusiness and Applied Economics at NDSU developed an I-O model for North Dakota back to the 1960s and it was an important economic tool examining energy development projects in the state during the 1970s. The basic data for the model came from surveys of firms and businesses in the state, and key economic statistics included a corresponding data set defining state-level net exports (economic base and export-based sales to final demand), employment productivity ratios, and tax coefficients. The model and supporting economic data were widely-used for examining economic impact and economic contribution effects in the region. Finally, maintenance and use of the North Dakota Input-output Model was suspended in 2018 as personnel and resources were no longer available to support the model. This prompted the impact assessment research team, spearheaded jointly by Dean Bangsund, Department of Agribusiness and Applied Economics, and Dr. Nancy Hodur, Director, Center for Social Research, to devise a new modeling platform.

A number of commonly used input-output models are available for conducting impact assessments for North Dakota. Publicly available models include RIMS II (Regional Input-Output Modeling System), IMPLAN (Impact Analysis for Planning), REMI (Regional Economic Models Inc.), and EMSI Analytics (Economic Modeling Specialists). There are other commercial models that are 1) not available for state-level analysis (e.g., REdyn, which combines I-O factors with CGE processes but is only used for the US national economy), 2) specialize in fiscal effects and do not provide the same degree of impact assessment as the more common I-O models (e.g., LOCI, which only examines government costs of various types of impacts), and 3) built with varying degrees of sophistication primarily targeting subject-matter issues (e.g., JEDI-NREL that examines some economic impacts of constructing and/or operating energy-based facilities).

REMI was considered the best option from an empirical capacity, but the cost of acquiring the model and subscribing to annual baseline data was prohibitive. RIMs II is inexpensive, but the analytical capacity is substantially limited, and does not have any baseline or supporting data sets. IMPLAN was chosen as the modeling system since it is supported with detailed baseline data, and cost was not prohibitive.

IMPLAN

IMPLAN modeling system is a popular input-output methodology because of its flexibility and customizability for structuring economic scenarios and ease of access to key data sets used in the modeling process (IMPLAN Group LLC 2016). IMPLAN can be structured to evaluate economic effects through a number of model operations. Those operations range from a change in sales for an entire industry to personal spending patterns for households with a specific income level. The flexibility to structure an assessment using multiple economic criteria, along with customization of baseline data, allow IMPLAN to be tailored to most economic conditions.

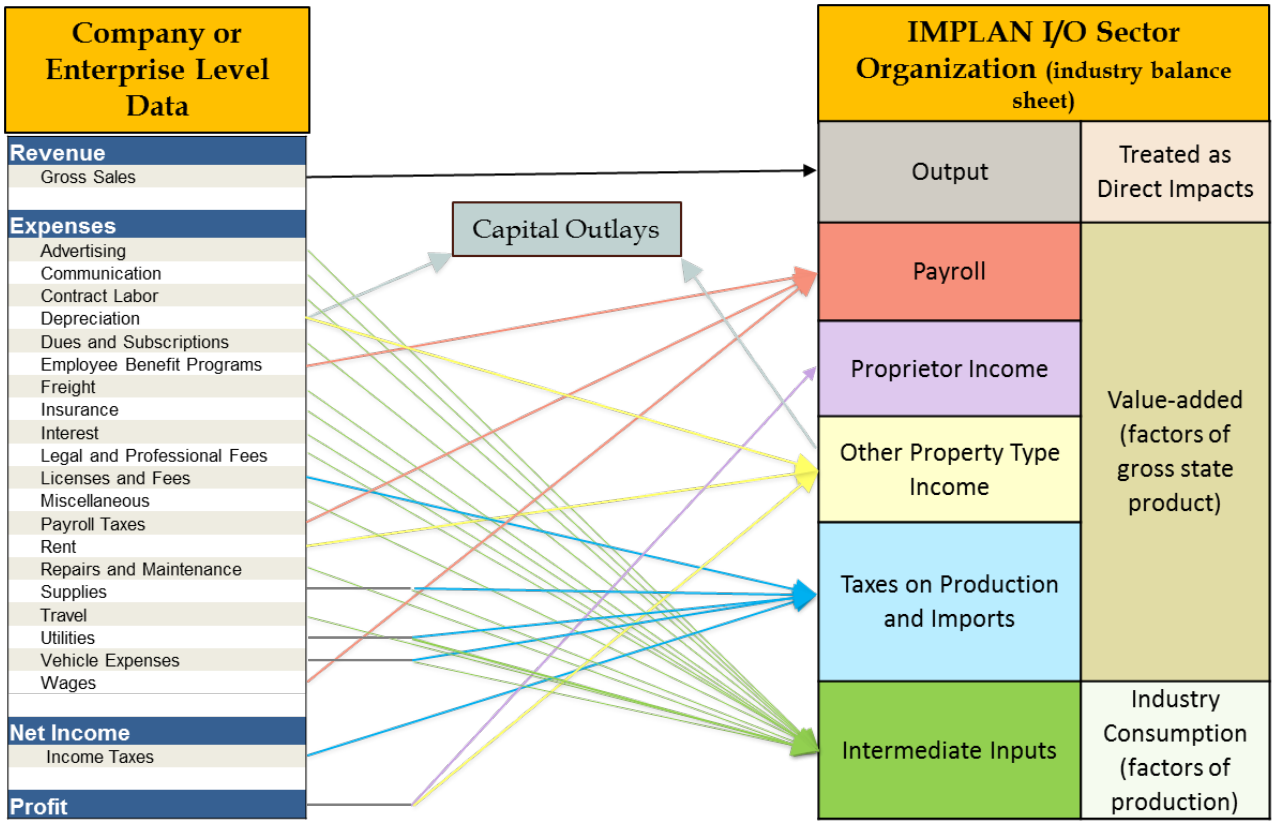
IMPLAN modeling system uses a variety of data sets to construct the I-O model. In general, those data sets begin with federal data, work through regional and state-level economic statistics, and if available, attempt to combine information for counties or other smaller geographic units. [see www.implan.com for more detail regarding data sets used to construct the model]. Some of the key data sets for IMPLAN include the following:

-) U.S. Bureau of Labor Statistics Covered Employment and Wages (ES202)
-) Bureau of Economic Analysis Benchmark I/O Accounts of the U.S. and Output Estimates
-) U.S. Census Bureau's Program and Consumer Expenditure Survey, Census Bureau County Business Patterns, Decennial Census and Population Surveys, Censuses and Surveys
-) U.S. Department of Agriculture National Agricultural Statistics Service
-) U.S. Geological Survey.
-) Information is also collected on military and non-military federal activities, railroads, personal consumption patterns based on various income levels, local and state tax collections, state and local government purchases and expenditures, and transfers among inter-institutional entities.

IMPLAN modeling system is a widely used and well-recognized source of economic data—this process is desirable because it allows for consistency and compatibility across regional, state, and sub-state economies. However, not all industries within all economies are accurately represented using federal, state, and local secondary data in combination with IMPLAN baseline data generation techniques (Downes 2012, Booz Allen Hamilton 2008). To address potential problems, IMPLAN has built flexibility into the modeling system so that local or other primary data can be substituted for default values within the model.

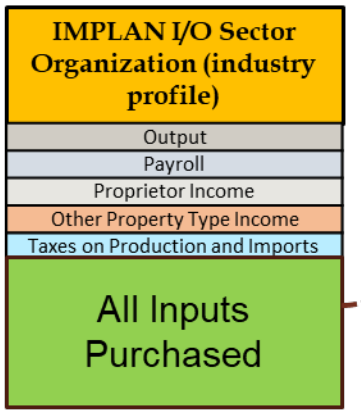
IMPLAN's Industry Structure

IMPLAN organizes financial information for industries in a manner different from traditional enterprise budgets or income statements.

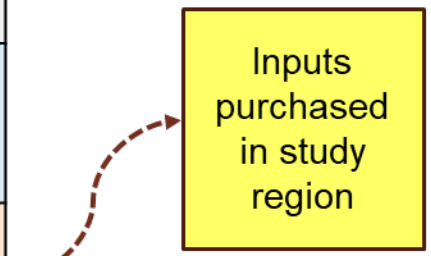


General Transposition of Financial Information into IMPLAN Economic Sector Profiles

Source: DA Bangsund, Department of Agribusiness and Applied Economics, NDSU



Title/Name	Definition	Estimation
Gross Inputs (Intermediate Inputs)	Commodities (goods/services) needed to produce a sector's commodity (goods/services)	Value of commodities (goods/services) needed to produce a commodity (goods/services)
Gross Absorption	Share of sales (gross revenue) that go to the purchase of a commodity (good/service) for that sector's production	Gross value of commodity needed divdied by gross revenue
Regional Inputs	The total amount of production requirements that can be sourced within the model's geographic boundaries	Regional Absorption coefficient multiplied by gross sales
Regional Purchase Coefficient	How much of an input needed to produce a specific commodity (good/service) is supplied by local sources	Value of the Inputs Supplied by In-state Sources divided by total value of commodities needed to produce a commodity
Regional Absorption	Share of sales (gross revenue) that goes to the purchase of a locally-supplied commodity (good/service) needed for that sector's production of a commodity	Value of regionally supplied inputs divided by gross sales



Adjusting Gross Purchases of Inputs to Share of Inputs Purchased within a Study Region through IMPLAN Economic Sector Profiles

Source: DA Bangsund, Department of Agribusiness and Applied Economics, NDSU

IMPLAN Mapping

IMPLAN uses a variety of mechanisms, or economic triggers, to introduce a direct impact into a specified economy. Using a variety of mechanisms is one of the key attributes of the model that provide substantial flexibility in tailoring assessments to match expected economic activity.

An ***Industry Change*** represents adjusting the demand for the goods and services produced by an economic sector by varying that sector's revenue. Within this context, changes in sector gross revenues automatically result in changes in required labor, goods and services used to produce the sector's output (intermediate inputs), taxes on production and inputs (e.g., sales tax, property tax), and sector income. After setting the level of revenue change for an economic sector, IMPLAN allows custom values for employment, employment compensation, and sector income to be entered if default values are not desired.

Industry Spending Patterns can be used to change an economic sector's use of intermediate inputs without triggering changes in revenues, labor expenses or requirements, or sector income. The specific input is the sum of the total expenses that are expected to be purchased by that economic sector.

Labor Income Change is not specific to an economic sector, rather it introduces an increase in the payment for labor inputs within an economy. This approach also by-passes the need to change other aspects of an industry's balance sheet to achieve a change in labor income; however, the *Labor Income Change* requires a manual (i.e., calculated outside of the IMPLAN model) estimate of the change in direct employment based on assumptions for payroll expenses per job.

Household Income Change is used when personal spending capacity within an economy is increased, but there is not necessarily any direct link to output changes in any particular economic sector or when personal spending capacity is not directly linked changes in labor income. These types of changes in household income might be represented by income from royalties, trusts, easements, gifts, inheritances, lotteries, and social transfer payments.

Institutional Spending Patterns are used to estimate how changes in public sector revenues influence the consumption of goods and services by government entities, educational institutions, non-profits and other non-governmental organizations. *Institutional Spending Patterns* also provide options for use of household spending patterns by income levels, which can be used to approximate the consumption of goods and services by households.

IMPLAN Fiscal Analysis Methodology

IMPLAN estimates fiscal impacts by examining total government revenues from a variety of data sources. The model then estimates the share of government revenues based on the individual source of revenue (e.g., sales tax, income tax, severance tax, fees, and licenses). IMPLAN compares total government revenues, from all sources, with total industry output from all sectors in the economy. That process produces an estimate of tax revenue per unit of average industry output (e.g., gross sales, state gross product). The model does not estimate tax collections stemming from individual economic sectors or industries. Therefore, to estimate the fiscal impacts of a project, program, or activity, IMPLAN estimates the change in economy-wide business output, and then estimates the fiscal effects by multiplying that change in business output by the ratio of government revenues to economy-wide output. This process produces a direct relationship between expected new government revenues and a change in industrial or economic output.

Shortcomings and limitations of IMPLAN's fiscal impact methodology in North Dakota include.

A. IMPLANs fiscal impact methodology is locked on the premise that all government revenues are intrinsically linked to changes in economy-wide economic output. This relationship is embedded within IMPLANs default tax ratios and leads IMPLAN to generate large changes in some tax revenues even when direct causation is not contained in the economic assessment (i.e., without linking an economic impact to a specific change in a tax base or tax rate, or linking tax revenues on a per-sector basis). For some tax revenues, such as severance taxes, that methodology produces erroneous estimates. For other tax revenues, general economic output is a reasonable proxy for estimated changes in tax revenues.

B. IMPLAN's fiscal impact methodology cannot be adjusted internally to reflect state rules and stipulations affecting the specific taxes relating to unique conditions or special treatment that adjusts the tax base or tax rate.

IMPLAN Fiscal Data Sources and Treatment of Tax Data

The following discussion of data sources is provided by IMPLAN Group LLC (2018).

IMPLAN's tax impact report values are based on the existing relationships of the data found in the IMPLAN database. The sources for these data are listed below, followed by description of each data element in the tax impact report.

- **NIPA Tables.** All items in the IMPLAN data sets are ultimately controlled to the U.S. level values from the Bureau of Economic Analysis' (BEA) National Income and Product Accounts (NIPA). Section 3 of the NIPA tables covers Government Current Receipts and Expenditures.

- **Consumer Expenditure Survey (CES).** The U.S. Census Bureau through the Consumer Expenditure Survey annually conducts surveys and diary samplings of household

expenditure patterns. The survey data are reported for nine different categories of household income, which we control to the NIPA's Personal Consumption Expenditure (PCE) totals (which are not split out by income category). From these data, we can establish the tax-to-income relationships for the nine different household income categories. It is based on these relationships that we can distribute many of the national-level tax data to states and state-level tax data to counties, using the number of households in each of the nine household categories in the state or county.

- **Annual Survey of State and Local Government Finances (SLGF).** The U.S. Census Bureau also collects annual State/Local Government receipts and expenditures data. These data act as preliminary controls for state-level values (subject to controlling to the national NIPA values). That data also provide the proportional split of the Tax on Production and Inputs (TOPI) value amongst the various types (sales, property, etc.). The actual value of total TOPI (at the state level) comes from the BEA's REA series.
    - The annual survey also provides local government collections by tax type. These data are used to estimate, for the total state/local tax receipts, the share of each type of tax that belongs to local government. The data for each local government is then used to apportion that local total (at the state level) to each county. Since the local total for each county is estimated, the model can distinguish between the state and local tax revenue in the tax impact report. In IMPLAN Online, the tax impact report includes 4 types of governments that compose State/Local Government:
        - State government
        - County government
        - Sub-county general government, which includes city and township governments, for example
        - Sub-county special government, which includes fire and public school districts, for example
    - IMPLAN supplements gaps in the SLGF with 5-year Census of Governments data, and supplements the SLGF state tax revenue with current-year state tax collections data from the Census.

- **Regional Economic Accounts (REA).** The Bureau of Economic Analysis collects and reports income, wealth, tax, and employment data on a regional, state and county basis. The REA data from these two tables are used to distribute the U.S. NIPA values to states and counties:
        - Table CA05 -- Personal Income by Major Source and Earnings by Industry
        - Table SA50 -- Personal Tax and Non-tax Payments

IMPLAN Tax Identification Scheme					
Description	**Employee Compens-ation**	**Proprietor Income**	**Tax on Production and Import**	**House holds**	**Corpor-ations**
State and Local Taxes					
Dividends					O
Social Ins Tax- Employee Contribution	A	C			
Social Ins Tax- Employer Contribution	B				
Tax on Production and Imports: Sales Tax			D		
Tax on Production and Imports: Property Tax			E		
Tax on Production and Imports: Motor Vehicle Lic			F		
Tax on Production and Imports: Severance Tax			G		
Tax on Production and Imports: Other Taxes			H		
Tax on Production and Imports: S/L NonTaxes			I		
Corporate Profits Tax					P
Personal Tax: Income Tax				J	
Personal Tax: NonTaxes (Fines-Fees				K	
Personal Tax: Motor Vehicle License				L	
Personal Tax: Property Taxes				M	
Personal Tax: Other Tax (Fish/Hunt)				N	
Federal Taxes					
Social Ins Tax- Employee Contribution	Q	S			
Social Ins Tax- Employer Contribution	R				
Tax on Production and Imports: Excise Taxes			T		
Tax on Production and Imports: Custom Duty			U		
Tax on Production and Imports: Fed NonTaxes			V		
Corporate Profits Tax					X
Personal Tax: Income Tax				W	
Source: IMPLAN Group LLC (2018).					

The following definitions and sources are provided by IMPLAN Group LLC (2018) and correspond with labeling in the IMPLAN Tax Identification Scheme.

A. Employee-paid portion for State/Local social insurance. This represents retirement plans and temporary disability insurance. The U.S. value comes from National Income and Products Accounts (NIPA) Table 3.6. This value is distributed to states based on each state's share of the following items from the State and Local Government Finances report (SLGF).

Employee Retirement – Local Employee Contribution;
Employee Retirement – State Employee Contribution;
Workers Compensation – Other Contributions.

These state values are distributed to counties based on each county's proportion of the state's State/Local Government Non-Education Employee Compensation. The county-level State/Local Employee Compensation figures come from U.S. Bureau of Economic Analysis. These are then split into Education vs. Non-Education using various data from the U.S. Census Bureau and the U.S. Department of Education.

B. Employer-paid portion for State/Local social insurance funds. This represents workers' compensation and temporary disability insurance. The U.S. value comes from NIPA Table 3.6. This value is distributed to states and based on each state's share of the following items from the SLGF:

Employee Retirement – From Local Government;
Employee Retirement – From State Government;
Unemployment Compensation – Contribution;
Workers Compensation – Own Contributions.

County distribution is based on county portion of state and local government non-education employee compensation from IMPLAN.

C. State/Local social insurance paid by self-employed. Self-employed individuals do not make payments to State/Local government, so this entry will always have a value of $0.

D. Sales Taxes on "Other Property Type Income" (TOPI) paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Total General Sales Tax from the SLGF. State government values are then distributed to counties based on total retail output.

E. TOPI property taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Total Property Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

F. TOPI motor vehicle license taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Motor Vehicle Operator's License Tax and Motor Vehicle License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

G. TOPI severance taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Severance Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

H. TOPI other taxes paid to State and Local Governments. This item consists largely of business licenses and documentary and stamp taxes. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of the following tax items from the SLGF: Corporation License; Amusement License; Other License; Documentary & Stock Transfer; Public Utility License; Alcoholic Beverage License; Occupation & Business License, NEC; and NEC. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

I. TOPI non-taxes paid to State and Local Governments. This item includes rents and royalties, special assessments, fines, settlements, and donations. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of the following tax items from the SLGF: Miscellaneous – Rents; Miscellaneous – Special Assessments; Miscellaneous – Royalties; and Miscellaneous – Donations from Private Sources. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

J. Personal income tax payments to State and Local Governments. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Individual Income Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

K. Personal non-tax payments to State and Local Governments. This item includes payments for fines and donations. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Motor Vehicle License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

L. Personal motor vehicle fee payments to State and Local Governments. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Miscellaneous – Fines & Forfeits from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

M. Personal property tax payments to State and Local Governments. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Property Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

N. Personal other tax payments to State and Local Governments. This item consists largely of hunting, fishing, and other personal licenses. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Hunting and Fishing License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

O. State/Local Government Dividends. This item represents net dividend payments to government by corporations from investments. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on the following items from the SLGF:

Employee Retirement – Securities – Mortgages;
Employee Retirement – Securities – Corporate Stocks;
Employee Retirement – Securities – Corporate Bonds;
Employee Retirement – Total Other Securities.

State government values are distributed to counties is based on their proportion of state Other Property Income (from IMPLAN database).

P. State/Local Government corporate profits tax. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Corporate Net Income Tax from the SLGF. State government values are then distributed to counties is based on counties based on their proportion of the state's Other Property Income (from IMPLAN database).

Q. Employee-paid portion for Federal social insurance. This item includes social security, survivors insurance, disability insurance, hospital insurance, supplemental medical insurance, unemployment insurance, veterans' life insurance, and railroad retirement plans. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

R. Employer-paid portion for Federal social insurance. This item includes social security, survivors insurance, disability insurance, hospital insurance, military medical insurance, unemployment insurance, pension benefit guaranty, veterans' life insurance, and railroad retirement plans. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

S. Self-Employed contribution to Federal social insurance. This item includes social security, survivors insurance, disability insurance, and hospital insurance. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

T. TOPI Federal Excise Taxes. This item includes federally levied excise taxes on alcohol, tobacco, telephones, coal, fuels, air transportation, vehicles, etc. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to U.S. total TOPI.

U. TOPI Federal Custom Duties. These are gross collections less refunds. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to US total TOPI.

V. TOPI Federal Non-taxes. This item includes rents and royalties4. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to U.S. total TOPI.

W. Personal Income taxes paid to the Federal Government. These are taxes paid through withholding, declarations and final settlement less refunds. The U.S. value comes from NIPA Table 3.2. The same value can also be found in NIPA Table 3.4. The U.S. value is distributed to states based on each state's value of "Federal government: Individual Income taxes (net of refunds)" from the BEA's SA50 table. State values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

X. Federal Corporate profits tax. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on their proportion of U.S. Other Property Income (from IMPLAN database).

Definition of Government Revenues Produced by IMPLAN	
Government Level	**Definition**
State and Local Government Revenues	
Dividends	State and Local government dividends represents dividend payments to government by corporations from investments.
Social Insurance Taxes: Employee Contribution	The social insurance contributions paid by state employees towards State sponsored pensions, in lieu of social security.
Social Insurance Taxes: Employer Contribution	The social insurance contributions paid by the State towards State sponsored pensions, in lieu of social security.
Indirect Business Tax: Sales Tax	Sales taxes paid to State and Local government.
Indirect Business Tax: Property Tax	Real estate based property taxes paid by firms to State and Local governments. Because of the special situation encountered with Sector 361, this includes payments of property taxes made on homes.
Indirect Business Tax: Motor Vehicle	Motor vehicle license taxes paid by firms to State and Local governments.
Indirect Business Tax: Severance Tax	Taxes imposed by a State on the extraction of natural resources.
Indirect Business Tax: Other Taxes	Other taxes paid to State and Local governments include business licenses, documentary and stamp taxes.
Indirect Business Tax: S/L Non-taxes	IBT state and local non-tax payments include fines (such as parking and speeding tickets), fees (State and County park passes or day fees) and donated funds.
Corporate Profits Tax	Corporate profits taxes paid to State and Local governments.
Personal Tax: Income Tax	Income taxes paid by individuals to State and Local Government through withholding, declarations and final settlement, less refunds.
Personal Tax: Non-taxes (fines and fees)	Household personal nontax payments to State and Local governments include fines, donations, passport and immigration fees, and migratory bird-hunting stamps.
Personal Tax: Motor Vehicle Licenses	Household personal motor vehicle fee payments to State and Local governments.
Personal Tax: Property Taxes	Household personal property tax payments to State and Local governments. Dividend, interest, and rental income of persons with capital consumption adjustment are sometimes referred to as property income.
Personal Tax: Other Tax (Fishing/Hunting)	Other taxes consist of miscellaneous fees and licenses (such as hunting and fishing licenses, marriage licenses, registration of pleasure boats, and licenses for pets) to State and Local governments.

Federal Government Revenues	
Social Insurance Taxes: Employee Contribution	The employee paid portion for Federal social insurance. These contributions include payments by employees, the self-employed, and other individuals who participate in the following government programs: Old-age, survivors, and disability insurance (social security, FICA); hospital insurance; supplementary medical insurance; unemployment insurance; railroad retirement; veterans life insurance; and temporary disability insurance.
Social Insurance Taxes: Employer Contribution	The employer paid portion for Federal social insurance. This includes social security, unemployment insurance, medical and retirement plans.
Indirect Business Tax: Excise Taxes	Includes Federally levied excise taxes on alcohol, tobacco, telephones, coal, fuels, air transportation, vehicles, etc.
Indirect Business Tax: Custom Duty	Custom duties are gross collections net refunds.
Indirect Business Tax: Non-Taxes	IBT Federal non-tax payments include petroleum royalties, fines, regulatory fees, forfeitures and donated funds.
Corporate Profits Tax:	Corporate profits taxes paid to Federal governments.
Personal Tax: Income Tax	Income taxes paid by individual to the Federal Government through withholding, declarations and final settlement, less refunds.
Source: IMPLAN Group LLC (2018).	

Appendix C

Adjustments to IMPLAN Baseline Data

IMPLAN Customization

For sake of brevity, industry financial data that has been collected from the Lignite Industry through surveys conducted by the Department of Agribusiness and Applied Economics at North Dakota State University is labeled as 'survey data.'

Survey data from 2010 through 2015 was used to calibrate IMPLAN for use in projecting potential economic impacts of CO2 Enhanced Oil Recovery (EOR) development in North Dakota as part of two Energy & Environmental Research Center projects (Energy & Environmental Research Center 2018a, 2018b). The source of CO2 in those studies would come from CO2 capture at the state's coal-fired electricity generation plants. While IMPLAN provides data for each of its 536 sectors, the first step in structuring IMPLAN for the CO2 studies was to insure that baseline economic data matched known parameters for North Dakota operations.

Survey data on in-state spending by firms in the Lignite Industry grouped industry expenditures according to Standard Industrial Classification (SIC) codes. Unfortunately, SIC codes do not directly map to IMPLAN's proprietary economic sectoring scheme. A model was constructed that would allow three-way mapping between SIC, North American Industrial Classification System (NAICS), and IMPLAN sector codes. By converting SIC codes to NAICS codes, survey data could then be compiled in a framework consistent with IMPLAN sectors.

Initially in-state expenditures derived from survey data were compared to IMPLAN data for the three sectors within IMPLAN that comprise the Lignite Industry. Expenditures from survey data were first re-classified by NAICS, and each participating firm was grouped into a three-digit NAICS code. The survey data could then be compared directly to each of IMPLAN's sectors in the Lignite Industry.

IMPLAN's baseline data on lignite mining and coal-fired electricity generation in the state was found to not match the industry's structural arrangement consistent with mine-to-mouth operations. IMPLAN's estimates of coal exports from ND suggested 80 percent of the lignite mined in the state was exported. This is obviously erroneous. Using state data that tracks coal tonnage severed in the state, combined with Energy Information Association (EIA) information on coal prices, implied that gross sales from coal mining within IMPLAN were double actual industry output. In other words, IMPLAN was suggesting coal mining was two times larger than what other data suggested.

Further, when the sector linkages between electricity generation from fossil fuels (IMPLAN sector 42) and coal mining were evaluated, IMPLAN sector 42 was only consuming 20 percent of the lignite coal mined (on a dollar basis). Purchases of natural gas by IMPLAN sector 42 were larger monetarily than purchases of coal – again, both of these conditions are obviously erroneous. Nearly all lignite mined in ND is consumed in ND. Clearly, IMPLAN baseline data did not represent the ND Lignite Industry. Due to the data sources and processes employed by IMPLAN in development of the North Dakota economy baseline data, it is postulated that the underlying data used to build the lignite industry inside IMPLAN reflected industry conditions prevalent in other parts of the country.

IMPLAN was modified to more accurately represent the lignite industry by adjusting gross sales, changing the linkages between industry-related sectors, and refining estimates of regional absorption of intermediate inputs. Essentially, those economic sectors were re-built to reflect the state's mine-to-mouth operations.

The following discussions highlight the process that was used to re-calibrate IMPLAN's lignite sectors using survey data, and other secondary data from state sources.

1) Align Data to Common Economic Sectors

Survey data from NDSU's previous economic assessments of the Lignite Industry were obtained from individual firms, which collectively represent all lignite-based activities in the state. NDSU economic contribution analyses for lignite-based activities in ND have consistently considered those activities to be one economic unit (sector). By contrast, IMPLAN divides lignite-based activities into three economic sectors, which include Sector 22 Coal Mining, Sector 42 Electricity Generation from Fossil Fuels, and Sector 49 Electricity Transmission and Distribution. Data from individual firms were grouped based on the operation of mines, generation of electricity, and/or the wholesale distribution of electricity. Rather than aggregating IMPLAN data to consolidate three economic sectors into one sector, firm-level data from survey data were compiled to align with the three IMPLAN sectors.

2) Organize IMPLAN and Survey Expenditure Data using Common Economic Definitions

A process was created that facilitated direct groupings and comparisons of economic data based on IMPLAN economic sector and commodity codes, North American Industrial Classification System codes (NAICS), and Standard Industry Classification (SIC) codes. IMPLAN data is organized with a unique economic classification system and survey data are largely based on SIC codes. SIC and IMPLAN codes are not directly comparable, however, the use of NAICS codes allows a common framework for comparison. IMPLAN default economic data were aligned based on NAICS codes and survey data was correspondingly aligned to NAICS codes. That process allowed direct comparison of economic data from IMPLAN and NDSU surveys.

The amount and type of intermediate expenditures for each of the three economic sectors were evaluated. The listing of "intermediate inputs" within IMPLAN represents all the goods and services consumed in the production of a commodity (i.e., a good or service). Intermediate inputs are sometimes referred to as an industry production function. The importance of having accurate spending patterns is fundamental to generating realistic economic impacts for any activity, policy, program, or event.

3) Adjusting Gross Inputs and Regional Inputs for IMPLAN sectors

A modeling process was developed to align survey expenditure data with IMPLAN industry production functions. IMPLAN's intermediate inputs are first identified as gross inputs, which represent the total amount of the good or service used by that economic sector within the defined study area. The amount of the good or service purchased within the study area (i.e., purchases

from local sources) is called regional inputs. Survey data was used to estimate regional inputs for the firms comprising the lignite industry.

IMPLAN's regional inputs, organized by NAICS codes, were aggregated into the SIC primary grouping consistent with the ND Input-Output Model. The primary SIC groupings represent 85 different 2-digit SIC codes. Within any particular primary SIC group, there would be anywhere from one NAICS code to numerous NIACS codes. The process of changing the level of regional inputs within IMPLANs production functions to more closely represent survey data required proportional adjustments to each regional input that was grouped into any of the 2-digit SIC codes. For example, expenditures for communications (2-digit SIC code 48) for intermediate inputs for IMPLAN Sector XYZ may contain $30 for internet, $50 phone, and $20 for data processing, for a total of $100. However, if total regional inputs for communications should more closely approach $200, then a new allocation of regional expenditures among the production function for Sector XYZ would be $60 for internet, $100 phone, and $40 for data processing.

Several additional adjustments were performed to re-align and retain IMPLAN's estimate of total purchases of intermediate inputs. Since survey data from 2010 through 2015 only represented the amount of goods and services acquired from local sources, IMPLAN's estimate of gross inputs was retained for goods and services. Some goods and services were adjusted to more closely align IMPLAN spending patterns with the structure of the lignite industry in ND. For example, IMPLAN Sector 42 contains substantial gross inputs for natural gas, which is reflective of the types of inputs used for electricity generation from fossil fuels found across a more diverse set of industry enterprises at the national or multi-state level. As a top-down model, many of those national and multi-state characteristics are retained as part of the model building process to form state and sub-state industries. However, because IMPLAN's data (or more precisely the choice to not custom develop a local industry from only local data sources) does not specifically match the operational characteristics of coal-fired electricity generational for ND, expenses such as natural gas, were substantially reduced from default levels found within IMPLAN's industry production function. The Electricity Generation from Fossil Fuels[1] sector in ND is primarily mine-to-mouth, and as such, lignite coal is the source of fossil fuel for the sector.

A key adjustment in the IMPLAN model included adjusting the source of coal purchases for all economic sectors that contain coal as a commodity in their intermediate inputs. Since the coefficients for acquisition of coal from IMPLAN sector 42 were set to equal the value of sales from IMPLAN sector 22, that would, by default, exhaust the in-state supply of coal. Therefore, to avoid distortions is the model and to balance the supply of coal with the demand for coal in ND, all other purchases of coal within IMPLAN would need to be made from out-of-state sources (imports). Regional purchase coefficients for coal were set to zero for all economic sectors except sector 42.

1 IMPLAN does not have a sector for electricity generation specifically from coal.

4) Adjusting Employment and Employment Compensation

IMPLAN data for employment represent a combination of full-time and part-time jobs. Survey data for employment represents full-time equivalents (FTE). IMPLAN has a coefficient identifying total jobs to FTE by economic sector (IMPLAN web site). That adjustment coefficient was used to change survey estimates of FTE employment to total jobs for sake of consistency with IMPLAN.

IMPLAN combines wages and salaries and employee benefits into 'employment compensation'. Survey data for wages, salaries and employee benefits were combined to be consistent with the IMPLAN modeling system. IMPLAN has coefficients, by economic sector, which allow wages and salaries to be estimated separately from estimates of employment compensation; however, those coefficients are available only for data comparison as the model uses employment compensation for impact computations.

5) Industry Output and IMPLAN Trade Flow Data

IMPLAN trade flow data (in-state supply and demand of commodities) was compared to state data for coal mining output, EIA data on coal prices, and ND Lignite Council estimates of lignite use in the state (ND Department of State Tax Commissioner 2018, EIA 2017, ND Lignite Council 2017). The supply and disappearance of coal within IMPLAN was not consistent with mine-to-mouth lignite operations and was not consistent ND coal mining output observed from 2010 through 2015. Lignite coal mining output was mostly constant from 2010-2015 (ND Department of State Tax Commissioner 2018), while IMPLAN data suggested substantial growth in mining output over that period -- clearly implying an erroneous trend of continueal growth in lignite mining output.

IMPLAN Sector 22 underwent substantial revisions to more closely align with the industry structure found in the state. The use of coal by Sector 42 also underwent substantial revision to match the mouth-to-mine industry structure in ND.

Finally, estimates for total sales, value-added, and intermediate inputs for IMPLAN sectors 22, 42, and 49 were produced. Value-added is defined to include employment compensation, proprietor income, taxes and inputs, and returns to other property-type income. Those five components were re-entered into IMPLAN for the three sectors comprising the industry.

6) Summary

-) reconcile financial data collected from the industry to existing data within IMPLAN
-) adjust mix of gross inputs and in-state inputs for lignite industry
-) adjust industry employment and compensation
-) examine and adjust coal mining output to coincide with input usage by electricity generation from fossil fuels (properly construct mine-to-mouth economic linkages)
-) adjust economic linkages within the model to force coal consumption for other sectors to be supply by imports (out-of-state sources)
-) industry balance sheets for Sectors 22, 42, and 49 represent various levels of customization (i.e., sales, employment, employment compensation, proprietor's income, other property-type income, taxes on production and inputs, and intermediate inputs)
-) At various stages of modification, IMPLAN requires the model to be recompiled. The end result is a customized model where multipliers are re-estimated after changes are made to baseline data.

Development and Comparison of Survey Data to Default IMPLAN Industry Profile, North Dakota Lignite Industry, 2017

IMPLAN Economic Sector	Gross Sales	Total Intermediate Inputs	In-state Purchase of Inputs	Gross Absorption	Regional Purchase Coefficient	Regional Absorption
IMPLAN Sector 22 Coal Mining						
2015 IMPLAN State Model Data	$1,073,244,000	$439,547,700	$231,174,540	0.409551	0.525937	0.215398
2017 NDSU Study Data	$519,558,024	$317,573,032	$203,856,102	0.611237	0.641919	0.392364
IMPLAN Sector 42 Electricity Generation						
2015 IMPLAN State Model Data	$1,725,888,000	$1,149,825,000	$561,322,586	0.666222	0.488181	0.325237
2017 NDSU Study Data	$1,299,922,955	$1,064,243,506	$625,970,068	0.818697	0.481544	0.588183
IMPLAN Sector 49 Electricity Transmission and Distribution						
2015 IMPLAN State Model Default Data	$2,029,357,300	$1,388,585,989	$1,270,483,269	0.684249	0.914947	0.626052
2017 NDSU Study Data	$1,570,142,020	$1,349,955,967	$547,850,315.	0.859767	0.348918	0.405828