

Petroleum Industry's Economic Contribution to North Dakota in 2019



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EXECUTIVE SUMMARY

The purpose of this study was to estimate the economic contribution of crude oil and natural gas exploration, extraction, transportation, processing, and capital investments in North Dakota in 2019. Total in-state expenditures in 2019 for oil and gas exploration (e.g., seismic testing, well drilling, fracking, well completions) were estimated from industry data and statewide drilling statistics. A total of 1,181 wells were completed in 2019, which yielded nearly \$7.8 billion in total financial outlays for well development. Financial data from previous studies suggest that about half the cost to complete a well in North Dakota represented economic leakage and was not included in the industry's direct economic impacts. Therefore, the \$7.8 billion was adjusted to reflect about \$3.85 billion of expenses captured in the North Dakota economy. The gross business volume from exploration was estimated at \$5.7 billion and was estimated to support 17,900 jobs in the state.

The state had 15,412 producing wells (average monthly) which combined for nearly 524.4 million barrels of oil and 933.8 million mcf (produced) of natural gas in 2019. Estimates of oil and gas extraction/production expenses, general business expenses for firms that own wells, private and public mineral royalties, and state severance taxes were derived from industry data and secondary information obtained from various government agencies. The volumes of oil and gas production in 2019 resulted in an estimated \$28.4 billion of commodity sales, \$2.4 billion in state severance taxes, and a combined \$2.2 billion of in-state private and public oil and gas royalties. The in-state gross business volume of oil and gas extraction/production was estimated at \$30.3 billion and supported 30,600 jobs in 2019.

Transportation of crude oil, pipeline operations, crude oil rail loading facilities, natural gas processing, and crude oil refining were estimated to have a direct impact in North Dakota of \$2.9 billion in 2019. Processing and transporting crude oil and natural gas generated a gross business volume of \$3.5 billion and supported about 5,600 jobs in 2019.

The petroleum industry was estimated to have spent about \$1.6 billion on capital projects located in the state in 2019. After adjustments for economic leakage (the portion of expenditures not captured in the North Dakota economy) and reconciliation with construction-related employment reported by Job Service North Dakota, it was estimated that about \$411 million was captured in the North Dakota economy. The gross business volume associated with infrastructure spending in North Dakota was estimated at \$660 million. Infrastructure spending, as defined in this report, would represent additional economic activity beyond that created by the exploration, production, processing, and transportation segments of the industry.

The gross business volume for the entire industry, including infrastructure spending, in North Dakota in 2019 was estimated at \$40.2 billion, of which \$28 billion represented sales of crude oil and natural gas. The industry supported over 59,000 jobs with a total payroll of \$4.5 billion. The industry was estimated to make direct contributions to local and state government tax revenues of \$3.7 billion. Secondary business activity generated an additional \$137 million in government revenues in 2019.

Biennial economic contribution studies for the petroleum industry have been conducted since 2005. From 2005 through 2013, biennial studies were measuring the substantial growth occurring in the industry from shale development. Subsequent to the industry's peak economic contribution in 2014, the industry has been heavily influenced by substantial price volatility which has subsequently created large swings in economic output, employment, and government revenues.

PETROLEUM INDUSTRY'S ECONOMIC CONTRIBUTION TO NORTH DAKOTA IN 2019

Dean A. Bangsund and Nancy M. Hodur*

INTRODUCTION

North Dakota's largest basic sector industries, which include agriculture, manufacturing, and energy, provide much of the economic stimuli for the state's economy. These large industries are generally comprised of distinct sectors or economic groups. For example, agriculture in North Dakota often is considered a combination of crop production and livestock. The energy industry in North Dakota also is comprised of several distinct sectors that are commonly treated as separate activities. North Dakota's energy industries can be conveniently separated into the activities that produce and distribute electricity, coal, petroleum, and renewable fuels.

While separating the energy industry into similar activities is relatively straight forward, identifying the economic players within those sectors is less clear. In the case of electricity generation, a handful of firms and generating facilities exist within the state. The same situation exists with coal production – a handful of companies operate at a limited number of locations. However, the industrial organization associated with oil and natural gas production is different. Rather than having a handful of firms and a limited number of site-specific facilities and locations, the petroleum industry involves hundreds of firms and a multitude of facilities spread throughout the western third of North Dakota.

North Dakota has been a top 10 oil-producing state for over a decade. To those familiar with North Dakota's economy, the petroleum sector has always been an important part of the state's economic base. Recent upswings in oil production became prevalent in the 2000s. In 2006 during the beginning of the latest expansion of oil field development, the first comprehensive economic assessment of the petroleum industry in the state was conducted (Bangsund and Leistritz 2007). Another assessment was conducted two years later (Bangsund and Leistritz 2009). From 2006 through 2015, North Dakota witnessed an unprecedented increase in oil production. Production dropped in the latter half of 2015 and through 2016, but increased in 2017 and 2018. While North Dakota has recently been recording state records for monthly oil production, the state remains second in oil production behind Texas (U.S. Department of Energy 2020).

The expansion of oil development associated with shale formations that started in the mid-2000s has continued to garner local, state, and national headlines. The rapid development of the oil patch in North Dakota is no longer a local phenomenon visible to only those working in the industry or living in western North Dakota. The economic value of the rapidly expanding petroleum industry is difficult to follow as the industry has grown and expanded beyond historical precedents. The state was beginning to adjust to a continually-expanding petroleum sector when a price collapse at the end of 2014 caused a substantial roll back in shale oil development, and substantially impacted employment, personal income, and government revenues. This assessment is the third effort to examine the economic footprint of the industry since the 2014 price collapse.

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Determining the economic contribution of a given industry quantifies its importance to state and local economies. Not only can the economic contribution to the state and local economies be measured, but the effects on specific economic sectors and related industries also can be identified. In addition, economic studies can demonstrate the susceptibility of the North Dakota economy to fluctuations in factors affecting petroleum development and production, demonstrate the economic dependence of the state on natural resource-based industries, and indicate the economic consequences that could result from potential changes in policies which affect the petroleum industry.

OBJECTIVES

The purpose of this report is to estimate the economic contribution (direct and secondary effects) of the petroleum industry to the economy of North Dakota. Specific objectives include

- 1) estimate the economic size of petroleum exploration, extraction, and processing sectors,
- 2) estimate in-state spending on petroleum industry infrastructure, and
- 3) provide estimates of industry-wide employment, tax revenues, and other key economic measures.

BACKGROUND

The industrial organization of the petroleum industry in the United States often is divided into upstream and downstream components. The upstream components of the petroleum industry generally include exploration, development, and production of crude oil and natural gas. The downstream components include transportation, processing, distribution, marketing, and retail delivery of petroleum products.

Industry Organization

The petroleum industry in North Dakota consists of both upstream and downstream components. For this study, the petroleum industry was defined to only include in-state exploration, extraction/production, transportation, and processing of crude oil and natural gas. Exploration can be generally thought of as the process of finding mineral resources. Extraction or production is the process of developing and recovering mineral resources. Transportation components of the industry, in this study, were limited to the movement of oil and gas from wells to collection points, and then on to processing facilities located either in-state or out-of-state. Petroleum processing in North Dakota included refining of crude oil and natural gas processing. The distribution, marketing, and retail sale of processed petroleum products (e.g., diesel, gasoline, kerosene, motor oil, lubricants, propane, natural gas) were not included.

The exploration and extraction phases of the petroleum industry are not organized like other industries in the state. Firms that own producing wells (oil operators) contract much of the work of exploration and extraction of oil and gas to other firms that specialize in various aspects of those processes. As a result, much of the expenditures incurred in the state for oil and gas production start with the oil operator but flow through the various firms engaged in providing support and service within

the oil fields. While oil operators represent a mix of small to large firms, a majority of the prominent oil operators in North Dakota also have operations in other states. For many oil operators, their operations in North Dakota do not represent the majority of their oil and gas revenues. As a result of having operations and/or headquarters in other states, net revenues from North Dakota oil and gas production may leave the state for a variety of reasons. However, North Dakota is still the beneficiary of exploration and discovery expenses from firms that may have minimal operations in the state.

Oil and gas wells typically have three types of economic interests. These players are often referred to as royalty interests, owner/operator interests, and working interests. Royalty interests receive a share of the value of a well's output but do not share in the expenses associated with the well. Owner and working interests share, based on various percentages or arrangements, the remaining revenues and all of the expenses of a well. The well owner or operator is generally responsible or in charge of all operations. The owner arranges to have work completed for most of the necessary activities associated with the well, and charges working interests for their share of the expenses. As a result of these typical arrangements, the total number of firms receiving revenues and incurring expenses from oil and gas wells in North Dakota is unknown. However, the number of oil operators (firms that own or operate wells) is known.

For various reasons, the magnitude of economic effects of oil and gas production are not necessarily equivalent to the market value (i.e., price times quantity) of oil and gas produced. Exploration and extraction technologies use specialized inputs and services, many of which are not available in North Dakota and must be purchased from out-of-state sources. Many oil operators have operations and/or are headquartered in other states, and revenues for some firms may leave the state to be used for projects elsewhere. The same situation may exist where firms use resources obtained from out-of-state operations for oil and gas exploration in the state. In addition, oil operators headquartered out-of-state often have minimal general business expenses in the state. Similarly, firms that only have working interests in producing wells may or may not have physical operations in the state. All of these factors make it problematic to base economic importance of the petroleum industry solely on the value of oil and gas production.

Production Statistics

Oil and gas production is limited to the western third of North Dakota (Figure 1). While crude oil has been produced in 19 western counties, 17 counties are currently producing crude oil (North Dakota Department of Mineral Resources 2020). Of the 17 counties producing oil, production is concentrated in Billings, Dunn, Bowman, McKenzie, Mountrail and Williams counties (North Dakota Department of Mineral Resources 2020). Production in key counties has fluctuated over the past 50 years as new oil deposits are found and developed in various locations in the state. Since 2002, major increases in oil production have occurred in Bowman, McKenzie, Dunn, and Mountrail counties.

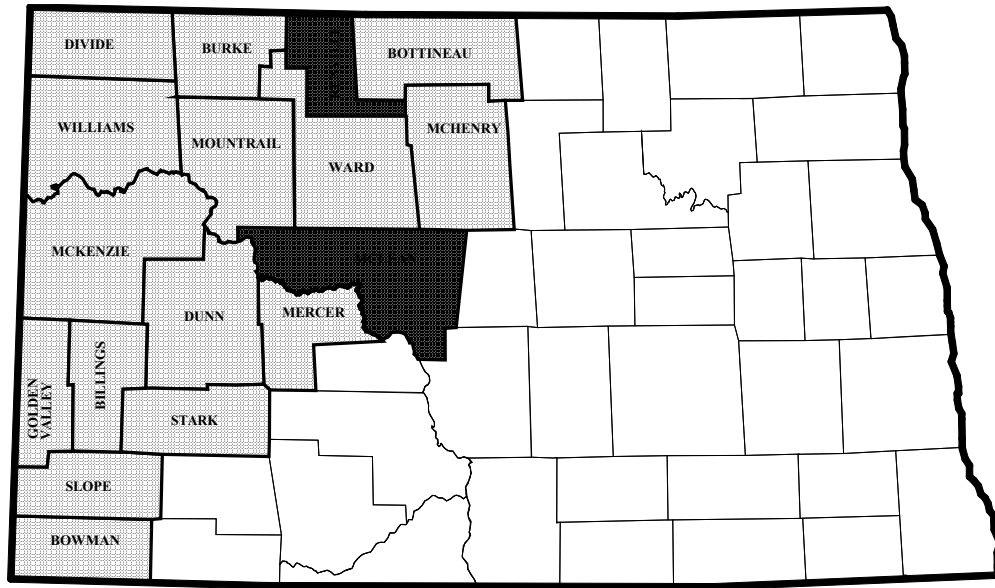
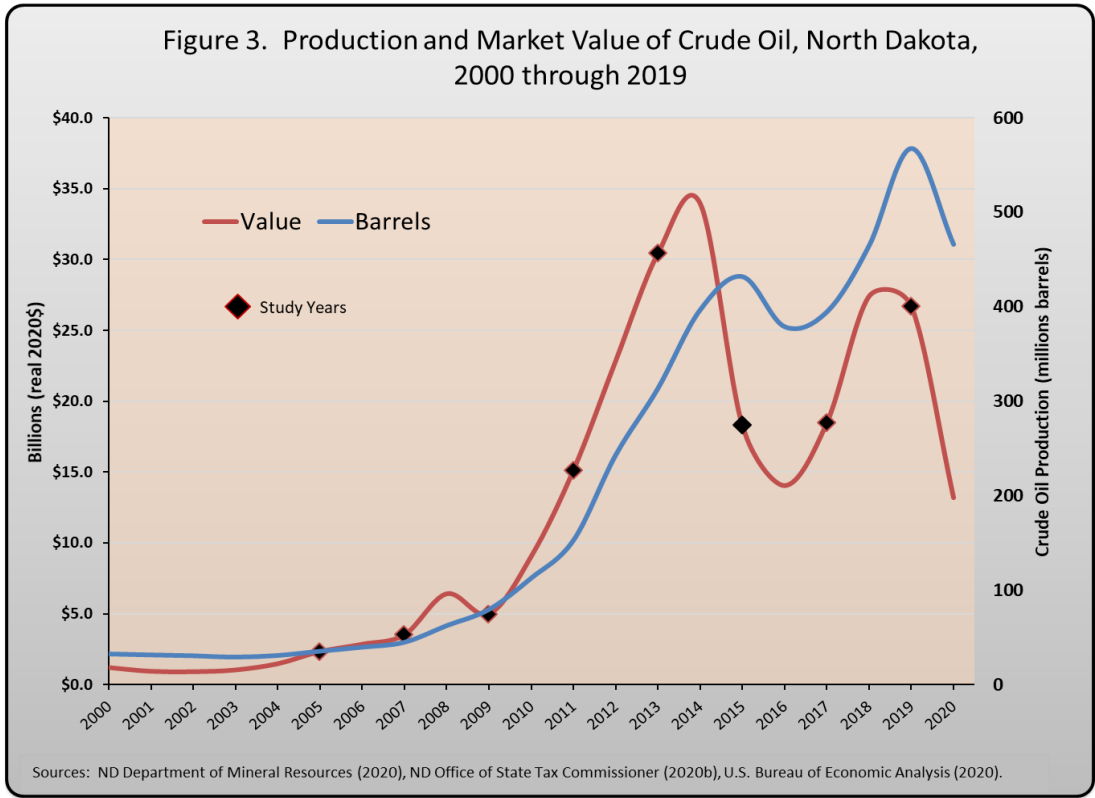
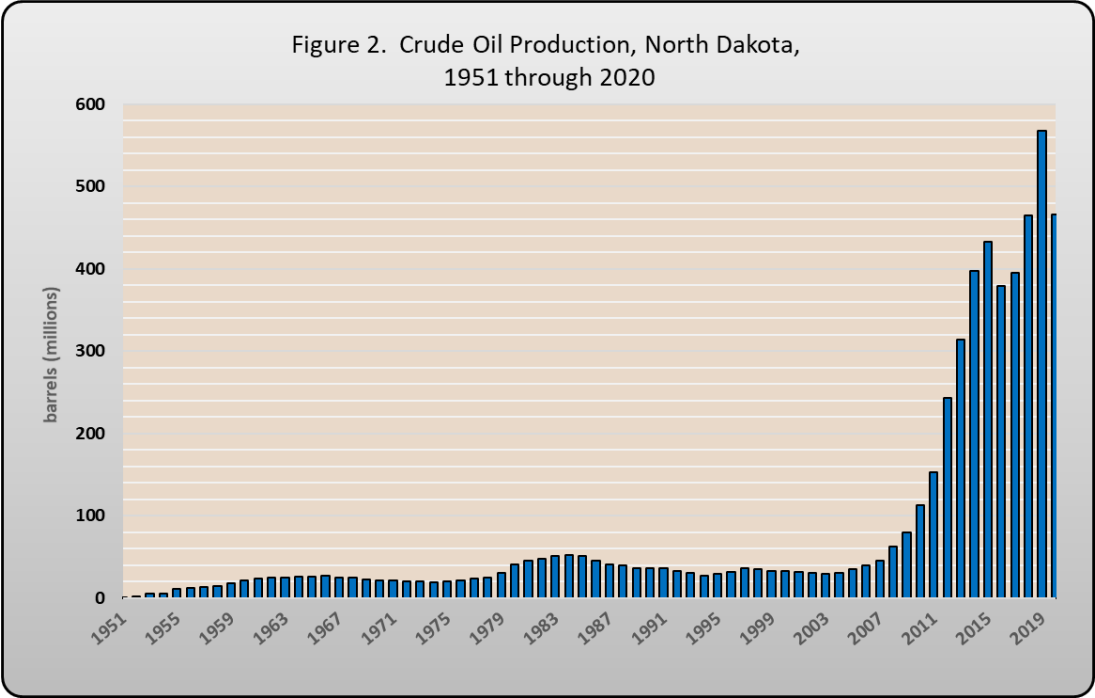


Figure 1. Oil Producing Counties, North Dakota

Oil production in North Dakota has fluctuated substantially since commercial production began in the early 1950s (Figure 2). Overall, there have been four periods of rapid growth in oil production in North Dakota. The first period was from 1951 through 1962, the second period occurred from 1974 to 1984, the third period from 1994 to 1997, and the current period which began in 2003. After historic highs in 1984, overall oil production in the state declined rapidly for 10 years. More recently, changes in crude oil production have been created by the price collapse in late 2014 and the covid-19 pandemic of 2020.

The annual value of oil production in North Dakota was estimated using monthly average price and production data from the North Dakota Department of Mineral Resources (2020). The overall value of oil production in North Dakota, in nominal terms, has generally paralleled oil production despite price fluctuations over time (Figure 3). Nominal oil prices were converted to real dollars (2020) using the Gross Domestic Product-Implicit Price Deflator (U.S. Bureau of Economic Analysis 2020).



PROCEDURES

An economic contribution analysis, as defined in this study, represents an estimate of all relevant in-state expenditures and returns associated with an industry. The economic contribution approach to estimating economic activity has been used for several other industries in North Dakota (Bangsund and Hodur 2017, 2019a, 2019b, 2020, 2021; Coon et al. 2012).

Data Collection

Previous studies from 2005 through 2015 used an expenditure-based approach, almost entirely driven by survey data, combined with the ND Input-Output Model to estimate statewide economic effects. A switch from the ND Input-Output Model to the IMPLAN modeling system occurred after the 2015 study. Survey questionnaires have been adjusted slightly to align more closely with the new Input-Output (I-O) modeling platform.

A sample of firms active in the petroleum industry in North Dakota were asked to provide estimates of the amount of expenditures made to entities (i.e., individuals, firms, and governments) in North Dakota. Oil operators (i.e., firms owning oil wells) represented one segment of the industry. Firms involved with natural gas collection and processing represented another segment of the industry. Finally, firms involved with rail loading and pipeline operations were surveyed.

Oil Operators and Oil Field Development

Firms that own or operate oil wells in the state were surveyed to obtain information on expenses for oil and gas exploration, oil and gas extraction/production, general business expenses in the state, employment, physical measures of oil and gas production, and leasing and drilling activity (Appendix A). The North Dakota Petroleum Council provided contact information for those firms. The survey process started with sending cover letters and a questionnaire to each firm on the mailing list. A second mailing was conducted for all firms that had not responded¹ to the first mailing.

Processors and Transportation

Another survey was conducted for firms engaged in pipeline transportation of crude oil and unprocessed natural gas produced in North Dakota, firms operating crude oil rail loading facilities, and firms involved with processing of crude oil and natural gas in North Dakota. The survey was used to obtain estimates of the amount and type of expenditures made in North Dakota and in-state employment by those firms (Appendix A).

¹Firms with non-deliverable addresses, those who responded with completed questionnaires, and those who indicated they would not or could not participate were excluded from the second mailing.

IMPLAN Industry Profiles

In previous studies, survey data combined with other publicly available statistics were used to set the level and distribution of spending by the industry. These estimates were based on relating various expenditures to levels of production (e.g., utilities expense per barrel of oil equivalent² (BOE) produced) to estimate direct impacts. In previous studies, expenditures (and other cash outlays such as royalty payments) represented the direct impacts for the contribution analysis. Those expenditures were considered analogous to sales in the affected economic sectors.

IMPLAN treats industry sales (e.g., value of crude oil sold) as the direct or first-round impacts for most economic contribution analyses. This differs from previous methodologies as only in-state expenditures and other selected revenue streams were treated as sales, and those sales were not within the petroleum sector but rather allocated to other sectors affected by petroleum industry spending (e.g., communications, transportation, manufacturing).

IMPLAN starts with sales or output for an economic sector, and uses several financial categories based on different classifications and economic requirements (Appendix B, Appendix Figure B1) to distinguish expenditures, payroll, taxes, and income. Expenditures for goods and services used to produce a product or service within IMPLAN are called 'intermediate inputs' and are treated as a function of sales. To arrive at IMPLAN's baseline data, a number of econometric techniques are used to estimate industry expenditures within a given economic sector and also the percentage of those expenditures supplied by local vendors (i.e., other economic sectors). Those values also are treated within the model as a percentage of sales. IMPLAN arrives at an estimate of industry expenditures supplied by local sources within a given economic area (Appendix B, Appendix Figure B2), which was also the goal of methodologies used in previous petroleum industry economic contribution studies in North Dakota.

Data used for economic contribution studies involving IMPLAN can be supplied by outside sources or rely on default data supplied by IMPLAN. However, some underlying data, such as trade flows, are not adjustable within the IMPLAN I-O matrix. The key sectors within IMPLAN relating to the petroleum industry were re-constructed since baseline data greatly underestimated the economic size of the industry. Appendix C contains information on the reconstruction of IMPLAN sectors associated with oil and gas exploration, development, and production for 2015, 2017, and 2019.

Input-Output Analysis

Economic activity from a project, program, policy, or activity can be 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 the project, program, policy, or activity.

Secondary impacts (often categorized into indirect and induced effects) result from subsequent rounds of spending and respending within the economy (Appendix B contains a more detail discussion). Indirect economic effects arise from the additional consumption of goods and services triggered by

²Barrel of oil equivalent places oil and gas production on a common basis, and is estimated by dividing mcf of natural gas by 6 and adding barrels of oil.

businesses that supply inputs to firms in a given sector/industry. Indirect effects can be interpreted as the additional economic activity created through purchases of goods and services by businesses. Induced economic effects arise from the 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 payrolls from businesses that supply goods and services to an impacted sector (induced effects), and proprietor income resulting from a change in sales volume of businesses that represent sole proprietorships. Induced effects measure the additional business activity that is triggered as changes in household income are translated into the purchase of goods and services for personal consumption.

I-O analysis is an accepted methodology to examine how initial changes in employment, income, and/or business activity translate into additional or subsequent rounds of economic output within a given economic unit. Economic units often represent individual economic sectors, groups of sectors that constitute industries, or an entire economy.

I-O models require an underlying database to calibrate the linkages among economic sectors, households, and governments. This study used the IMPLAN modeling system based on its proprietary data set and I-O methodologies. [See Appendix B for more discussion of the IMPLAN model].

KEY ECONOMIC METRICS

A number of key economic metrics have been developed in previous studies that help articulate the economic output of the industry. The estimation of those metrics was continued in this study even though not all that information is directly used in the IMPLAN modeling system. The values reported in this section were used as direct effects in previous assessments. However, the values were used to reconstruct the oil and gas sectors in the IMPLAN modeling system as part of the industry profiles, and were not necessarily considered a direct effect as used in previous assessments.

Exploration and Development

Estimates of total 2019 in-state expenditures for exploration were derived from the survey of oil operators and used with drilling statistics from the North Dakota Department of Mineral Resources (2020). Gross expenditures for exploration, drilling, and well completion were estimated at about \$6.6 million per well drilled in North Dakota in 2019. The petroleum industry completed 1,181 new wells in North Dakota in 2019, yielding about \$7.8 billion in total financial outlays for well development. Financial data on expenses for well development from Bangsund and Hodur (2015, 2017) were used to adjust for in-state spending. Considering the rapid expansion of well drilling, and the volume of economic activity, adjustments to the capital costs to drill and complete a well were performed to reflect specific inputs only supplied by in-state sources. Examples of well development expenses that were determined to be primarily supplied by out-of-state firms included drill bits, well casing, well head equipment, conductor pipe, fuel, cement, packers, christmas tree, sucker rod, heater/treater, fracture materials, and emissions control. Removing input expenses supplied primarily by out-of-state sources revealed that about 48 percent of the capital cost to complete a well came from in-state sources. Therefore, the \$6.6 million completion cost per well in North Dakota in 2019 was adjusted to reflect about \$3.3 million of expenses captured in the North Dakota economy (Table 1).

Lease bonuses retained or paid to in-state entities were estimated at \$38 million in 2019, which included \$10.6 million for state leases and about \$27 million for private mineral leases. Net federal lease bonuses, reported by the Office of Natural Resource Revenues, were -\$255,000. Disbursements of lease bonuses from tribal lands back to North Dakota are not reported; however, tribal lease bonuses are contained within “gross” estimates of lease bonuses on Federal lands reported by the Office of Natural Resource Revenue, U.S. Department of the Interior.

Table 1. Selected Statistics and Economic Metrics, Petroleum Industry, North Dakota, 2017 and 2019

	2017	2019
Number of wells drilled and completed	1,039	1,181
Cost per well completed (000s nominal \$) ^a	6,601	6,601
In-state expenditures per completed well (000s nominal \$)	3,285	3,285
Lease bonuses (000s nominal \$)		
Net federal and state	4,505	10,610
Private ^b	13,472	27,590
Crude oil (000s barrels) ^c	465,030	524,432
Natural gas produced (mmcf) ^c	688,771	933,850
Natural gas sold (mmcf) ^c	568,790	787,750
Crude oil and natural gas produced (000s Barrel of Oil Equivalents)	509,622	680,074
Number of operating/active wells (monthly average) ^c	13,951	15,412
Number of wells completed ^c	1,039	1,181
Crude oil price (first purchaser prices nominal \$ per bbl) ^d	\$45.67	\$50.91
Natural gas price (nominal \$ per mcf) ^c	\$2.54	\$2.12
Crude oil sales (millions nominal \$)	18,034	26,699
Natural gas sales (millions nominal \$)	1,445	1,701
Oil and gas combined (millions nominal \$)	19,478	28,400
Oil royalty rate ^e	18.26%	
Gas royalty rate ^e	18.17%	
Royalties (millions nominal \$)		
Net federal, state, and Tribal	649.2	830.6
Private		
Total	2,490.2	3,622.5
In-state	938.8	1,367.7
All net public and private royalties	1,588.0	2,206.2
Severance taxes (millions nominal \$) ^d	1,637.7	2,418.8

Mmcf = 1,000,000 cubic feet. Mcf = 1,000 cubic feet.

^aWell costs in 2019 obtained from 2017 survey data.

^bPrivate lease bonuses represented only payments to in-state mineral owners.

^cND Department of Mineral Resources (2020).

^dND Office of State Tax Commissioner (2020b).

^eData obtained from industry surveys.

Oil and Gas Production

Estimates of total in-state expenditures in 2019 for extraction/production and general business expenses were derived from the survey of oil operators and estimated on a BOE basis. Data obtained from the survey of oil operators for general business expenses and oil and gas production expenses were specific to expenses paid to entities within North Dakota.

North Dakota produced 524.4 million barrels of oil and 933.8 million MCF of natural gas in 2019 (Table 1) (North Dakota Department of Mineral Resources 2020). State oil and gas royalties were about \$264 million (net of severance taxes) (North Dakota Department of Trust Lands 2020). Federal royalties returned to North Dakota were about \$566 million (net of severance taxes), which includes tribal royalties (Office of Natural Resources Revenue 2020). Separate estimates of tribal royalties are not published by the Office of Natural Resources Revenue.

Private royalties were based on production data obtained from industry surveys and information on the distribution of in-state and out-of-state mineral payments. Overall royalty percentages used in this study were 18.26 percent and 18.17 percent of well output for oil and gas, respectively (Table 1). The total value of oil and gas production was estimated at \$28.4 billion using data obtained from the North Dakota Department of Mineral Resources (2020) and the North Dakota Office of State Tax Commissioner (2020b) (Table 1). Total royalties were estimated by applying the industry-wide oil and gas royalty percentages to the gross sales value of crude oil and estimated sales value of natural gas. Private royalties were estimated by subtracting state and gross federal royalties from estimated total royalties. Gross private royalties (i.e., both in-state and out-of-state mineral owners) from oil and gas production in North Dakota in 2019 were estimated to be \$3.6 billion.

In-state payments of private royalties were estimated by applying the percentage of in-state versus out-of-state mineral owners' royalty payments (37.7 percent) to the estimated total private royalties (\$3.6 billion). The in-state percentage of mineral ownership (37.7%) was estimated from private royalty payments made by oil operators in the state. The survey of oil operators provided information on total private mineral payments from North Dakota wells (includes both mineral owners who reside in the state and those that live elsewhere) and total private in-state mineral payments from North Dakota wells (only private mineral payments going to North Dakota mailing addresses).

In-state private royalties in 2019 were estimated at \$1.4 billion (without adjustments for severance taxes) or about \$1.3 billion net of severance taxes (severance taxes were included as a separate component of direct impacts and subtracted from private in-state mineral royalty payments).

Total collections from the gross production tax and extraction tax in calendar year 2019 were about \$1.26 billion and \$1.16 billion, respectively (North Dakota Office of State Tax Commissioner 2020a). Those tax collections were included in the extraction/production segment of the petroleum industry.

Processing and Transportation

Direct impacts included \$780 million in transportation expenses paid to in-state entities by oil operators. Processing activities, which included pipeline transportation of unprocessed natural gas and crude oil, natural gas processing, crude oil rail loading, and crude oil refining were estimated to have in-state expenditures of \$2.89 billion (see Table 9). One-time spending for infrastructure by processors was included in processing expenditures prior to the 2011 industry assessments; however, infrastructure spending has been estimated separately since the 2011 assessment. Processors were directed to omit any infrastructure spending in their operational expenditures (Appendix A). To avoid double counting of potential economic effects, in-state purchases of crude oil and unprocessed natural gas by processors were excluded in the study.

Government Revenues

Some of the most closely monitored measures of the petroleum industry are estimates of government revenues. Government revenues attributable to the petroleum industry stem from collections of property, sales and use, personal income, and corporate income taxes. Other direct revenue sources include royalties on oil and gas production and lease bonus payments. The largest single source of government revenue from the petroleum industry in the state has been severance taxes. Total government revenues paid directly by the industry to governments in North Dakota was estimated at \$3.69 billion, of which severance taxes comprised \$2.42 billion or 66 percent of the total (Table 2). An additional \$137 million in tax revenues were estimated from indirect and induced economic effects. Total government revenues attributable to the oil and gas industry in 2019 were estimated to be \$3.8 billion.

Table 2. Comparison of Economic Estimates, Government Revenues, Petroleum Industry, North Dakota, 2017 and 2019

Category	2017	2019
Included in Direct Effects		
Sales and Use, Property, and Income Taxes	271.3	299.2
Royalties ^a	649,194	830,635
Severance Taxes	1,637,742	2,418,791
Lease Bonuses (net federal and state)	4,597	10,610
Licenses, Fees, Permits, Donations, and Undetermined Taxes	131.1	129.9
Totals	2,422,877	3,688,456
Estimated from Secondary Effects		
Sales and Use	50,420.0	49,033.0
Personal Income	16,026.8	13,559.4
Other taxes (IMPLAN analysis)	68,975.8	74,312.8
Direct and Secondary Generation Total	2,881,500	3,825,361

^aNet federal and state royalties from oil and gas production, and royalties from processing activities returned to North Dakota from federal mineral ownership.

ECONOMIC CONTRIBUTION

The economic contribution of the petroleum industry was primarily based on estimates of total sales, gross and net (in-state) expenditures, government taxes, and payroll for exploration, extraction, transportation, and processing of crude oil and natural gas. In-state expenditures, oil and gas royalties, state severance taxes, and lease bonuses were included in the development of economic profiles of various sectors of the IMPLAN modeling system.

Employment

The petroleum industry is responsible for creating and supporting a variety of jobs. Those jobs are traditionally divided into direct and secondary employment when measuring the economic contribution of industries. Direct employment is a term used to describe jobs that are considered to be an integral part of an industry. For example, workers operating an oil drilling rig would represent direct employment in the petroleum industry. Similarly, someone who works at a natural gas processing plant or crude oil refinery would be considered direct employment in the petroleum industry.

Secondary employment represents employment supported by economic output using two different economic mechanisms. *Indirect* employment represents the employment supported through the business purchases of goods and services. An oil drilling firm contracting with a construction firm to build a road and drilling pad would be an example of indirect employment. *Induced* employment represents jobs that are supported by the purchase of goods and services by households. The jobs supported by the purchase of goods and services for personal consumption by employees of the drilling firm and those employees supported in the construction firm would constitute induced employment.

From 2013 through 2016, Job Service North Dakota conducted a special annual assessment to measure the number of private jobs in the petroleum industry using the Quarterly Census of Employment and Wages (QCEW) program (Table 4) (Job Service North Dakota 2014, 2015, 2016, 2017) (see Appendix D for detailed Job Service North Dakota data and additional discussion of Job Service North Dakota methodologies). The Job Service North Dakota study of petroleum industry employment was discontinued in 2017. Using recent NAICS code data and relating those values to past relationships in the Job Service North Dakota studies and using other economic metrics, estimates of employment in the industry were produced that match the organization and descriptions used in the 2013 through 2016 Job Service North Dakota reports (Appendix D).

The U.S. Bureau of Labor Statistics (BLS) collects data from state agencies responsible for implementation of the QCEW. The BLS reporting of the employment within NAICS code 21 contains key divisions between oil and gas development and oil and gas production (Table 4). Employment in NAICS code 213 is often reported as a total for that sector. However, that sector includes jobs that support oil and gas development (drilling and fracking) and oil and gas production. The split in labor between those two groups was used in the development of the IMPLAN industry profiles, and has only recently been made available by the BLS (U.S. Bureau of Labor Statistics 2020) (see Appendix C for development of IMPLAN industry profiles and the approximate split in oil field services between oil and gas production and oil field development).

Statewide, 10.3 percent of all private sector jobs covered by unemployment insurance were directly employed in the oil and gas industry in 2019 (Table 5). Including all secondary employment, the oil and gas industry supported 59,100 jobs in 2019 equating to 16 percent, respectively, of all private sector jobs covered by unemployment insurance (Table 5).

Direct employment in the industry was estimated to have a payroll of \$3.6 billion which represented 18.7 percent of the state's total private QCEW employment compensation. Including indirect and induced employment, total private wages and salaries supported by the petroleum industry were nearly \$4.5 billion in 2019, equating to 23.2 percent of all private sector wages and salaries (Table 6).

Table 3. Estimates of Industry Employment, Selected NAICS Codes and Job Service North Dakota Analysis, Petroleum Industry, North Dakota, 2003 through 2019

Categories	Employment in Petroleum Industry ^{a,b}																
	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
	----- jobs -----																
Statewide NAICS code 211	2,742	2,616	2,548	2,738	2,906	2,489	1,980	1,614	1,167	844	704	544	432	427	474	445	443
Statewide NAICS code 213	<u>16,598</u>	<u>16,158</u>	<u>13,263</u>	<u>10,437</u>	<u>18,111</u>	<u>25,115</u>	<u>22,032</u>	<u>20,627</u>	<u>13,759</u>	<u>8,119</u>	<u>4,608</u>	<u>4,651</u>	<u>3,103</u>	<u>2,688</u>	<u>2,090</u>	<u>1,605</u>	<u>1,334</u>
Total	19,340	18,774	15,811	14,215	21,017	27,604	24,012	22,241	14,926	8,963	5,312	5,195	3,535	3,115	2,564	2,050	1,777
Oil & Gas Drilling, Extraction, Production, & Refining	19,532	19,178	16,150	13,516	21,348	27,865	24,254	na									
Infrastructure Development	5,442	5,675	5,767	6,521	7,978	10,983	9,541										
Professional Services	2,950	2,983	2,869	2,847	4,891	6,277	5,055										
Transportation	4,819	4,609	4,446	4,393	8,540	11,331	10,173										
Wholesale Trade and Manufacturing	<u>3,567</u>	<u>3,505</u>	<u>3,440</u>	<u>3,541</u>	<u>5,613</u>	<u>6,486</u>	<u>6,114</u>										
Total	36,311	35,949	32,672	30,818	48,369	62,942	55,137										

na=not available.

NAICS 211—Oil and gas extraction activities.

NAICS 213—Providing support services, on a contract or fee basis, for the mining and quarrying of minerals and for the extraction of oil and gas.

^a Petroleum sector defined to include exploration, production, processing, and transportation of crude oil and unprocessed natural gas. Does not include distribution from processors to retail markets or sale of petroleum products in retail outlets. Employment estimates do not include sole proprietors or self-employed individuals not contributing to unemployment insurance.

^b All Data for 2003 through 2016 obtained from Job Service North Dakota. NAICS code 211 and 213 for 2017 and 2018 obtained from Job Service North Dakota; however, other employment categories for 2017 and 2018 were estimated from NAICS data and previous Job Service North Dakota reports. NAICS code 213 contains roughly 35 or fewer jobs, per year, that support mining industries other than oil and gas production.

Sources: Job Service North Dakota (various years), North Dakota Job Service (2017, 2016, 2015, 2014).

Table 4. Oil and Gas Industry Employment and Employment Compensation, NAICS Code 21, North Dakota, 2010 through 2019

NAICS Code and Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Employment		----- jobs -----									
21	Mining, Quarrying, Oil and Gas	10,660	16,786	24,376	26,196	29,836	23,248	15,303	17,841	20,804	21,380
211	Oil and Gas Extraction	844	1,167	1,614	1,980	2,489	2,906	2,738	2,548	2,616	2,742
2111	Oil and Gas Extraction	844	1,167	1,614	1,980	2,489	2,906	2,738	2,548	2,616	2,742
21112	Only oil and gas	na	na	na	na	na	2,654	2,501	2,327	2,408	2,516
21113	Only NGLs	na	na	na	na	na	252	237	221	208	226
213111	Drilling oil and gas wells	na	na	na	na	6,670	3,821	1,927	2,435	2,802	2,928
213112	Support activities for oil and gas	4,692	8,575	14,385	15,749	18,414	14,259	8,481	10,798	13,324	13,641
Total Wages and Salaries		----- millions nominal \$ -----									
21	Mining, Quarrying, Oil and Gas	852.5	1,506.2	2,354.0	2,568.3	3,127.0	2,362.0	1,473.5	1,804.0	2,216.4	2,326.8
211	Oil and Gas Extraction	81.0	113.9	181.5	220.7	297.8	359.6	329.7	326.8	352.1	389.8
2111	Oil and Gas Extraction	81.0	113.9	181.5	220.7	297.8	359.6	329.7	326.8	352.1	389.8
21112	Only oil and gas	na	na	na	na	na	327.5	300.2	297.6	325.5	363.2
21113	Only NGLs	na	na	na	na	na	32.1	29.4	29.2	26.7	26.5
213111	Drilling oil and gas wells	na	na	na	na	783.4	454.5	211.6	256.3	307.2	326.8
213112	Support activities for oil and gas	360.0	747.1	1335.0	1,466.8	1,852.0	1,351.3	741.0	1,035.2	1,362.0	1,405.9
Average Wages and Salaries per Job		----- nominal \$ per job -----									
21	Mining, Quarrying, Oil and Gas	80,000	89,700	96,600	98,000	104,700	101,600	96,300	101,100	106,500	108,800
211	Oil and Gas Extraction	96,000	97,600	112,500	111,500	119,700	123,800	120,400	128,200	134,600	142,200
2111	Oil and Gas Extraction	96,000	97,600	112,500	111,500	119,700	123,800	120,400	128,200	134,600	142,200
21112	Only oil and gas	na	na	na	na	na	123,400	120,100	127,900	135,200	144,400
21113	Only NGLs	na	na	na	na	na	127,500	124,000	132,100	128,200	117,500
213111	Drilling oil and gas wells	na	na	na	na	117,500	118,900	109,800	105,200	109,600	111,600
213112	Support activities for oil and gas	76,700	87,100	92,800	93,100	100,600	94,800	87,400	95,600	102,200	103,100

na=not available.

Source: U.S. Bureau of Labor Statistics (various years).

Table 5. Employment, Direct and Secondary Economic Activity, Petroleum Industry, North Dakota, 2011 through 2019

Private Employment (Quarterly Census of Employment and Wages)							
Year	Statewide ^a	Direct Jobs		Indirect and Induced Jobs		Direct, Indirect, and Induced Jobs	
		Oil and Gas ^b	Share of State	Oil and Gas	Share of State	Oil and Gas	Share of State
2011	312,525	40,856	13.1%	18,703	6.0%	59,559	19.1%
2012 ^c	344,543	50,074	14.5%	22,443	6.5%	72,000	20.9%
2013	359,415	55,137	15.3%	26,270	7.3%	81,407	22.6%
2014 ^c	376,068	62,941	16.7%	28,324	7.5%	91,266	24.3%
2015	367,157	48,372	13.2%	23,984	6.5%	72,353	19.7%
2016 ^c	345,731	30,818	8.9%	16,341	4.7%	47,159	13.6%
2017	343,191	32,672	9.5%	18,756	5.5%	51,427	15.0%
2018 ^c	346,456	35,710	10.3%	19,460	5.6%	55,410	16.0%
2019	351,470	36,311	10.3%	22,757	6.5%	59,068	16.8%

^aJob Service North Dakota (various years).

^bEmployment in 2013, 2014, 2015, and 2016 obtained from Job Service North Dakota (2014, 2015, 2016, 2017). Employment in 2011, 2012, 2017, 2018, and 2019 estimated using formats similar to those found with Job Service North Dakota (2014, 2015, 2016, 2017).

^cEstimate of oil and gas industry employment for 2012 was obtained from IHS, oil and gas industry employment in 2014, 2016, 2018 should be interpreted as being approximate as a comprehensive economic contribution assessment was not conducted in those years.

Table 6. Employment Compensation, Direct and Secondary Economic Activity, Petroleum Industry, North Dakota, 2013 through 2019

Private Wages and Salaries (Quarterly Census of Employment and Wages)							
Year	Statewide ^a	Direct Jobs		Indirect and Induced Jobs		Direct, Indirect, and Induced Jobs	
		Oil and Gas ^b	Share of State	Oil and Gas	Share of State	Oil and Gas	Share of State
	----- millions nominal \$ -----		--- % ---	- millions nominal \$ -	---- % ---	- millions nominal \$ -	---- % ---
2013	17,518	5,000	28.5	960	5.5	5,960	34.0
2014 ^c	19,586	6,077	31.0	1085	5.5	7,162	36.6
2015	18,937	4,550	24.0	973	5.1	5,523	29.2
2016 ^c	17,055	2,758	16.2	659	3.9	3,416	20.0
2017	17,439	2,977	17.1	822	4.7	3,798	21.8
2018 ^c	18,432	3,524	19.1	838	4.5	4,362	23.7
2019	19,351	3,611	18.7	882	4.6	4,493	23.2

^aJob Service North Dakota (various years).

^bEmployment compensation in 2013, 2014, 2015, and 2016 obtained from Job Service North Dakota (2014, 2015, 2016, 2017). Employment compensation in 2017, 2018, and 2019 estimated using formats similar to those found with Job Service North Dakota (2014, 2015, 2016, 2017).

^cOil and gas industry employment compensation in 2014, 2016, 2018 should be interpreted as being approximate as a comprehensive economic contribution assessment was not conducted in those years.

Exploration and Development

The economic effects of exploration and development come primarily from activities that involve searching and discovering viable oil and gas resources. Exploration/development was defined to include, but not limited to, seismic testing, geological research, lease expenses, other environmental research, land survey work, excavation, road building, construction of drill site, construction and delivery of electricity, pipeline development, and all other activities associated with drilling and completing oil and/or gas wells (Appendix A).

Direct employment relating in oil and gas exploration and development was estimated at 6,800 jobs. An additional 11,000 jobs (i.e., indirect and induced) were supported in 2019 in various economic sectors by oil and gas exploration and development in the state. Overall, exploration and development was responsible for 17,900 jobs in the state in 2019 (Table 7). Appendix E contains detailed data, by economic causality by 2-digit NAICS, for oil field development.

Table 7. Direct, Indirect, and Induced Economic Effects, Well Development, Petroleum Industry, North Dakota, 2019

Economic Effects	Employment	Employment Compensation	Value-added	Gross Business Volume
	--- jobs ---	----- millions \$ -----		
Direct	6,832	861.4	1,582.7	3,843.6
Indirect	5,656	311.7	566.1	1,096.1
Induced	5,386	226.3	428.0	785.4
Total	17,874	1,399.4	2,576.8	5,725.1

Jobs supported by exploration and development had a total payroll of \$1.4 billion, and oil and gas exploration and development contributed about \$2.6 billion to the state's gross domestic product (value-added). Gross business volume related to activities of exploration and development across all economic sectors was estimated at \$5.7 billion in 2019 (Table 7).

Oil and Gas Production

The economic effects of extraction/production come from a series of revenue streams associated with bringing crude oil and natural gas from underground formations to the earth's surface. Extraction/production was defined to include, but not limited to, all activities associated with the removal of crude oil and natural gas from the ground, and maintenance and periodic inspections of equipment used to extract oil and gas, and other production related activities, such as well work overs, well idling, shutdown, and abandonment activities (Appendix A). Also included in this segment of the industry are the general business expenditures incurred by oil operators in North Dakota. Examples of these expenditures include, but are not limited to, office rent, office supplies, wages and salaries, communications, public utilities, business and professional services, insurance, and interest expenses (Appendix A). Royalty revenues, both private and public, are included in the industry balance sheets (i.e., IMPLAN sector descriptions) for oil and gas production. Collections from state severance taxes, which include the gross production tax and extraction tax, are also part of the economic profile for the sector (see Appendix C).

Direct employment relating to oil and gas production was estimated at 11,600 jobs. An additional 19,000 jobs (i.e., indirect and induced) were supported in 2019 in various economic sectors by

oil and gas production in the state. Overall, oil and gas production was responsible for 30,600 jobs in the state in 2019 (Table 8).

Table 8. Direct, Indirect, and Induced Economic Effects, Oil and Gas Production, Petroleum Industry, North Dakota, 2019				
Economic Effects	Employment	Employment Compensation	Value-added	Gross Business Volume
	--- jobs ---		----- millions \$ -----	
Direct	11,626	1,376.1	19,667.0	27,430.3
Indirect	9,120	619.6	1,072.2	1,978.7
Induced	9,879	415.1	785.1	907.5
Total	30,625	2,410.8	21,524.3	30,316.5

Jobs supported by oil and gas production had a total payroll of \$2.4 billion, and oil and gas production contributed \$21.5 billion to the state's gross domestic product (value-added). Gross business volume related to activities of oil and gas production across all economic sectors was estimated at \$30.3 billion in 2019 (Table 8). Appendix E contains detailed data, by economic causality by 2-digit NAICS, for oil and gas production.

Processing and Transportation

The processing and transportation segment of the petroleum industry included transportation of crude oil and natural gas by truck and pipeline to collection points and processing centers, natural gas processing, and crude oil refining. In-state transportation expenses paid by oil operators were estimated on a BOE equivalent. Those expenses were extrapolated based on state production statistics. Estimates of in-state expenditures for natural gas pipeline operation, crude oil pipeline operation, natural gas processing, crude oil rail loading facilities, and crude oil refining were obtained from the survey of processors.

Direct employment relating to processing and transportation was estimated at 2,000 jobs. An additional 3,600 jobs (i.e., indirect and induced) were supported in 2019 in various economic sectors by processing and transportation of oil and gas in the state. Overall, oil and gas production was responsible for 5,600 jobs in the state in 2019 (Table 9).

Jobs supported by processing and transportation had a total payroll of \$331 million, and oil and gas processing and transportation contributed \$897 million to the state's gross domestic product (value-added). Gross business volume related to activities of processing and transportation across all economic sectors was estimated at \$3.5 billion in 2019 (Table 9). Appendix E contains detailed data, by economic causality by 2-digit NAICS, for processing and transportation.

Table 9. Direct, Indirect, and Induced Economic Effects, Processing and Transportation, Petroleum Industry, North Dakota, 2019

Economic Effects	Employment	Employment Compensation	Value-added	Gross Business Volume
	--- jobs ---	----- millions \$ -----		
Direct	1,997	154.1	552.1	2,890.3
Indirect	1,790	101.1	201.7	335.4
Induced	1,803	75.7	143.2	262.9
Total	5,589	330.9	897.0	3,488.6

Capital Expenditures

The petroleum industry in North Dakota has been adding infrastructure to the Williston Basin since the beginning stages of developing the Bakken/Three Forks Formations. Additional transportation capacity has been added to the region in the form of new export pipelines, expansions of existing crude oil pipelines, crude oil gathering systems, and crude oil rail loading facilities. New gas plants and expansions of existing plants have been added to the region, along with associated expansion and development of new collection systems to capture and transport natural gas and natural gas liquids to processing locations. Additional infrastructure added by the petroleum industry includes office buildings, regional transportation and distribution centers, worker housing, fracking water re-cycling facilities, and general facility and building upgrades and renovations. Capital expenditures for many forms of infrastructure have not been directly included in the previous industry assessments (Bangsund and Leistritz 2007, 2009, 2010), as industry costs and expenses in those studies focused solely on expenditures associated with well drilling/completion, oil and gas production, transportation, and processing operations.

Information to estimate capital expenditures for infrastructure came from survey data and secondary sources containing published estimates of project costs. Some estimates of capital expenditures represent discrete projects (e.g., gas plant) whereas other estimates represent projects that have less definable start and finish dates and less site-specific designations (e.g., oil field gathering systems).

Estimating industry-wide infrastructure spending requires addressing several key issues. First, timing of the start and completion of project-based infrastructure (e.g., gas plant) does not necessarily coincide with the study time frame. Projects can be initiated in one year and completed in another (e.g., started in 2019 while completion may not occur until 2020 or later). Survey data represented expenditures made for project(s) in 2019, while various secondary sources of capital expenditures represent total costs for specific projects that might involve spending over extended periods. Therefore, secondary data on infrastructure costs was reconciled with the anticipated timing of project-based expenditures. A project's total cost does not necessarily require all spending to occur in a single year, or occur solely in 2019.

Information was not available, on an industry-wide basis or on a project basis, to determine what portion of capital expenditures was captured in the North Dakota economy. For example, a substantial portion of the cost of a new gas processing plant or pipeline represents specialized equipment. Specialized equipment is acquired from out-of-state sources as primary suppliers are not available in North Dakota. Other studies have identified that a high proportion of specialized equipment

for various types of processing facilities constructed in North Dakota results in economic leakage (Bangsund et al. 2012; Coon et al. 2012a).

Based on published estimates of project expenditures, survey data, and extrapolation of survey data in combination with unpublished data, the petroleum industry was estimated to have spent around \$1.6 billion on infrastructure projects in the state in 2019 (Table 10).

Table 10. Capital Expenditures (Infrastructure), Petroleum Industry, North Dakota, 2011 through 2019					
Industry Category	2011^a	2013^a	2015^a	2017^a	2019^a
----- millions of nominal \$ -----					
Gas Processing	961.7	753.0	925.6	600.0	810.0
Gas Midstream (excluding processing plants)	252.9	490.7	325.2	236.2	338.0
Crude Oil Pipelines, Crude Oil Rail Loading Facilities, and Refineries	654.7	690.4	732.4	668.7	116.2
Gathering Systems	221.5	515.7	318.6	281.8	365.8
Water Re-cycling Facilities ^{b,c}	33.2	185.8	122.4	11.6	na
Housing and Lodging ^{b,c}	240.9	64.2	21.1	2.3	na
Office and Other Facilities ^{b,c}	184.9	263.2	162.2	170.2	na
Other (miscellaneous) ^{b,c,d}	50.3	241.1	13.8	0	na
Total	2,599.8	3,203.9	2,621.2	1,970.8	1,630.0
na=not available.					
^a Represent an estimate of capital expenditures spent in calendar year. Capital expenditures in any particular year will not necessarily equal the total estimated cost of any particular project(s).					
^b Estimated based on extrapolation of survey data.					
^c Only includes expenditures for firms surveyed as part of the oil and gas industry.					
^d Based on survey of firms providing service and support in the oil fields, and represented miscellaneous or unclassified infrastructure investments. This category also includes capital expenditures for development of the crude oil refinery in Dickinson.					
Sources: North Dakota Pipeline Authority (2020), North Dakota Department of Mineral Resources (2020), North Dakota Public Service Commission (2020), North Dakota Office of the State Tax Commissioner (2020c) and confidential survey data.					

Infrastructure spending, as defined in this report, would represent additional economic activity beyond that created by the exploration, production, transportation, and processing segments of the industry. Within the IMPLAN modeling system, capital expenditures are not included with intermediate inputs (Appendix B). Therefore, capital expenditures are modeled as a separate source of impacts, even if some of the construction activity would be aligned in one of the industry's key segments (e.g., construction of gathering systems as part of oil and gas production).

In the analysis performed by Job Service North Dakota (2013, 2014, 2015, 2016) construction employment was included as part of the industry's 'related' employment. The estimated construction jobs not considered part of the indirect and induced effects from exploration and drilling, oil production, transportation, and processing were used with several construction sectors in IMPLAN to estimate the overall economic effects of infrastructure spending. Because of the nature of the employment estimates generated by the Job Service North Dakota assessment, indirect and induced effects in NAICS 23 were treated as double counting, and not included in the final contribution figures.

The gross business volume associated with infrastructure spending in North Dakota was estimated at \$660 million in 2019 (Table 11), which would include adjustments for construction inputs

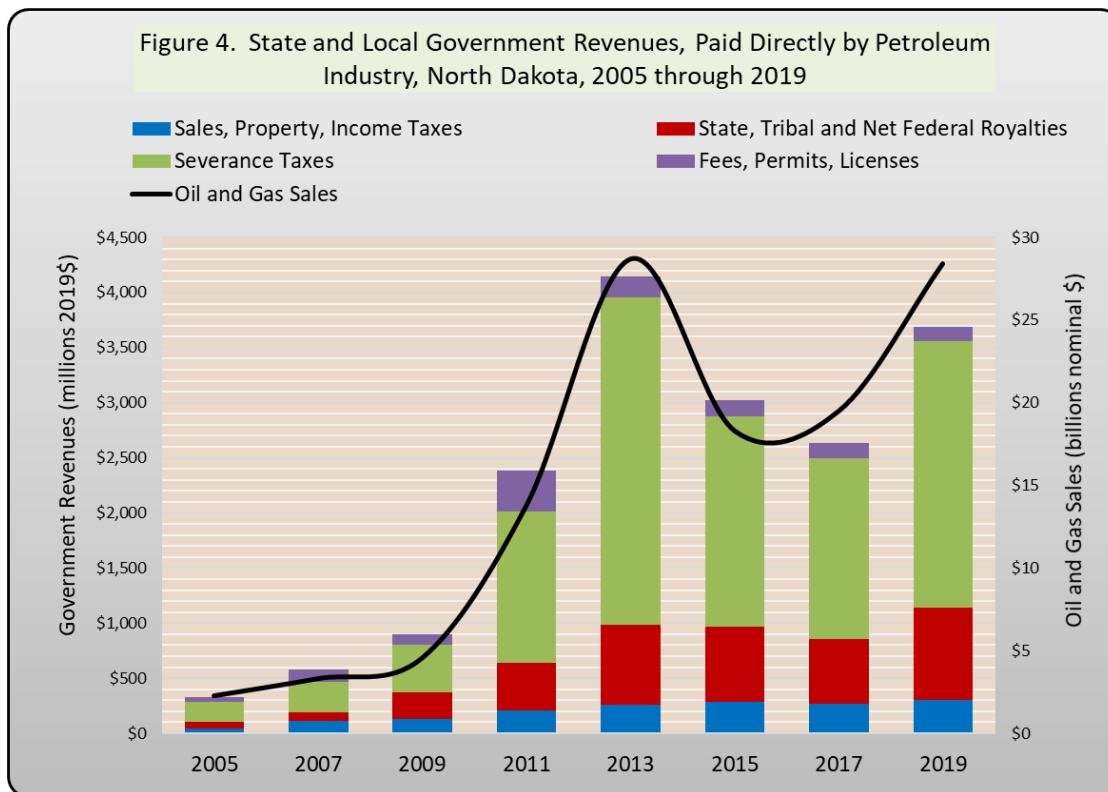
not obtained from in-state sources. Total employment related to petroleum industry capital expenditures was estimated at about 5,000 jobs with a payroll of \$316 million. Capital expenditures by the industry in 2019 was estimated to contribute \$376 million to the state's GDP.

Table 11. Direct, Indirect, and Induced Economic Effects, Infrastructure, Petroleum Industry, North Dakota, 2019				
Category	Employment	Employment Compensation	Value-added	Gross Business Volume
	--- jobs ---	----- millions \$ -----		
Direct	3,453	228.8	243.0	411.2
Indirect	408	32.5	43.9	86.1
Induced	1,119	54.8	88.9	163.2
Total	4,980	316.1	375.8	660.5

Government Revenues

Governmental revenues, usually based on tax collections, are another important measure of the economic impact of an industry on an economy. The petroleum industry in North Dakota, specifically oil and gas production, is responsible for substantial amounts of state and local government revenues. One distinction is that unlike many other industries in North Dakota, severance taxes (taxes placed on the value of oil and gas removed from the ground) collect money based on gross revenues produced by the industry. In contrast, taxation for most other industries is more traditional and usually limited to real property and net income. Another distinction that makes the petroleum industry different from other industries in the state is that governments can hold oil and gas leases and receive royalties from the value of oil and gas production. Of course, the petroleum industry also generates revenues from traditional sources, such as personal income, corporate income, sales and use, and property tax collections.

Severance taxes, sales and use taxes, personal income taxes, corporate income taxes, property taxes, royalties, lease bonuses, charitable donations, and licenses, fees, and permits combined for \$3.7 billion in government revenues that were directly attributable to the petroleum industry in North Dakota in 2019 (Figure 4). Severance taxes accounted for 66 percent of all government revenues from the petroleum industry in North Dakota in 2019. The second largest source was government royalties at 20 percent, followed by the most common general taxes (i.e., property, personal income, sales and use, and corporate income) at 10 percent. The remainder of government revenues represented lease bonuses, permits/fees/licenses, and miscellaneous revenues.



Economic activity from indirect and induced economic effects also create revenues for state and local governments. Secondary economic effects generated about \$135 million in state and local government revenues in 2017 with the dominate share being revenues from sales taxes (Table 12). Secondary economic effects generated about \$137 million in government revenues in 2019, with over \$51 million of the total representing sales tax collections.

Table 12. State and Local Government Revenues from Indirect and Induced Economic Activity, Petroleum Industry, North Dakota, 2015, 2017, and 2019

Year and Revenue Category	Industry Segment				
	Exploration and Development	Oil and Gas Production	Transp. and Processing	Infrastructure	Total
	----- 000s nominal \$ -----				
2015					
Corporate Income	2,624	4,877	581	517	8,598
Fines/Fees/Permits	1,465	2,649	372	290	4,776
Motor Vehicle	1,326	2,520	357	298	4,501
Miscellaneous	3,435	6,857	961	860	12,112
Personal Income	6,314	11,415	1,602	1,250	20,581
Property	6,529	13,937	2,012	1,908	24,386
Sales Tax	16,878	36,170	5,224	4,973	63,246
Social Insurance	826	1,497	209	165	2,697
Total	39,398	79,921	11,317	10,261	140,897
2017					
Corporate Income	468	889	5,447	112	6,915
Fines/Fees/Permits	982	1,939	1,353	238	4,512
Motor Vehicle	977	1,929	973	276	10,576
Miscellaneous	3,176	6,238	180	982	4,155
Personal Income	2,214	4,370	8,906	537	16,027
Property	9,259	18,277	1,721	3,089	32,346
Sales Tax	15,089	29,786	493	5,052	50,420
Social Insurance	3,129	6,153	432	758	10,472
Total					
2019					
Corporate Income	1,494	2,588	580	199	4,860
Fines/Fees/Permits	1,506	2,694	614	194	5,008
Motor Vehicle	1,161	2,187	525	171	4,044
Miscellaneous	3,177	6,252	1,568	532	11,529
Personal Income	4,188	7,492	1,708	539	13,927
Property	9,399	19,890	5,283	1,821	36,393
Sales Tax	13,184	27,900	7,410	2,554	51,048
Social Insurance	2,973	5,497	1,231	394	10,095
Total	37,083	74,449	18,920	6,403	136,905
Note: Appendix B contains description of tax categories and methodology used by IMPLAN to estimate government revenues.					

Total Economic Contribution

The petroleum industry in North Dakota was defined to include exploration and drilling, oil and gas production, transportation and processing, and infrastructure development. Direct impacts were based on industry sales, in-state expenditures, private and public royalties, taxes, lease bonuses, and expenditures retained in North Dakota for infrastructure development.

The petroleum industry's total economic contribution in 2019 was estimated at \$40.2 billion. About 75 percent of the industry's overall economic contribution was from oil and gas production (Table 13). Aside from impacts in the NAICS Oil and Gas Sector, employment and gross business volume were fairly evenly distributed among most two-digit NAICS groupings in North Dakota (Tables 14 and 15). [See Appendix E for more details on the distribution of economic activity across the state's key economic sectors].

Table 13. Total Economic Contribution, All Segments, Petroleum Industry, North Dakota, 2019					
Economic Metric and Type of Economic Effect	Industry Segment				Total
	Exploration and Drilling	Oil and Gas Production	Transp. and Processing	Infrastructure	
Employment ^a	----- jobs -----				
Direct	6,832	11,626	1,997	3,453	23,908
Indirect	5,656	9,120	1,790	408	16,974
Induced	5,386	9,879	1,803	1,119	18,187
Total	17,874	30,625	5,589	4,980	59,068
Employment Compensation	----- millions \$ -----				
Direct	861.4	1,376.1	154.1	228.8	2,620
Indirect	311.7	619.6	101.1	32.5	1,065
Induced	226.3	415.1	75.7	54.8	772
Total	1,399.4	2,410.8	330.9	316.1	4,457
Value-added	----- millions \$ -----				
Direct	1,582.7	19,667.0	552.1	243.0	22,045
Indirect	566.1	1,072.2	201.7	43.9	1,884
Induced	428.0	785.1	143.2	88.9	1,445
Total	2,576.8	21,524.3	897.0	375.8	25,374
Gross Business Volume	----- millions \$ -----				
Direct	3,843.6	27,430.3	2,890.3	411.2	34,575
Indirect	1,096.1	1,978.7	335.4	86.1	3,496
Induced	785.4	907.5	262.9	163.2	2,119
Total	5,725.1	30,316.5	3,488.6	660.5	40,191

^aEmployment estimates under IMPLAN modeling system will differ from estimates of direct employment using Job Service North Dakota (2014, 2015, 2016, 2017) designations.

Note: IMPLAN output for Indirect and Induced effects for all industry segments was adjusted to more closely align with employment distributions obtained from applying previous Job Service North Dakota (2016, 2017) delineations to current industry estimates. Those adjustments act to reduce the overall level of indirect and induced economic effects and increase the overall size of the direct impacts.

Table 14. Direct, Indirect, and Induced Employment, by Economic Sector, Petroleum Industry, North Dakota, 2019

NAICS code and Economic Sector		Industry Segments				Total
		Exploration and Drilling	Oil and Gas Production	Transp and Processing	Infrastruct-ure	
----- jobs -----						
11	Ag, Forestry, Fish & Hunting	28	40	8	6	82
21	Mining	6,860	11,647	868	4	19,380
22	Utilities	35	171	67	7	280
23	Construction	228	284	267	3,462	4,242
31-33	Manufacturing	62	96	405	67	631
42	Wholesale Trade	567	840	196	94	1,697
44-45	Retail trade	1,081	1,949	411	229	3,670
48-49	Transportation & Warehousing	482	1,250	1,116	96	2,944
51	Information	161	300	51	23	533
52	Finance & Insurance	1,470	1,985	230	102	3,787
53	Real Estate & Rental	667	1,062	153	87	1,969
54	Professional, Scientific & Technical Services	1,554	2,754	225	85	4,618
55	Management of Companies	192	837	79	11	1,119
56	Administrative & Waste Services	876	1,246	293	68	2,483
61	Educational Services	1,315	2,412	440	273	4,441
62	Health & Social Services	114	206	39	24	383
71	Arts, Entertainment & Recreation	210	378	66	39	693
72	Accommodation & Food Services	1,082	1,620	323	152	3,177
81	Other Services	807	1,269	313	138	2,527
92	Government	82	279	40	13	415
Totals		17,874	30,625	5,589	4,980	59,068

Table 15. Gross Business Volume, by Economic Sector, Petroleum Industry, North Dakota, 2019

NAICS code and Economic Sector		Industry Segments				Total
		Exploration and Drilling	Oil and Gas Production	Transp and Processing	Infrastruct- ure	
----- millions \$ -----						
11	Ag, Forestry, Fish & Hunting	3	3	1	1	7
21	Mining	3,860	27,441	84	1	31,386
22	Utilities	39	165	66	8	278
23	Construction	52	59	52	413	577
31-33	Manufacturing	25	33	2,653	19	2,729
42	Wholesale Trade	181	236	71	28	517
44-45	Retail trade	92	108	35	20	255
48-49	Transportation & Warehousing	63	267	205	14	549
51	Information	59	89	17	8	173
52	Finance & Insurance	362	469	56	27	914
53	Real Estate & Rental	291	361	63	38	754
54	Professional, Scientific & Technical Services	235	368	30	13	645
55	Management of Companies	41	177	15	2	235
56	Administrative & Waste Services	74	103	22	6	205
61	Educational Services	163	189	55	34	441
62	Health & Social Services	6	7	2	1	16
71	Arts, Entertainment & Recreation	13	16	4	2	34
72	Accommodation & Food Services	70	74	20	10	173
81	Other Services	76	83	28	12	199
92	Government	19	68	10	3	101
Totals		5,725	30,317	3,489	660	40,191

COMPARISON OF PREVIOUS INDUSTRY ASSESSMENTS

The first comprehensive economic evaluation of the petroleum industry in North Dakota, conducted in 2006, was reflective of conditions present in the industry in calendar year 2005 (Bangsund and Leistritz 2007). Biennial assessments have been conducted since the 2005 study (Bangsund and Leistritz 2009, 2010; Bangsund and Hodur 2013, 2015, 2017, 2019). The results reported in this study were based on conditions present in the industry in calendar year 2019.

Biennial assessments from 2005 through 2019 have documented the meteoric rise in economic output as the industry ramped up development of shale oil resources and have measured the precipitous drop in output as the industry contracted from a price collapse at the end of 2014.

Methods and data sources among the eight studies had undergone several refinements in data collection and estimation techniques since the first economic assessment in 2005. In the 2007 study, a separate survey of lease/brokerage firms was initiated to help generate estimates of in-state lease bonuses on private land in North Dakota. Firms providing oil field services were not surveyed in the 2007, 2013, 2015, 2017 and 2019 studies, but those firms were surveyed in the 2005, 2009, and 2011 studies. Detailed data on input sourcing for well drilling and well completions were obtained from oil operators to examine economic leakage associated with well drilling and well completion activities in the 2011 study and the same information was solicited in the 2019 study. Also, estimates of in-state mineral royalty revenues in 2011 were refined based on payment data obtained from oil operators in the state. Finally, the 2011 study collected survey data on infrastructure spending by the industry. The 2013 study expanded the survey of firms to include rail loading facilities. The 2013 and 2015 studies used data from Job Service North Dakota to estimate direct employment in the industry, rather than develop estimates from survey or other secondary data.

The largest change in the data and methods are found with the 2017 and current study. In previous studies, various revenue streams to the state (e.g., spending by the industry for inputs, payroll, and selected government revenues) were estimated using a combination of survey data and information from secondary sources. The primary tool to estimate how those dollar flows affected the state's economy in the previous six studies was the ND Input-output Model. Prior to running inputs through the model, adjustments were made to expenditure data to obtain estimates of only in-state expenditures.

The 2017 and the current study use the IMPLAN modeling system. Many of the revenue flows estimated in the previous studies were retained, and used to shape the economic profile for several economic sectors within IMPLAN. IMPLAN's analytical structure includes many of the elements used in the previous studies, but combines them in a more comprehensive manner and in a manner more closely reflecting the information in the National Income and Product Accounts produced by the U.S. Bureau of Economic Analysis. Further, IMPLAN initiates the economic analysis using sector revenue or sales; this is a departure from the previous studies' methodologies.

Also, this study accesses the underlying I-O matrix data for North Dakota. The dataset obtained from IMPLAN contains data not previously used in the 2005 through 2015 economic contribution studies. While many of the data sources in previous studies were retained in this study, the switch from the ND Input-Output Model to the IMPLAN modeling system does produce different estimates of economic output. As a result of those differences, data from the 2015 study and the 2015 IMPLAN input-output matrix were used to reconstruct the 2015 study economic contribution estimates using IMPLAN as the modeling platform. The goal of producing 2015 estimates using IMPLAN was to allow a more effective comparison of recent economic contributions from the petroleum industry that are more reflective of changes in industry output than changes in modeling platforms (Table 16).

Table 16. Key Economic Values, Petroleum Industry, North Dakota, Selected Years 2005 through 2019

Category	2005 ^a	2007 ^a	2009 ^a	2011 ^a	2013 ^a	2015 ^a	2015 ^b	2017 ^b	2019 ^b
----- millions nominal \$ -----									
Direct Effects									
Exploration and Drilling	445.1	1,536.3	2,802.7	6,141.1	7,609.4	5,301.0	5,733.9	3,381.4	3,843.6
Oil and Gas Production	819.8	1,308.4	1,799.4	3,976.6	7,676.8	6,211.1	19,964.0	22,214.6	27,430.3
Transp. and Processing	132.5	261.7	310.8	475.0	812.6	1,204.4	2,357.1	2,270.8	2,890.3
Infrastructure	not estimated	not estimated	not estimated	1,143.0	1,463.4	1,142.3	852.1	577.5	411.2
Total	1,397.4	3,106.4	4,912.9	11,736.7	17,562.2	13,858.9	28,907.1	28,444.3	34,575.4
Indirect and Induced Effects^c									
Exploration and Drilling	775.0	2,721.4	4,727.8	10,697.5	12,788.5	8,868.9	2,685.0	1,071.6	1,881.5
Oil and Gas Production	1,408.4	1,956.3	2,455.7	4,672.6	7,668.3	6,345.2	3,150.6	2,235.8	2,886.2
Transp. and Processing	238.1	445.5	566.3	895.1	1,510.0	2,241.8	462.1	566.1	598.3
Infrastructure	not estimated	not estimated	not estimated	2,419.0	3,098.6	2,414.6	394.2	299.4	249.3
Total	2,421.5	5,123.2	7,749.8	18,685.2	26,065.4	19,870.5	6,691.9	4,172.9	5,615.3
Gross Business Volume									
Exploration and Drilling	1,220.1	4,257.7	7,530.5	16,838.6	20,397.9	14,169.9	8,418.8	4,453.0	5,725.1
Oil and Gas Production	2,228.2	3,264.7	4,255.0	8,649.2	15,345.1	12,556.3	22,561.8	24,450.4	30,316.5
Transp. and Processing	370.6	707.2	877.1	1,370.1	2,322.6	3,146.2	2,819.3	2,836.8	3,488.6
Infrastructure	not estimated	not estimated	not estimated	3,562.0	4,562.0	3,556.8	1,246.3	876.9	660.5
Total	3,818.9	8,229.6	12,662.6	30,419.9	43,627.6	33,729.3	35,991.1	32,617.2	40,190.7
Government Revenues	336.3	629.8	1,010.1	2,647.8	4,496.8	3,362.6	3,167.1	2,881.5	3,825.3
----- jobs -----									
Total Jobs Supported in ND^d	20,022	29,425	36,057	59,559	81,407	72,353	72,353	51,428	59,068

^a Estimated using North Dakota Input-Output Model and associated methodologies.

^b Estimated using IMPLAN modeling platform and associated methodologies.

^c Indirect and induced effects in the IMPLAN analysis for 2015, 2017, and 2019 were adjusted downward to reflect the treatment of indirect business activity being counted as direct activity. The adjustments were conducted so that economic output would be similar and consistent with the differences between employment from the Job Service North Dakota (2016, 2017) studies and employment using traditional Input-output analysis.

^d Employment estimates in 2005, 2007, and 2009 were based on North Dakota Input-Output model's economic base dataset. Estimates in subsequent years used traditional input-output approaches examining indirect and induced effects for supporting secondary employment in combination with information from Job Service North Dakota (2014, 2015, 2016, 2017).

SUMMARY and CONCLUSIONS

Over the past decade, the adoption of new technologies to extract oil and gas from shale has made the petroleum industry one of the largest single basic-sector industries in the state. This study represents the eighth study to measure the economic contribution of petroleum industry activities on North Dakota's economy.

The purpose of this study was to estimate the economic contribution of the petroleum industry in North Dakota in 2019. The petroleum industry was defined to include exploration/development, extraction/production, transportation, and processing of crude oil and natural gas. Also included in this study was an assessment of capital expenditures for infrastructure projects.

In previous studies, only money spent in North Dakota by companies involved in the petroleum sector was included in the study and represented the direct impacts of the industry. This study used the IMPLAN modeling system which uses industry sales to represent the direct impacts of the industry. These changes, and other differences between the previous study's methodologies, make detailed comparisons between the two methodologies challenging. The input-output analysis in this study was modified to be more consistent with Job Service North Dakota employment estimates of direct employment in the industry.

Exploration and drilling was estimated to have a \$5.7 billion economic contribution to the state, and was estimated to support 17,900 jobs. Statewide employment compensation from exploration and drilling was estimated at \$1.4 billion.

Oil and gas production was estimated to have a \$30.3 billion economic contribution to the state, and was estimated to support 30,600 jobs. Statewide employment compensation from oil and gas production was estimated at \$2.4 billion.

The processing and transportation component of the petroleum industry was estimated to have an economic contribution in the state of \$3.5 billion. Statewide, transportation and processing of crude oil and natural gas supported about 5,600 jobs having \$330 million in employment compensation.

Infrastructure expenditures in the IMPLAN modeling system are not contained within an industry's intermediate inputs, and are modeled separately from other sectors of the industry. Development of infrastructure was estimated to support 4,900 jobs statewide and have an economic contribution of \$660 million.

Overall, the industry was estimated to support 59,100 jobs in the state having a \$4.45 billion payroll. The industry's economic contribution was estimated at \$40.2 billion in 2019. The industry was estimated to contribute \$25 billion to North Dakota's gross state product. The industry was responsible for \$3.8 billion in local and state government revenues.

Regardless of the economic measure used, the petroleum industry is one of the largest basic-sector industries in North Dakota, even though the economic size of the industry has not rebounded to the historical peak in 2014. Current activity levels in the petroleum industry clearly make it one of the key forces in the North Dakota economy.

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<https://www.bls.gov/bls/proghome.htm#employment> U.S. Bureau of Economic Analysis, U.S. Department of Labor, Washington, D.C.
- U.S. Department of Energy. 2020. <http://www.eia.doe.gov/> Energy Information Administration, U.S. Department of Energy, Washington, D.C.

The graphic consists of a vertical dark blue bar on the left. A blue arrow points from this bar to the right, containing the text 'Appendix A'. To the right of the arrow is a large yellow rectangle with a light-to-dark gradient, containing the text 'Survey Questionnaires'.

Appendix A

Survey Questionnaires

Economic Contribution of the Petroleum Industry to North Dakota

Survey of Oil Operators

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

This survey is being conducted by the **Department of Agribusiness and Applied Economics** at NDSU

Instructions and Guidelines for Filling Out the Questionnaire

Data provided from this survey will be used to help estimate the economic contribution of the oil industry to the North Dakota economy. The goal is to determine how much money the oil industry spends in North Dakota. All expenditure data will be synthesized in a manner that only industry-wide totals will be reported. In no way will any information presented in the study identify or be reflective of any single firm or operation.

The following is a list of general guidelines for the questionnaire.

1. Use information from 2017 or your most recently completed fiscal year.
2. Expenditures should be expressed in U.S. dollars.
3. If the actual amount of the expenditure is not easily determined or is not readily known, please provide an estimate of the expense.
4. For contractor expenditures (Part II of this questionnaire), please include all expenditures made for services provided in North Dakota, even if the office or headquarters of the contractor or service provider is not located in North Dakota.
4. For infrastructure expenditures (Part III of the questionnaire), include costs associated with the various categories for 2017.
5. For general expenditures for day-to-day operations (Part IV of the questionnaire), include only how much your company paid out to entities in North Dakota.
6. If you cannot identify whether an expenditure was made in North Dakota or in another state, indicate this on the form.
7. Definitions for some expenditure items and their corresponding Standard Industrial Classification (SIC) code listing are included to help in determining allocation of expenditures.
8. Please complete the survey by **September 15th, 2018** and mail the questionnaire in the return envelope.
9. If you have questions, please contact:

Dean Bangsund 701-231-7471

Email: d.bangsund@ndsu.edu

or

Dr. Nancy Hodur 701-231-7357

Email: nancy.hodur@ndsu.edu

Department of Agribusiness and Applied Economics

North Dakota State University

Fargo, ND 58108-6050

Part I - - General Information

Business Name: _____

Mailing Address: _____

The following questions pertain only to wells for which your company is the operator.

Number of producing oil wells in ND in 2017 for which your company was the operator _____		
	Oil	Gas
Total production from your operated wells in 2017	_____ bbls	_____ mcf
Operator interest share of production	_____ %	_____ %
All royalty interest share of production	_____ %	_____ %
Remaining working interest share of production	_____ %	_____ %

Total number of employees working in North Dakota: _____ (Full-time equivalents)	
Number of jobs (FTE's) above dedicated to exploration/drilling	_____
Number of jobs (FTE's) above dedicated to general production/extraction	_____

Part II. Payments made to Contractors, Sub-contractors, and Consultants

The following instructions pertain to **Part II** of the Questionnaire.

- 1) Only report contracted expenses for wells in North Dakota for which your company serves as the operator even if your company's stake in those wells is small. Do not include expenses for wells for which your company only has a working interest share—those expenses will be reported by other oil operators.
- 2) Please include the total cost for the contracted service for those wells. The total cost will include your company's share of the costs as well as the costs billed to the working interest holders on the well.
- 3) Please indicate expenses for producing wells, wells currently being drilled, and wells that were drilled, but never used.
- 4) Only include contracted expenses for the last year.
- 5) Please include all expenditures made for services provided in North Dakota, even if the office or headquarters of the contractor or service provider is not located in North Dakota.

Part II. Type of Contracting Work Performed	Payments for work done in North Dakota
General Exploration Examples of services include lease brokerage costs (lease arrangements and landowner negotiations), landman expenses, environmental services, seismic testing and geological research	\$
Drilling Activities (Capital Investments) Examples of services include land survey work, excavation, road building, construction of drill site, other drill site preparations such as providing electricity, setting up storage facilities, etc., erecting derrick, mudding operations, spudding operations, wellbore casing, case perforation, logging, fracing services, wellhead placement, pipeline development and construction, and any other services provided that are associated with drilling activities This category of expenses should include all phases of drilling for both primary wells and secondary/tertiary/EOR injection wells	\$
Oil and Gas Extraction and Production (Operating Expenses) Examples of services include pump, well, and storage tank maintenance and servicing; daily & weekly well visits for tank switching, periodic inspections, general monitoring, and other activities; well stimulations; well work overs; well idling, shutdown, and/or abandonment activities	\$
Transportation Include expenses for <u>truck transportation</u> of oil from well site to pipeline collection points (terminal) and expenses for truck transportation of other products and by-products from well site to secondary locations, also include all charges for transportation of gas and oil <u>by pipeline or rail</u> until products are sold to a purchaser or buyer	\$
Any other services or activities provided by contracted arrangements not listed above: <div> <div>_____ (please specify)</div> <div>_____ (please specify)</div> <div>_____ (please specify)</div> <div>_____ (please specify)</div> </div>	<div> <div>\$ _____</div> <div>\$ _____</div> <div>\$ _____</div> <div>\$ _____</div> </div>

Part III. This section relates to your company's expenses associated with infrastructure development in North Dakota. To avoid double counting, do not include any expenditures here that are reported in Part II dealing with exploration, drilling/well development, or operating expenses. Please report total expenditures in 2017 for the following categories with respect to infrastructure in North Dakota. Figures can be rounded to thousands.

If your company had no expenses in a particular category, please enter zero.

Infrastructure Categories	Expenses for projects in North Dakota in 2017
Oil Field Gathering Systems Construction of oil pipeline gathering systems (field systems) to move crude oil to transmission pipelines or rail facilities.	\$
Gas Midstream Projects Construction of gas gathering systems, construction of gas plants, construction of fractionation facilities, and pipelines for distribution of gas to main pipelines.	\$
Oil Shipment Facilities Facilities for shipment of crude oil, including pipeline capacity enhancements, rail loading facilities, and any storage facilities associated with those facilities.	\$
Water Treatment Facilities Construction expenses for water disposal facilities, frac water recycling facilities, and any distribution systems (in-field pipelines) for movement of frac and brine water to treatment or disposal facilities.	\$
Housing and Lodging Include expenses associated with the construction/development of man camps, lodging facilities at work sites, and construction of other housing projects (e.g., company owned apartments and houses). NOTE: please include all lodging expenses for actual housing of workers (motel rooms, meals, other arrangements) that are not related to constructing housing infrastructure in Section II.	\$
Office and Other Facilities Expenditures for construction/development of company offices, central facilities, maintenance facilities, and holding/transit facilities.	\$
Other Facilities Please specify	\$

Part IV. The following expenses relate to your company's general business operations in North Dakota and should represent expenses paid only to North Dakota entities. These expenses should not include any payments made to oil industry contractors or consultants associated with exploration or extraction. Please refer to the accompanying sheet for definitions and clarification of what expenses should be included in the expenditure categories.

If your company had no expenses in a particular category, please enter zero.

General Business Expenses	Expenses paid to North Dakota entities
Building and equipment leases (e.g., office space, vehicles)	\$
Business and personal services	\$
Professional and social services	\$
Communications	\$
Construction	\$
Public utilities	\$
Employee wages and salaries	\$
Employee benefits (retirement, health insurance, etc.)	\$
Payroll taxes (FICA, etc.)	\$
Insurance	\$
Interest, finance, and banking expenses	\$
Retail trade	\$
Wholesale trade	\$
Research and development	\$
North Dakota taxes:	
Property	\$
Income	\$
Sales and use	\$
Transportation (note: pipeline expenses should be reported in Part II)	\$
Any miscellaneous payments to working interests	\$
Any miscellaneous payments to royalty interests	\$
Other expenses (please specify).	\$

Definitions for Expenditure Categories—Part III of Questionnaire

The following definitions are derived from Standard Industrial Classification Manual (SIC codes) and have been provided to assist in allocating expenses into common categories. If needed, please refer to the following web site for additional examples of the expenses included in each category: http://www.osha.gov/pls/imis/sic_manual.html Each category has several Major Group numbers, which contain additional detail on the type of activities in each category.

Construction: Includes expenses for construction projects, such as construction (including new work, additions, alterations, remodeling, and repairs) of residential, industrial, public, office, warehouse, and other buildings and structures. (Major Groups 15, 16, and 17)

Transportation: Includes expenses for railroad, motor freight, water transportation, air transportation, and other transportation to include packing and crating services, and rental of transportation equipment. (Major Groups 40, 41, 42, 43, 44, 45, 46, and 47)

Communications: Includes expenditures for telephone, telegraph, radio, television, satellite services, Internet transactions, and other communication services. (Major Group 48)

Public Utilities: Includes expenses for natural gas, electricity, water supply, and sanitary (sewer & garbage) services. (Major Group 49)

Wholesale Trade: Expenses paid to establishments primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, or professional users; or to other wholesalers, or acting as agents in buying merchandise for or selling merchandise to such persons or companies. (Major Groups 50 and 51)

Retail Trade: Includes expenses for building materials, hardware, food, general merchandise, office supplies, automobile fuel, computers, eating and drinking establishments, work uniforms, and most other business and office-related supplies. (Major Groups 52, 53, 54, 55, 56, 57, 58, and 59)

Finance, Insurance, and Real Estate: Includes expenses for loan service, interest on loans, investment counseling, insurance, real estate transactions, brokerage fees, and any other financial service expenditures. (Major Groups 60, 61, 62, 63, 64, 65, 66, and 67)

Business and Personal Services: Examples of business and personal services include expenses for advertising, collection services, photocopying/duplication/printing services, equipment rental, computer services, computer software, security services, tax preparation, automotive/equipment/miscellaneous repairs, entertainment, janitorial services, and overnight lodging. (Major Groups 70, 72, 73, 75, 76, 78, 79, and 87)

Professional and Social Services: Includes expenses for health/pharmaceutical, medical, legal, educational, research and development, child care, vocational training, and other professional services. (Major Groups 80, 81, 82, 83, 84, 86, 88, and 89)

Part V. Drilling Activity in North Dakota. Please summarize your company's drilling activities in North Dakota over the past year.

Drilling	2017
Overall number of wells drilled	
Number of wells drilled that were plugged (dry holes)	
Number of wells drilled that went into production (completed as a producer)	

Part VI. Mineral Royalty Payments. This section is looking for total private mineral royalty payments and mineral payments mailed to entities in North Dakota.

Payments to Private Mineral Royalty Owners	2017
<p>Gross Payment of mineral royalties to all private mineral owners associated with oil and gas wells in North Dakota</p> <p>Note: Only include payments to private mineral owners, <u>exclude</u> payments to working interests and public mineral owners (e.g., state, Federal).</p>	
<p>Gross Payments for private mineral royalties that went to North Dakota addresses</p> <p>Note: This is the portion of the payment above that went to some entity (person, bank, trust) in North Dakota.</p>	

Part VII. List of Contractors/Venders. Please provide the name and mailing address of all companies that your firm has contracted with over the last year to perform work in the oil fields in North Dakota. Please include all companies even if they do not have a North Dakota address. If a computer listing is not available, please use the following space to provide the information.

Name of Company

Address (street, city, state, zip)

This image shows a single page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, leaving small margins at the top and bottom. There are no vertical margin lines, and the page is completely blank except for the lines themselves.

Please add sheets or attach printouts as needed.

Thank You for completing this questionnaire!

Please return the questionnaire in the postpaid envelope.

If you would like a copy of the study results mailed to you, make sure you have provided a mailing address in Part I of the questionnaire. Otherwise, you may 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://ageconsearch.umn.edu/>

Study results should be available at the end of 2018.

Economic Contribution of the Petroleum Industry to North Dakota

Survey of Midstream Operations

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

This survey is being conducted by the **Department of Agribusiness and Applied Economics** at **NDSU**

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 or most recent year end.
2. Do not include expenditures for inputs/services purchased last year for this year's operations.
3. If information is not readily available, please estimate.
4. Definitions for selected expenditure items are included to help in determining allocation of expenditures.
5. Please complete the survey by September 14, 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

Contribution of Petroleum Industry to North Dakota

Survey of Midstream Operations

Company: _____

Contact Person: _____

Email: _____ Phone: _____

Part I: General Characteristics of Operations in ND

Many firms have more than one midstream operation in ND. We are looking to identify all of the operations your firm has in ND.

Please provide some measure of the physical size or output of your midstream operations in ND.

Operations in ND	Measure of Size	
Gas plants/processing	MMcf gas processed/yr	
Field gathering systems (oil, gas, water)	Volumes collected and moved (bbls, mcf, bbls)	
Intra- and/or Inter-state crude oil pipelines (excluding gathering lines)	Bbls shipped/yr	
Intra- and/or inter-state gas pipelines (excluding gathering lines)	MMcf shipped/yr	
Crude oil refining	Bbls processed/yr	
Rail loading/truck loading terminals	Bbls loaded/yr	
Operation of water disposal/injection wells	Bbls injected/yr	

Part II: General Financial Characteristics

Included below are confidential questions on financial characteristics of the midstream operations identified in the previous section.

Do not include capital expenditures in this section—those expenditures should be placed in Part III of this questionnaire.

Each midstream component has a separate one-page form identifying the key data for this study.

We understand for firms that have more than one midstream operation in ND or for those firms that have operations crossing state borders (pipelines), it may not be clear how to separate some administrative and centralized business expenses among those operations. In those cases, please use your best judgement --a general estimate is sufficient.

In looking at what share of expenses are from ND sources, think of where your firm's vendors and suppliers are located. For example, if your firm was billed for a particular service from a firm located in ND then 100% of that particular expense would be considered from ND sources. If your firm shipped in pipe or replacement valves from a company in Oklahoma or Texas, then 0% of that expense would qualify as being from ND sources.

The information provided in the following sheets will be aggregated and extrapolated to produce state totals. The result of that process prevents any single firm or facility location from being identified in the economic impact figures.

Gas Plants in ND			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Gas Plants			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities for Processing			
Natural Gas (include natural gas liquids)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)		Total Expenditure for Operating Gas Plants in ND	Acquired from North Dakota Sources
Examples: Equipment		\$250,000	30%
Electricity		\$80,000	95%
Utilities (electricity, gas, water, sewer, garbage)		\$	%
Repairs and Maintenance		\$	%
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)		\$	%
Contracted Services (advertising, legal, payroll, security, IT support, engineering)		\$	%
Office Expenses, Computers, Software, Communications		\$	%
Rents, Leases, Loan Interest		\$	%
All other expenses		\$	%
		\$	%
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, FICA, and Workforce Safety Insurance contributions.			

Oil Pipelines in ND			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Crude Oil Pipelines			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities for Delivery			
Crude Oil (if not applicable please enter NA)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)		Total Expenditure for Operating Crude Oil Pipelines in ND	Acquired from North Dakota Sources
Examples: Equipment		\$250,000	30%
Electricity		\$80,000	95%
Utilities (electricity, gas, water, sewer, garbage)		\$	%
Repairs and Maintenance		\$	%
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)		\$	%
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)		\$	%
Office Expenses, Computers, Software, Communications		\$	%
Rents, Leases, Loan Interest		\$	%
All other expenses		\$	%
		\$	%
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Gas Transmission Pipelines in ND			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Gas Pipelines			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities for Delivery			
Natural Gas (if not applicable please enter NA)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)	Total Expenditure for Operating Gas Transmission Pipelines in ND		Acquired from North Dakota Sources
Examples: Equipment	\$250,000	30%	
Electricity	\$80,000	95%	
Utilities (electricity, gas, water, sewer, garbage)	\$	%	
Repairs and Maintenance	\$	%	
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)	\$	%	
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)	\$	%	
Office Expenses, Computers, Software, Communications	\$	%	
Rents, Leases, Loan Interest	\$	%	
All other expenses	\$	%	
	\$	%	
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Oil Refining and Processing in ND			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Refineries			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities for Processing			
Crude Oil			\$
Other (please specify _ _)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)		Total Expenditures in ND	Acquired from North Dakota Sources
Examples: Equipment Electricity		\$250,000 \$80,000	30% 95%
Utilities (electricity, gas, water, sewer, garbage)		\$	%
Repairs and Maintenance		\$	%
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)		\$	%
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)		\$	%
Office Expenses, Computers, Software, Communications		\$	%
Rents, Leases, Loan Interest		\$	%
All other expenses		\$	%
		\$	%
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Gathering Systems in ND			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Gathering Systems			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities			
Crude Oil (if not applicable please enter NA)			\$
Natural Gas (if not applicable please enter NA)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)	Total Expenditures for Gathering Systems in ND		Acquired from North Dakota Sources
Examples: Equipment Electricity	\$250,000 \$80,000		30% 95%
Utilities (electricity, gas, water, sewer, garbage)	\$		%
Repairs and Maintenance	\$		%
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)	\$		%
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)	\$		%
Office Expenses, Computers, Software, Communications	\$		%
Rents, Leases, Loan Interest	\$		%
All other expenses	\$		%
	\$		%
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Rail Loading Facilities			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Rail Loading Facilities			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Raw Commodities			
Crude Oil (if not applicable please enter NA)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)	Total Expenditures for Rail Loading Facilities in ND		Acquired from North Dakota Sources
Examples: Equipment Electricity	\$250,000 \$80,000		30% 95%
Utilities (electricity, gas, water, sewer, garbage)	\$	%	
Repairs and Maintenance	\$	%	
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)	\$	%	
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)	\$	%	
Office Expenses, Computers, Software, Communications	\$	%	
Rents, Leases, Loan Interest	\$	%	
All other expenses	\$	%	
	\$	%	
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Disposal Wells			
General Financial Operating Characteristics in 2017			
Gross Revenue from Operation of Disposal Wells			\$
Payroll	Number	Wages and Salaries ¹	Benefits ²
Full-time jobs		\$	\$
Part-time and seasonal		\$	\$
Purchases of Commodities			
Brine/waste water (if not applicable please enter NA)			\$
Taxes Paid in North Dakota (please exclude payroll taxes)			
Property Tax			\$
Sales and Use			\$
Corporate Income			\$
Others (please list)			\$
General Operating, Facility, and Overhead Expenditures (please <u>exclude</u> commodities, payroll, and ND taxes)	Total Expenditures for Disposal Wells in ND		Acquired from North Dakota Sources
Examples: Equipment Electricity	\$250,000 \$80,000		30% 95%
Utilities (electricity, gas, water, sewer, garbage)	\$	%	
Repairs and Maintenance	\$	%	
Equipment (vehicles, electric motors, pumps, storage tanks, pipe, valves, etc.)	\$	%	
Contracted Services (advertising, legal, payroll, security, IT support, reclamation, engineering)	\$	%	
Office Expenses, Computers, Software, Communications	\$	%	
Rents, Leases, Loan Interest	\$	%	
All other expenses	\$	%	
	\$	%	
¹ Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Please exclude payroll benefits. ² Includes payments for health, dental, and vision insurance, retirement contributions, unemployment taxes, and Workforce Safety Insurance contributions.			

Part III: Infrastructure Expenditures

This section relates to your company's expenses associated with infrastructure development in North Dakota. To avoid double counting, do not include any expenditures here that are reported as general operating expenses. Please report total expenditures in 2017 for the following categories with respect to infrastructure in North Dakota. Figures can be rounded to thousands.

If your company had no expenses in a particular category, please enter zero.

Infrastructure Categories	Expenses for projects in North Dakota in 2017
Oil Field Gathering Systems Construction of oil pipeline gathering systems (field systems) to move crude oil to transmission pipelines or rail facilities.	\$
Gas Midstream Projects Construction of gas gathering systems, construction of gas plants, construction of fractionation facilities, and pipelines for distribution of gas	\$
Oil Shipment Facilities Facilities for shipment of crude oil, including pipeline capacity enhancements, rail loading facilities, and any storage facilities	\$
Water Treatment Facilities Construction expenses for water disposal facilities, frac water recycling facilities, and any distribution systems (in-field pipelines) for movement of frac and brine water to treatment or disposal facilities.	\$
Housing and Lodging Include expenses associated with the construction/development of man camps, lodging facilities at work sites, and construction of other housing projects (e.g., company owned apartments and houses). NOTE: please include all lodging expenses for actual housing of workers (motel rooms, meals, other arrangements) that are not related to	\$
Office and Other Facilities Expenditures for construction/development of company offices, central facilities, maintenance facilities, and holding/transit	\$
Other Facilities	\$

Thank You for completing this questionnaire!

Please return the questionnaire in the postpaid envelope.

If you would like a copy of the study results mailed to you, make sure you have provided a mailing address in Part I of the questionnaire. Otherwise, you may 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

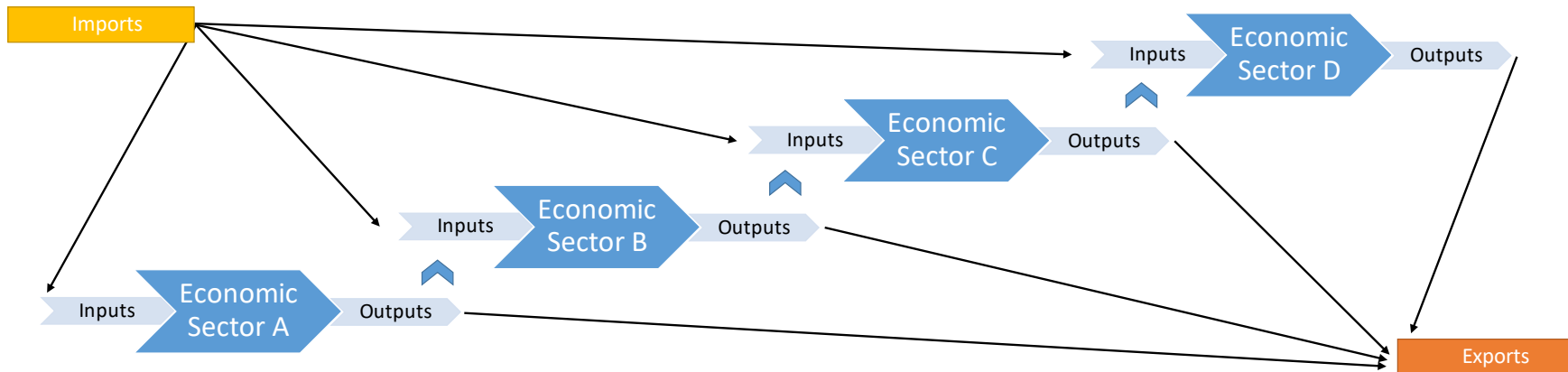
Input-output analysis is a mathematical representation of the production and consumption of goods and services within a given economy. The basic premise to input-output modeling can be traced to economic base theory, or the understanding that a given economy is comprised of both 1) economic sectors or 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.

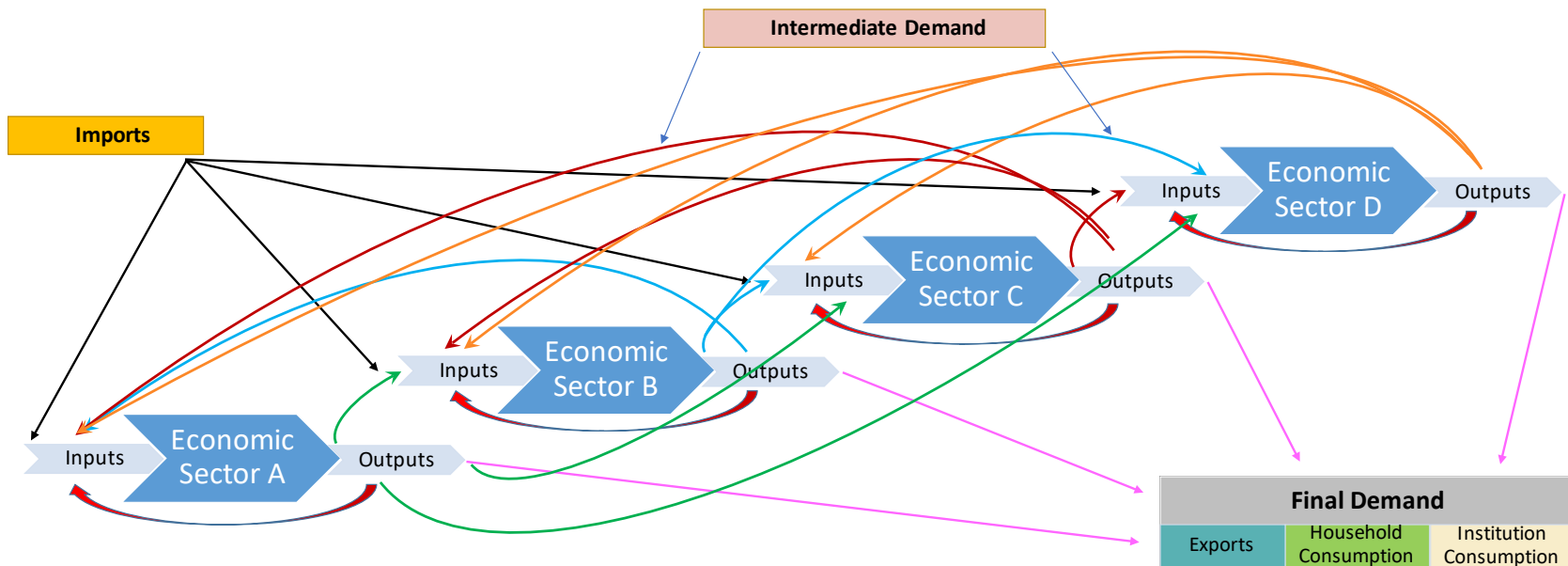
While input-output analysis is a popular methodology used by a host of different stakeholders, the methodology has a number of fundamental assumptions or limitations. Key assumptions in input-output methodologies include 1) the economy is in equilibrium, 2) any expansion or contraction is linear, constant, 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.

Economic sectors are linked through production and consumption and economies are not self-contained



Tracking consumption and production is best handled using a matrix



		List of Consuming Sectors (called Industries)						Institutions (considered Final Users)					
		Industry A	Industry B	Industry C	Industry D	Industry E	Industry (n)	Private Consumption	Private Investment	Net Exports	Gov't	Total	
List of Producing Industries (called Commodities)	Industry A	Intermediate Inputs						Final Use (Final Demand)					Total Gross Output
	Industry B												
	Industry C												
	Industry D												
	Industry E												
	Industry (n)												
	Labor Compensation	Value-added						GDP					
	Taxes												
	Gross Surplus												
	Total	Total Gross Output											

Each industry is measured for its production and for its consumption.

Rows are dollars spent on commodities (goods and services) by other economic sectors, households, and government.

Total gross output is the market value of all commodities and goods produced—total production must equal total consumption.

Column totals are expenditures (purchases) for commodities (goods and services), labor, and taxes.

GDP can be measured by examining consumption (sum of rows) or through the net value-added from production (sum of columns).

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.

When comparing these economic analyses, it is important to know what type of study was conducted so valid comparisons can be made. For a detailed discussion of these types of analyses, see Leistritz (1994) and Leistritz (1998).

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.

Proprietor Income: Income to individuals associated with sole proprietorships, partnerships, tax-exempt cooperatives, or other self-employment. Does not include any dividends, interest, or rental income, but does include capital consumption allowance found on Federal Tax form 1040C. Individuals receiving Tax Forms 1099 would be counted as sole-proprietors and compensation would be treated as proprietor income.

Labor Income: Labor income is often interchanged with employment compensation, but labor income is a broader measure of payments to labor since it includes employment compensation and proprietor income.

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.

Other Property-type Income: These economic values can be defined as Gross Operating Surplus less Proprietor Income (BEA defines GOS as gross output less intermediate inputs, employee compensation, and taxes on production and imports less subsidies). The consumption of fixed capital (i.e., capital outlays for most depreciable assets) is included, along with corporate profits and business transfer payments (net of government subsidizes).

Indirect Business Taxes: Can be generally considered as the sum of sales, property, and excise taxes. This category also includes fines, licenses, permits, and fees. Another perspective is that

the category of indirect business taxes are those taxes/nontax liabilities (i.e., any business liability to governments than are treated like a tax) that can be included as business expenses when estimating business profit.

Selection of Input-output Model

The Department of Agribusiness and Applied Economics at NDSU developed an I-O model for North Dakota that dates back to the 1960s and was an important 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), 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 adopt 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) specialized 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 updates 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 is supported with detailed baseline data, and cost was not prohibitive.

IMPLAN Modeling System

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 2013). IMPLAN can be structured to evaluate economic effects through a number of model operations. Those operations range from 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].

Major Data Sources, IMPLAN Modeling Platform, Economic Information		
Agency	Program	Data Set(s)
U.S. Bureau of Labor Statistics	Unemployment Insurance Covered Employment and Wages Program	CEW (ES-202)
	Consumer Expenditure Survey	CE LABSTAT
U.S. Bureau of Economic Analysis	National Income and Product Accounts Regional Economic Accounts Benchmark I-O Accounts	SA7, SA27, SA06, SA05, SA25, CA05, CA06, CA25, KLEM
U.S. Census Bureau	Numerous Census Surveys and Programs	ACES, ARTS, ASE, ASM, APES, ASPP, STC, AWTs, BES, COG, CBP, CIR, EC, IA, GUS, ICT, MHS, NES, QTAX, SAS
	Construction Definitions and Spending	
	Decennial Census and Population Surveys	CPS, Decennial Census, ACS
USDA -- National Agricultural Statistics Service, and Economic Research Service	Quinquennial Assessments and Annual Surveys	Census of Agriculture Annual Agricultural Statistics Agriculture Resource Management Survey

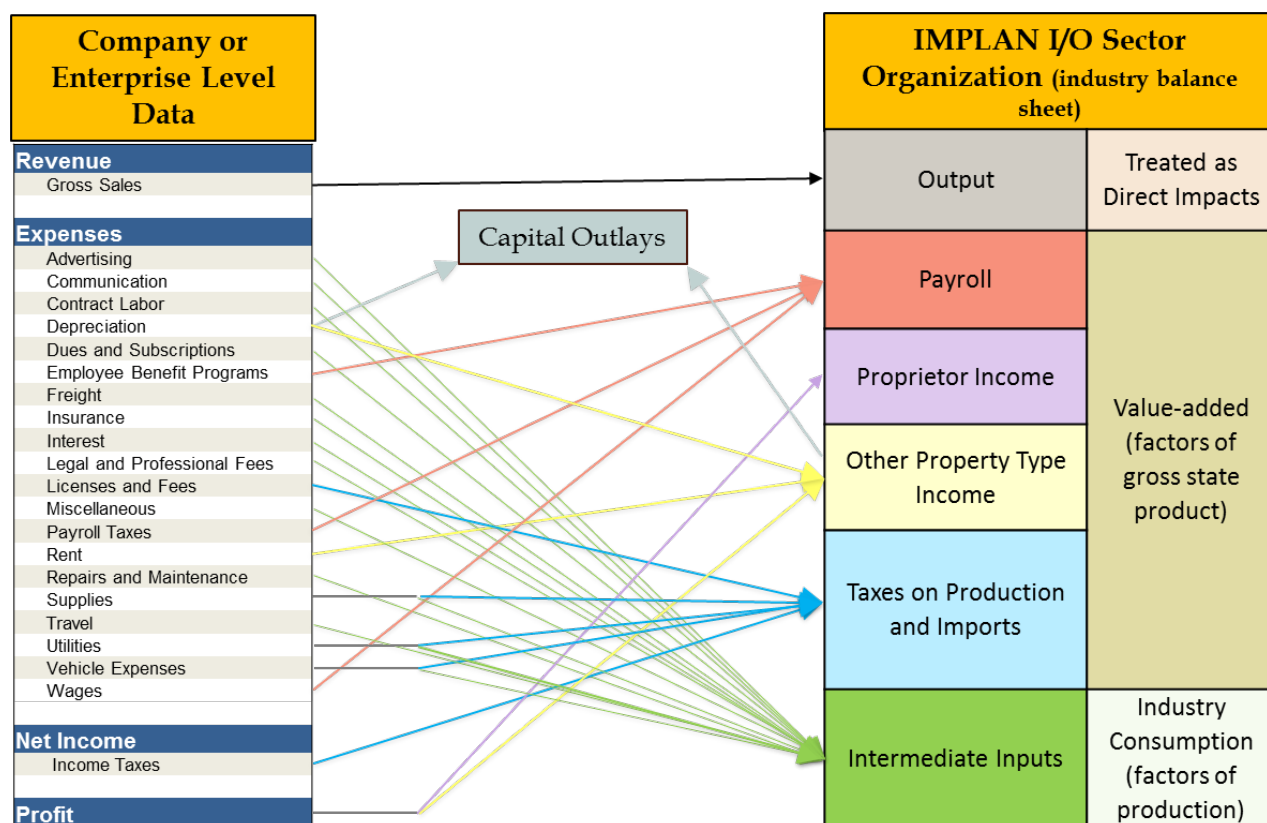
IMPLAN modeling system is a widely used and well-recognized source of economic data—this process is desirable because it allows for consistency and compatibility across regional, state, and sub-state economies. However, not all industries within all economies are accurately represented using federal, state, and local secondary data in combination with IMPLAN baseline data generation techniques (Bangsund and Hodur 2018a,b; Bangsund and Hodur 2012; Downes 2012; Taylor 2013; Booz Allen 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 uses a Double Constrained Gravity Model, along with several databases to estimate trade flows in various economic geographies. In the most general sense, gravity models work with the mass of demand and supply of commodities, and are constrained so that imports into a region do not exceed demand and exports from a region do not exceed available supply.

IMPLAN uses data from Center for Transportation Analysis at Oak Ridge National Laboratory (ORNL) on travel impedances (based on a commodity's modal mix as reported by the Commodity Flow Survey) to serve as the distances in IMPLAN's gravity model. ORNL also provides the circle distances between county centroids — those are used to calibrate the gravity model to Commodity Flow Survey data. Commodity Flow Survey (CFS) and Freight Analysis Framework (FAF) data are used to calibrate the gravity model to estimate trade flows between economic geographies. The two data sets contain information on the value, weight, distance traveled, transportation mode, and origin and destination (i.e., state) of the shippable commodities. These commodities are classified according to the standard classification of transported goods (SCTG) system, and the survey data are typically reported at the two-digit SCTG level.

Use of Financial Information to Construct or Adjust Industry Balance Sheets

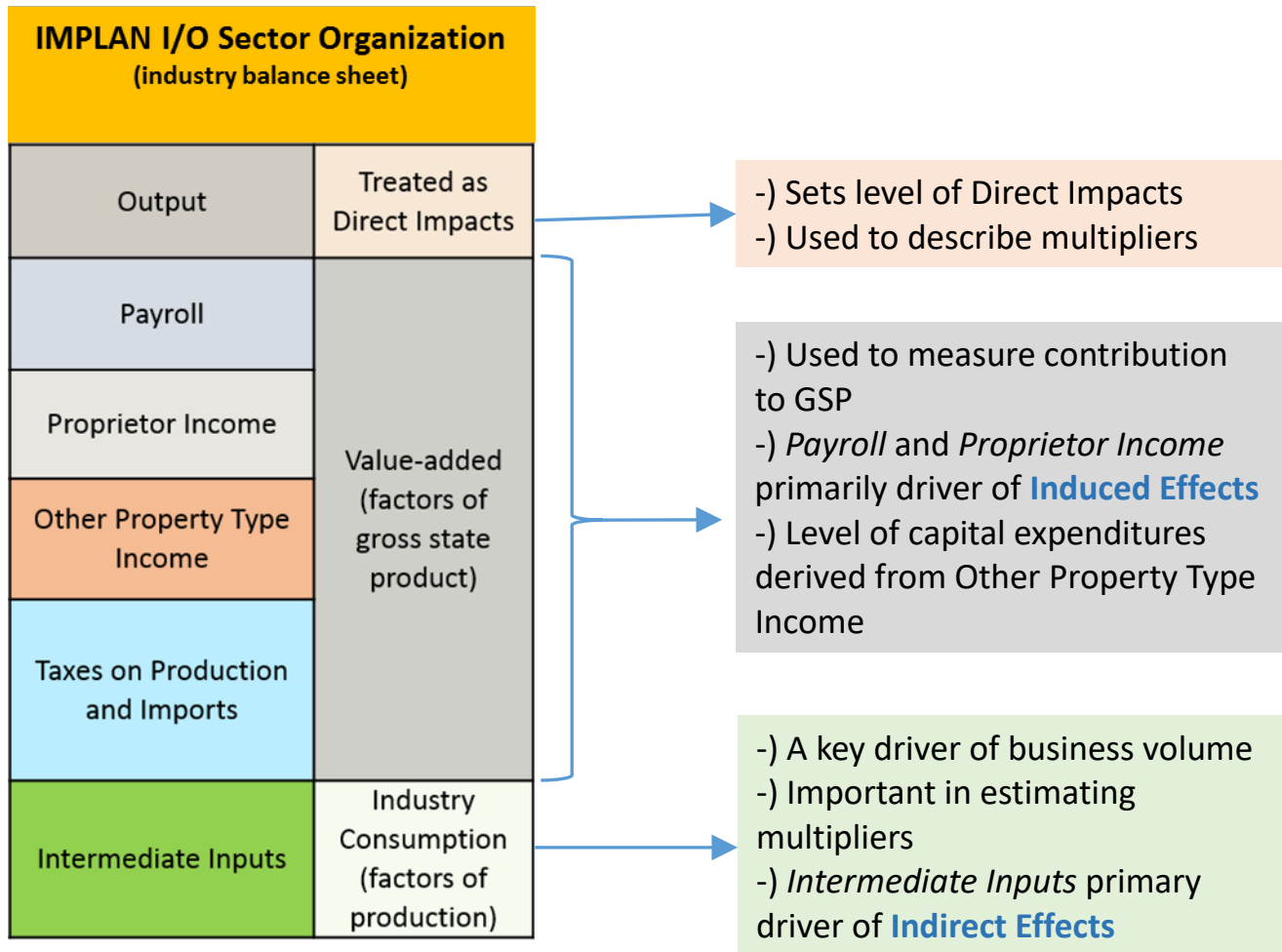
IMPLAN organizes financial information for industries in a manner different from traditional enterprise budgets or income statements. Despite these seemingly unrelated financial data, financial data for any particular business or economic sector can be used to customize an industry balance sheet. In the case of production agriculture, cost-of-production budgets are helpful in constructing industry balance sheets. Financial statements for firms or businesses also can serve to adjust or construct an industry balance sheet; however, accounting terms, income and expense categories, and treatment of debt, capital outlays, and taxes will not necessarily match perfectly to the industry balance sheet components.



General Transposition of Financial Information into IMPLAN Economic Sector Profiles

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

Components of Economic Profile	
Sales / Output	The value of an industry's production for the year and represents the sum of sales to final users in the economy (GDP) plus sales to other industries (intermediate inputs) and change in inventory.
Payroll	Includes all wages and salaries, all benefits, and all payroll taxes for employees.
Proprietor Income	Consists of payments received by self-employed individuals and unincorporated business owners. However, additional items include income of partnerships and tax-exempt cooperatives, dividends (payments in cash or other assets, monetary interest received by nonfinancial business, and rental income received by persons not primarily engaged in the real estate business).
Other Property Type Income	Represents gross operating surplus minus proprietor income, and includes consumption of fixed capital, corporate profits, and business current transfer payments (net), income derived from dividends, royalties, corporate profits, interest income, and is a source of income for households, business, and governments. OPTI is treated as an economic leakage to the study region such that any OPTI generated as part of an analysis will not generate any additional economic effects.
Taxes on Production and Imports	Includes sales and excise taxes, customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments. This category is net of subsidies and therefore can be negative for an industry in a given year if that industry received more subsidies from the government than it paid out in the above taxes in that year. Social insurance taxes are placed in payroll and income taxes are part of Other Property Type Income.
Intermediate Inputs	Purchases of goods and services used for the production of other goods and services rather than used for final consumption. These inputs do not include capital purchases nor do they include the expenses for capital and labor.
Sources: IMPLAN 2020; DA Bangsund, Department of Agribusiness and Applied Economics, NDSU	



Economic Sector Organization and Use within IMPLAN

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 changed 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 household spending patterns by income levels, which can be used to approximate the consumption of goods and services by households.

Mechanisms for Introducing Economic Effects into an Economy, IMPLAN Pro Software

IMPLAN Activity	Description
Industry Change	Represents a change in sales or revenue to an economic sector. Increases/decreases in sales, unless manually overrode within the model, will automatically produce increases/decreases in employment, employment compensation, purchases of intermediate inputs, and profits based on the economic sector's balance sheet.
Industry Spending Pattern	Represents the expenses for goods and services used by an economic sector, and provides for adjustments in the percentage of those individual goods and services acquired within a specified economy.
Labor Income Change	Represents a general change in wages, salaries, and benefits within a specified economy.
Household Income Change	Represents a general change in the amount of personal income available to households in the specified economy.
Institutional Spending Pattern	Represents the proportional consumption of goods and services by governments, schools, and non-profits per unit of revenue. Includes spending patterns estimating personal consumption of goods and services by households.
Source: DA Bangsund, Agribusiness and Applied Economics, NDSU	

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. IMPLAN's 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 IMPLAN's 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

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 annually conducts surveys and diary samplings of household expenditure patterns (the CES). 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). They also give us the proportional split of the 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. We use these data to estimate, for the total state/local tax receipts, the share of each type of tax that belongs to local government. We then use data for each local government to apportion that local total (at the state level) to each county. Since we know the local total for each county, we can distinguish 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
 - We supplement gaps in the SLGF with 5-year Census of Governments data, and supplement the SLGF state tax revenue with current-year state tax collections data from 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 Compensation	Proprietor Income	Tax on Production and Import	House holds	Corporations
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 (2020).					

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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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).

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).

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.

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.

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.

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.

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.

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.

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.

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 (2020).	

The graphic consists of a vertical dark blue bar on the left. A blue arrow points from this bar to the right, containing the text 'Appendix C'. To the right of the arrow is a large yellow rectangle with a light gray border. Inside the yellow rectangle, the title 'Reconstructed Economic Sectors for IMPLAN, Petroleum Industry, North Dakota, 2015, 2017 and 2019' is written in bold black text.

Appendix C

Reconstructed Economic Sectors for IMPLAN, Petroleum Industry, North Dakota, 2015, 2017 and 2019

Appendix Table C1. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Well Development and Oil and Gas Extraction, Petroleum Industry, North Dakota, 2019

IMPLAN Industries (sectors) and Industry Balance Sheet Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 20 (Extraction of Natural Gas and Petroleum) and Sector 21 (Extraction of Natural Gas Liquids)				
Employment	5,249	2,742	Use of BLS QCEW data to remove royalty and investment individuals from IMPLAN data	BLS data NAICS 2111
Output (sales)	3,554,660,222	25,803,824,311	Oil and gas quantity x value (first purchaser prices) less oil field services' share of IMPLAN sector 36	NDDRM / NDOSTC
Employee Compensation (EC)	365,695,631	460,481,033	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	52,788,369	4,117,786,733	Sole proprietor income plus private and tribal royalties (net of severance taxes)*	ONRR/NDSU Survey
Other Property-type Income (OPTI)	421,374,587	14,869,424,270	Sales minus (EC, PI, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	939,570,585	3,026,594,652	Severance tax, property tax, sales taxes, public royalties, misc. government fees	NDOSTC/NDSU Survey
Total Value-added (VA)	1,779,429,172	22,474,286,688	Sum of EC, OPTI, PI & TPI	calculation
Intermediate Inputs	1,775,231,049	3,329,537,623	\$/BOE production expenses x BOE produced, Intermediate Inputs plus VA must equal Sales	NDSU Survey
*Royalties would normally be assigned to OPTI, but royalties were run through as proprietor income, and output for induced effects were subsequently reduced by the share of induced going to proprietor income, and those values were subsequently adjusted to account for only rates of in-state spending for royalties received by in-state mineral owners.				
Sector 37 (Drilling Oil and Gas Wells)				
Employment	3,448	2,928	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	1,630,686,465	1,247,411,311	Estimate of the portion of total well drilling costs allocated between IMPLAN sectors 37 and 38. Just for clarification, not all welling drilling costs are allocated to sectors 37 and 38.	NDSU Survey / NDDMR/IMPLAN
Employee Compensation (EC)	399,133,856	386,070,503	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	22,144,991	16,940,051	Ratio analysis using IMPLAN data	IMPLAN
Other property-type Income (OPTI)	435,158,339	90,552,383	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	86,797,910	66,397,003	Ratio analysis using IMPLAN data	IMPLAN
Total Value-added (VA)	943,235,095	559,959,940	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	687,451,370	687,451,370	Retained IMPLAN default values	IMPLAN

Appendix Table C2. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Support Activities, Petroleum Industry, North Dakota, 2019

IMPLAN Industries (sectors) and Industry Balance Sheet Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 38 (Support activities for oil and gas operations)				
Employment	14,726	13,641	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	4,378,860,311	5,491,621,799	Combined analysis, see Table C3	BLS/IMPLAN/NDSU/DMR
Employee Compensation (EC)	1,630,725,016	1,478,858,850	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	93,454,308	117,203,034	Ratio analysis using IMPLAN data	IMPLAN
Other property-type Income (OPTI)	668,715,026	838,649,729	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	161,145,649	202,096,183	Represents a combination of taxes from various sources	NDOSTC & NDSU Survey
Total Value-added (VA)	2,554,039,999	2,636,807,797	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	1,824,820,312	2,854,814,003	Combined analysis, see Table C3	NDSU Survey

Appendix Table C3. Input-Output Modeling Industry Components, Estimation of Well Drilling and Oil Field Service Shares for IMPLAN Sector 38, Petroleum Industry, North Dakota, 2019

IMPLAN Industries (sectors) and Industry Balance Sheet Components	Study Values for IMPLAN Sector 38		Estimation and Adjustment	Data Sources
	Well Drilling	Oil Field Service		
Employment	3,904	9,737	Computed based on NDDMR data on rig counts and well counts, BLS labor division by NAICS codes, combined with Job Service North Dakota information on employment in related sectors.	BLS, NDDMR, & Job Service North Dakota
Output (sales)	2,596,174,790	2,895,447,009	Well drilling revenues represented share of reported drilling expenditures that represent spending in IMPLAN Sector 38. The share was estimated from secondary sources. Total well drilling expenses estimated from number of wells drilled and NDSU survey data. Revenues for oil field service is ratio of sales to employment from default IMPLAN data multiplied by new estimate of employment.	NDSU (2013), HIS (2014), BLM WY (2014), Eagle Ford (2011) & NDDMR & NDSU Survey IMPLAN
Employee Compensation (EC)	475,329,074	1,003,529,776	BLS data used to estimated employment compensation	BLS & IMPLAN
Proprietor Income (PI)	55,407,960	61,795,074	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Other property-type Income (OPTI)	396,473,276	442,176,453	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Tax on Production and Imports (TPI)	95,541,360	106,554,823	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Total Value-added (VA)	1,022,751,671	1,614,056,126	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	1,573,423,119	1,281,390,883	Sales less Value-added	calculation

Appendix Table C4. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Well Development and Oil and Gas Extraction, Petroleum Industry, North Dakota, 2017

IMPLAN Industries (sectors) and Industry Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 20 (Extraction of Natural Gas and Petroleum) and Sector 21 (Extraction of Natural Gas Liquids)				
Employment	7,642	2,548	Use of BLS QCEW data to remove royalty and investment individuals from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$3,060,469,360	\$19,478,833,957	Oil and gas quantity x value (first purchaser prices)	NDDRM / NDOSTC
Employee Compensation (EC)	\$398,927,585	\$386,007,356	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$308,860,260	\$2,274,233,380	Private and tribal royalties (net of severance taxes)	ONRR/NDSU Survey
Other Property-type Income (OPTI)	\$780,389,921	\$12,067,289,874	Sales minus (EC, PI, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$874,194,366	\$2,049,230,902	Severance tax, property tax, sales taxes, public royalties, misc. government fees	NDOSTC/NDSU Survey
Total Value-added (VA)	\$2,401,905,587	\$16,992,750,157	Sum of EC, OPTI, PI & TPI	calculation
Intermediate Inputs	\$658,563,773	\$2,486,083,800	\$/BOE production expenses x BOE produced, Intermediate Inputs plus VA must equal Sales	NDSU Survey
Sector 37 (Drilling Oil and Gas Wells)				
Employment	3,446	2,435	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$2,563,396,240	\$1,097,426,208	Estimate of total well drilling cost for well owners allocated between IMPLAN sectors 37 and 38	NDSU Survey / NDDMR/IMPLAN
Employee Compensation (EC)	\$354,037,628	\$302,728,914	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$54,680,013	\$23,280,853	Ratio analysis using IMPLAN data	IMPLAN
Other property-type Income (OPTI)	\$1,811,608,887	\$500,912,199	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$127,412,613	\$5,454,7143	Ratio analysis using IMPLAN data	IMPLAN
Total Value-added (VA)	\$2,347,439,141	\$881,469,109	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$215,957,099	\$215,957,099	Retained IMPLAN default values	IMPLAN

Appendix Table C5. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Support Activities, Petroleum Industry, North Dakota, 2017

IMPLAN Industries (sectors) and Industry Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 38 (Support activities for oil and gas operations)				
Employment	11,419	10,798	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$2,012,027,100	\$3,647,465,361	Combined analysis, see Table C6	
Employee Compensation (EC)	\$1,205,441,895	\$1,222,970,174	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$135,051,849	\$244,826,196	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Other property-type Income (OPTI)	\$311,447,083	\$564,600,967	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$70,684,410	\$128,138,899	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	NDOSTC & NDSU Survey
Total Value-added (VA)	\$1,722,625,237	\$2,160,536,236	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$289,401,863	\$1,486,929,125	Combined analysis, see Table C6	NDSU Survey

Appendix Table C6. Input-Output Modeling Industry Components, Estimation of Well Drilling and Oil Field Service Shares for IMPLAN Sector 38, Petroleum Industry, North Dakota, 2017

IMPLAN Industry Components	Study Values for IMPLAN Sector 38		Estimation and Adjustment	Data Sources
	Well Drilling	Oil Field Service		
Employment	3,060	7,738	Computed based on NDDMR data on rig counts and well counts, BLS labor division by NAICS codes, combined with Job Service North Dakota information on employment in related sectors.	BLS, NDDMR, & Job Service North Dakota
Output (sales)	\$2,284,018,295	\$1,363,447,066	Well drilling revenues represented share of reported drilling expenditures that represent spending in IMPLAN Sector 38. The share was estimated from secondary sources. Total well drilling expenses estimated from number of wells drilled and NDSU survey data. Revenues for oil field service is ratio of sales to employment from default IMPLAN data multiplied by new estimate of employment.	NDSU (2013), HIS (2014), BLM WY (2014), Eagle Ford (2011) & NDDMR, NDSU Survey, & IMPLAN
Employee Compensation (EC)	\$346,572,396	\$876,397,778	BLS data used to estimated employment compensation	BLS & IMPLAN
Proprietor Income (PI)	\$153,308,519	\$91,517,677	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Other property-type Income (OPTI)	\$353,549,331	\$211,051,636	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Tax on Production and Imports (TPI)	\$80,239,717	\$47,899,182	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Total Value-added (VA)	\$933,669,963	\$1,226,866,273	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$1,350,348,332	\$136,580,792	Sales less Value-added	calculation

Appendix Table C7. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Well Development and Oil and Gas Extraction, Petroleum Industry, North Dakota, 2015

IMPLAN Industries (sectors) and Industry Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 20 (Extraction of Natural Gas and Petroleum) and Sector 21 (Extraction of Natural Gas Liquids)				
Employment	6,075	2,906	Use of BLS QCEW data to remove royalty and investment individuals from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$2,648,208,939	\$18,292,074,198	Oil and gas quantity x value (first purchaser prices)	NDDRM / NDOSTC
Employee Compensation (EC)	\$422,629,761	\$424,864,859	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$247,734,333	\$2,468,318,104	Private and tribal royalties (net of severance taxes)	ONRR/NDSU Survey
Other Property-type Income (OPTI)	\$581,582,474	\$9,774,084,285	Sales minus (EC, PI, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$996,906,441	\$2,369,550,948	Severance tax, property tax, sales taxes, public royalties, misc. government fees	NDOSTC/NDSU Survey
Total Value-added (VA)	\$2,248,853,009	\$15,036,818,195	Sum of EC, OPTI, PI & TPI	calculation
Intermediate Inputs	\$399,355,930	\$3,255,256,002	\$/BOE production expenses x BOE produced, Intermediate Inputs plus VA must equal Sales	NDSU Survey
Sector 37 (Drilling Oil and Gas Wells)				
Employment	4,663	3,821	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$1,731,619,019	\$1,752,482,384	Estimate of total well drilling cost for well owners allocated between IMPLAN sectors 37 and 38	NDSU Survey / NDDMR/IMPLAN
Employee Compensation (EC)	\$569,077,576	\$536,893,793	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$33,568,954	\$33,568,954	Ratio analysis using IMPLAN data	IMPLAN
Other property-type Income (OPTI)	\$533,624,573	\$533,624,573	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$136,789,063	\$136,789,063	Ratio analysis using IMPLAN data	IMPLAN
Total Value-added (VA)	\$1,273,060,165	\$1,240,876,383	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$458,558,853	\$511,606,001	Retained IMPLAN default values	IMPLAN

Appendix Table C8. Input-Output Modeling Industry Components, Default IMPLAN Data and Customized Values, Support Activities, Petroleum Industry, North Dakota, 2015

IMPLAN Industries (sectors) and Industry Components	IMPLAN Default	Study Values	Estimation and Adjustment	Data Sources
Sector 38 (Support activities for oil and gas operations)				
Employment	14,858	14,259	Use of BLS QCEW data to remove uncovered workers from IMPLAN data	BLS data NAICS 2111
Output (sales)	\$2,947,731,201	\$5,319,282,459	Combined analysis, see Table C9	
Employee Compensation (EC)	\$1,498,621,338	\$1,596,411,520	Wages/salaries adjusted to obtain employment compensation	BLS/IMPLAN
Proprietor Income (PI)	\$26,206,831	\$47,291,129	Ratio analysis using IMPLAN data	IMPLAN
Other property-type Income (OPTI)	\$564,930,176	\$1,019,435,956	Sales minus (EC, TPI, & Intermediate Inputs)	calculation
Tax on Production and Imports (TPI)	\$51,547,386	\$93,019,033		NDOSTC & NDSU Survey
Total Value-added (VA)	\$2,141,305,731	\$2,756,157,638	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$806,425,470	\$2,563,124,820	Combined analysis, see Table C9	NDSU Survey

Appendix Table C9. Input-Output Modeling Industry Components, Estimation of Well Drilling and Oil Field Service Shares for IMPLAN Sector 38, Petroleum Industry, North Dakota, 2015

IMPLAN Industry Components	Study Values for IMPLAN Sector 38		Estimation and Adjustment	Data Sources
	Well Drilling	Oil Field Service		
Employment	5,832	8,427	Computed based on NDDMR data on rig counts and well counts, BLS labor division by NAICS codes, combined with Job Service North Dakota information on employment in related sectors.	BLS, NDDMR, & Job Service North Dakota
Output (sales)	\$3,647,353,962	\$1,671,928,497	Well drilling revenues represented share of reported drilling expenditures that represent spending in IMPLAN Sector 38. The share was estimated from secondary sources. Total well drilling expenses estimated from number of wells drilled and NDSU survey data. Revenues for oil field service is ratio of sales to employment from default IMPLAN data multiplied by new estimate of employment.	NDSU (2013), IHS (2014), BLM WY (2014), Eagle Ford (2011) & NDDMR, NDSU Survey, & IMPLAN
Employee Compensation (EC)	\$652,898,865	\$943,512,655	BLS data used to estimate employment compensation	BLS & IMPLAN
Proprietor Income (PI)	\$32,426,833	\$14,864,295	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Other property-type Income (OPTI)	\$699,012,282	\$320,423,673	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Tax on Production and Imports (TPI)	\$63,781,787	\$29,237,247	Based on ratio from IMPLAN default data and new estimate of sales for IMPLAN Sector 38	IMPLAN
Total Value-added (VA)	\$1,448,119,768	\$1,308,037,870	Sum of EC, OPTI, & TPI	calculation
Intermediate Inputs	\$2,199,234,194	\$363,890,626	Sales less Value-added	calculation

The graphic consists of a vertical dark blue bar on the left. A blue arrow points from this bar to the right, containing the text 'Appendix D'. To the right of the arrow is a large yellow rectangle with a light gray gradient at the top and bottom. The title text is centered within the yellow area.

Appendix D

Direct Employment and Employment Compensation, Petroleum Industry, North Dakota, 2013 through 2019

Direct Employment

While employment figures are frequently reported by various governmental agencies and are broken into a hierarchy of categories (e.g., North American Industry Classification System), deriving specific estimates of employment for large basic-sector industries can be problematic. Much of the problem arises in defining the type of job, and attributing which industry(s) created that employment. For example, the process of drilling an oil well typically requires developing a road and a drilling site; work that requires heavy construction with earth moving or excavating equipment. Most oil companies will contract that work to local firms that specialize in heavy construction or excavating. The individuals performing the road building and preparation of the drill site are likely to be employed with some type of construction firm, and as a result, those jobs are typically classified and reported by government agencies as construction.

Government agencies (e.g., Bureau of the Census, Bureau of Labor Statistics) that track employment often base the classification of those jobs on the type of activities that generate the most revenue for a firm (primary activities). In this example, the primary activity for this firm is likely to be construction, even if the revenues for the construction firm are derived from road building and drill site preparation for an oil firm. However, in the case of assigning which basic-sector industry created that employment, it may be more accurate to suggest those jobs exist as a result of the petroleum industry rather than the construction industry. Yet, in other cases, the level of oil well drilling activity may be insufficient to sustain employment in heavy construction for an entire year. Those situations result in seasonal or part-time job creation. The challenge is to measure or estimate the total number of full-time jobs created and sustained by the petroleum industry, even if those jobs appear to be part of another industry or are only created for part of a year.

From 2013 through 2016, Job Service North Dakota conducted an annual special assessment to measure the number of private jobs in the petroleum industry using the QCEW program (Job Service North Dakota 2014, 2015, 2016, 2017) (see Appendix Tables D1 through D14 for detailed Job Service North Dakota data). The Job Service assessment divided employment into 'direct' and 'related' employment. Direct oil and gas employment was based entirely on NAICS codes. Related oil and gas employment was estimated using NAICS codes and survey information. Survey information was based on inquiries to establishments requesting them to estimate the percentage of their business volume received/obtained from oil and gas industry activities.

The Job Service North Dakota reports were discontinued in 2017. In an attempt to keep current employment estimates consistent with past estimates, a process of relating employment among the various economic sectors was used with 2-digit NAICS data for 2017, 2018, and 2019 to approximate the distribution of employment found in the Job Service North Dakota previous studies (Appendix Tables D1-D6).

Secondary Employment

The methodology used by Job Service North Dakota is similar in concept to the delineation of direct jobs and indirect jobs using input-output (I-O) methodologies. All industries have employment that inherently represents a direct job, based on the nature of the employment in relation to the definition of the industry. For example, doctors and nurses working at a medical clinic would inherently be considered direct employment in the Medical Service industry just as a farmer is directly employed in the Agriculture industry. NAICS is helpful in identifying direct employment since it provides a high

degree of specificity to the type of activities engaged in by an establishment and its employees. As a point of consistency, both I-O methodologies and the methodology used by Job Service North Dakota for measuring employment in the Petroleum Industry rely on NAICS codes to define direct employment.

Large industries often have employment, classified and measured as indirect jobs with I-O analysis, which is claimed to be 'direct' employment by industry leaders and representatives. From an empirical perspective, the shifting of jobs among classifications between studies and across different methodologies can create confusion, and also presents potential problems for double counting or over estimation of the number of jobs supported by an industry. The challenge with using the Job Service North Dakota data and its methodology of estimating direct and 'related' employment is to ensure that employment that is traditionally measured as indirect jobs does not get used as a direct employment component within an I-O analysis framework.

The study considered two routes or analyses that can produce estimates of economy-wide employment in the petroleum industry. Each method has distinct advantages and disadvantages. Alternative 1 was chosen for this study.

Alternative 1:

Description: Use Job Service North Dakota (JSND) employment as the basis for estimating indirect and induced employment. JSND reports employment in several sectors as representing petroleum industry employment. However, this designation is not consistent with I-O analysis, and if not properly handled, could grossly overstate total indirect and induced employment arising from the industry. The challenge with this method is to combine I-O analysis in a manner that eliminates any duplication of indirect and induced labor.

Advantage: JSND data represents a unique data set based on information gathered directly from firms and businesses in the state.

Disadvantage: JSND approach mixes jobs defined as indirect and induced, and presents those estimates as representing direct and 'related' employment in the industry. The treatment of the employment designations with the JS data is not consistent, or compatible with traditional I-O employment designations without considerable adjustment to modeling procedures. It is unclear from the JSND data which employment estimates are truly 'related' versus direct employment.

Methods: JSND data is allocated to IMPLAN sectors 20, 37, 38, 156, and 50 (representing production, drilling, transportation, and processing). The I-O model is run to estimate the employment from IMPLAN for sectors 62, 449, 411, and 485 for both indirect and induced employment. Those particular values would represent double counting, as they show up as indirect and induced jobs for core industry activities under traditional I-O modeling; however, JSND already has estimated employment in those sectors (IMPLAN sectors 62, 449, 411, and 485), and is treating those jobs as being direct employment in the industry. Therefore, any indirect and induced employment produced by the core industry sectors in 62, 449, 411, and 485 would necessarily already be measured (counted) in JSND direct estimate.

The indirect employment leftover in the other economic sectors from the above analysis is considered the remainder of indirect (i.e., those jobs not already counted as direct employment).

The direct employment from JSND in IMPLAN sectors 62, 449, 411, & 485 is then combined with data for IMPLAN sectors 20, 37, 38, 156, and 50 and ran through IMPLAN. All JSND employment, treated as direct employment, is used to estimate induced employment. Induced employment is further reduced to reflect two conditions: 1) some wages/salaries will leave the state reflective of workers retaining residency outside of North Dakota and working shift schedules in the industry that allow them sufficient periods to return home—these workers do not require permanent lodging and they purchase much of their personal goods and services from providers at their permanent address, and 2) all private in-state royalty revenue cannot be treated as personal consumption of goods and services, as income taxes, savings and investments result in money streams being diverted out of household spending.

All of the above analyses are based on a 2-digit NAICS mapping scheme for output from IMPLAN's 536-sector model.

Alternative 2:

Description: Traditional economic contribution analyses use a series of economic criteria, tied to backward linkages among economic sectors, to define employment as being directly or primarily used in the core components of an industry (direct employment). This particular approach would specify direct employment in the core industry activities, and then use an I-O matrix, with specific backward linkages disconnected to avoid overestimation of total employment in any particular sector, to estimate indirect and induced employment.

Advantage: This is a straightforward process, consistent and compatible with traditional economic contribution modeling.

Disadvantage: This approach relies on the I-O matrix to properly measure employment response to a direct impact. I-O modeling requires an appropriate measure of direct sales or direct employment. Further, data on the amount and percentage of local acquisition of goods and services for any particular industry are paramount to accurately estimating indirect and induced employment. How much local (within the study region) acquisition of goods and services are made by an industry can be obtained through baseline data (e.g., IMPLAN) or from a combination of survey data. The challenge is that, in complex industries, spending patterns of industry segments may not be accurately portrayed with default software data, and collection of survey data is a resource-intensive pursuit.

An additional disadvantage is that IMPLAN's default data for oil and gas production in the state is substantially underrepresented in their baseline database. It is unclear if the default data for oil and gas services are also underrepresented, and internal data from the model are not consistent with industry behavior in the state. For example, activity in sector 38 is meant to represent the service aspect of firms supplying goods and services to oil production firms and firms actively drilling and fracking wells; however, trade flow data within IMPLAN suggest those services are exported from the state. This is obviously an erroneous condition that must be rectified for an accurate assessment of the industry.

Methods: The reconstruction of IMPLAN sectors for the Petroleum Industry requires collecting information from a number of sources, including Bureau of Labor Statistics, Job Service ND, ND Office of State Tax Commissioner, Office of Nature Resources Revenue, ND Land Department, ND Department of Mineral Resources, IMPLAN, and private industry (surveys).

Industry sectors in IMPLAN have several key components, which include sales, employment, employment compensation, proprietor income, other property-type income, taxes on production and imports, and intermediate inputs (industry profiles in the IMPLAN modeling system are detailed in Appendix B). Additional modification is possible through adjustments to intermediate input spending patterns and regional purchases.

After re-constructing the IMPLAN industry profiles using data from all appropriate sources, the I-O framework can be used to estimate indirect and induced employment.

Appendix Table D1. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2019

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,593	4,593		19,146	178			
21 Mining, Quarrying, Oil & Gas	21,380	2,056	19,324		604			
22 Utilities	3,448	2,844	604		3,870			
23 Construction	27,961	24,091	3,870	386				
31-33 Manufacturing	26,471	24,631	1,840					1,454
42 Wholesale Trade	24,252	22,140	2,112					2,112
44-45 Retail Trade	45,621	45,621			772			
48-49 Transportation and Warehousing	18,002	12,411	5,591				4,819	
51 Information	6,093	6,093						
52 Finance and Insurance	17,832	17,822	10			10		
53 Real Estate and Rental & Leasing	5,432	4,439	993			993		
54 Professional and Technical Services	16,262	14,922	1,340			1,340		
55 Mgmt of Companies & Enterprises	3,578	3,392	186		18	186		
56 Administrative and Waste Services	13,016	12,846	170			152		
61 Educational Services	2,794	2,794						
62 Health Care and Social Assistance	62,977	62,977						
71 Arts, Entertainment, and Recreation	5,617	5,617						
72 Accommodation and Food Services	34,806	34,806						
81 Other Services	11,337	11,068	269	19,532	5,443	269		
Total	351,472	315,161	36,311	19,146	178	2,950	4,819	3,567

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2014, 2015, 2016, 2017).

**Job Service North Dakota (2020).

Appendix Table D2. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2019

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$201.8	\$201.8						
21 Mining, Quarrying, Oil & Gas	\$2,326.8	\$229.9	\$2,096.9	\$2,083.7	\$13.2			
22 Utilities	\$380.2	\$315.6	\$64.6		\$64.6			
23 Construction	\$1,905.6	\$1,536.7	\$369.0		\$369.0			
31-33 Manufacturing	\$1,460.6	\$1,322.2	\$138.4	\$50.9				\$87.6
42 Wholesale Trade	\$1,704.7	\$1,519.9	\$184.7					\$184.7
44-45 Retail Trade	\$1,462.2	\$1,462.2						
48-49 Transportation and Warehousing	\$1,195.2	\$701.8	\$493.4		\$106.3		\$387.1	
51 Information	\$435.9	\$435.9						
52 Finance and Insurance	\$1,232.6	\$1,231.9	\$0.7			\$0.7		
53 Real Estate and Rental & Leasing	\$297.7	\$213.8	\$83.9			\$83.9		
54 Professional and Technical Services	\$1,230.5	\$1,103.7	\$126.8			\$126.8		
55 Mgmt of Companies & Enterprises	\$366.8	\$344.4	\$22.4			\$22.4		
56 Administrative and Waste Services	\$502.1	\$492.0	\$10.1		\$1.3	\$8.8		
61 Educational Services	\$105.4	\$105.4						
62 Health Care and Social Assistance	\$3,353.2	\$3,353.2						
71 Arts, Entertainment, and Recreation	\$99.5	\$99.5						
72 Accommodation and Food Services	\$651.3	\$651.3						
81 Other Services	\$438.7	\$418.6	\$20.1			\$20.1		
Total	\$19,351.0	\$15,740.1	\$3,610.8	\$2,134.6	\$554.2	\$262.6	\$387.1	\$272.3

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2013, 2014, 2015, 2016).

**Job Service North Dakota (2020).

Appendix Table D3. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2018

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,618	4,618						
21 Mining, Quarrying, Oil & Gas	20,804	2,056	18,748	18,575	173			
22 Utilities	3,666	3,023	643		643			
23 Construction	26,002	21,957	4,045		4,045			
31-33 Manufacturing	25,906	24,097	1,809	386				1,423
42 Wholesale Trade	23,892	21,811	2,081					2,081
44-45 Retail Trade	46,858	46,858						
48-49 Transportation and Warehousing	17,219	11,840	5,379		770		4,609	
51 Information	6,221	6,221						
52 Finance and Insurance	17,834	17,824	10			10		
53 Real Estate and Rental & Leasing	5,311	4,367	944			944		
54 Professional and Technical Services	15,950	14,640	1,310			1,310		
55 Mgmt of Companies & Enterprises	5,282	5,007	275			275		
56 Administrative and Waste Services	13,327	13,129	198		22	176		
61 Educational Services	2,665	2,665						
62 Health Care and Social Assistance	59,519	59,519						
71 Arts, Entertainment, and Recreation	5,690	5,690						
72 Accommodation and Food Services	34,685	34,685						
81 Other Services	11,307	11,038	269			269		
Total	346,756	311,046	35,710	18,961	5,652	2,984	4,609	3,505

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2013, 2014, 2015, 2016).

**Job Service North Dakota (2019).

Appendix Table D4. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2018

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$200.5	\$200.5						
21 Mining, Quarrying, Oil & Gas	\$2,216.4	\$228.6	\$1,987.8	\$1,979.0	\$8.8			
22 Utilities	\$389.5	\$316.2	\$73.3		\$73.3			
23 Construction	\$1,679.3	\$1,235.2	\$444.1		\$444.1			
31-33 Manufacturing	\$1,395.9	\$1,262.5	\$133.3	\$49.7				\$83.7
42 Wholesale Trade	\$1,626.4	\$1,450.2	\$176.2					\$176.2
44-45 Retail Trade	\$1,458.0	\$1,458.0						
48-49 Transportation and Warehousing	\$1,091.3	\$638.3	\$453.1		\$99.6		\$353.5	
51 Information	\$436.7	\$436.7						
52 Finance and Insurance	\$1,180.7	\$1,180.1	\$0.6			\$0.6		
53 Real Estate and Rental & Leasing	\$283.2	\$205.6	\$77.6			\$77.6		
54 Professional and Technical Services	\$1,163.8	\$1,044.3	\$119.6			\$119.6		
55 Mgmt of Companies & Enterprises	\$452.8	\$425.2	\$27.6			\$27.6		
56 Administrative and Waste Services	\$518.3	\$507.1	\$11.2		\$0.9	\$10.3		
61 Educational Services	\$97.0	\$97.0						
62 Health Care and Social Assistance	\$3,099.5	\$3,099.5						
71 Arts, Entertainment, and Recreation	\$93.2	\$93.2						
72 Accommodation and Food Services	\$629.0	\$629.0						
81 Other Services	\$420.8	\$401.5	\$19.2			\$19.2		
Total	\$18,432.4	\$14,908.6	\$3,523.8	\$2,028.7	\$626.7	\$255.0	\$353.5	\$259.9

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2013, 2014, 2015, 2016).

**Job Service North Dakota (2019).

Appendix Table D5. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2017

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,554	4,554						
21 Mining, Quarrying, Oil & Gas	17,841	2,053	15,788	15,624	164			
22 Utilities	3,782	3,119	663		663			
23 Construction	26,732	22,577	4,155		4,155			
31-33 Manufacturing	24,681	22,799	1,882	526				1,356
42 Wholesale Trade	23,928	21,844	2,084					2,084
44-45 Retail Trade	47,732	47,732						
48-49 Transportation and Warehousing	16,609	11,399	5,210		765		4,446	
51 Information	6,502	6,502						
52 Finance and Insurance	17,915	17,905	10			10		
53 Real Estate and Rental & Leasing	5,220	4,362	858			858		
54 Professional and Technical Services	15,905	14,630	1,275			1,275		
55 Mgmt of Companies & Enterprises	5,314	5,037	277			277		
56 Administrative and Waste Services	13,082	12,904	178		20	157		
61 Educational Services	2,584	2,584						
62 Health Care and Social Assistance	59,263	59,263						
71 Arts, Entertainment, and Recreation	4,557	4,557						
72 Accommodation and Food Services	34,759	34,759						
81 Other Services	12,231	11,940	291			291		
Total	343,191	310,519	32,672	16,150	5,767	2,869	4,446	3,440

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2013, 2014, 2015, 2016).

**Job Service North Dakota (2019).

Appendix Table D6. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2017

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings*				
	Total**	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$202.1	\$202.1						
21 Mining, Quarrying, Oil & Gas	\$1,804.0	\$212.9	\$1,591.1	\$1,579.7	\$11.3			
22 Utilities	\$379.3	\$314.9	\$64.4		\$64.4			
23 Construction	\$1,684.9	\$1,318.6	\$366.3		\$366.3			
31-33 Manufacturing	\$1,298.0	\$1,154.1	\$143.9	\$66.1				\$77.8
42 Wholesale Trade	\$1,557.6	\$1,388.8	\$168.8					\$168.8
44-45 Retail Trade	\$1,461.3	\$1,461.3						
48-49 Transportation and Warehousing	\$1,012.0	\$587.6	\$424.3		\$96.5		\$327.8	
51 Information	\$423.4	\$423.4						
52 Finance and Insurance	\$1,125.3	\$1,124.7	\$0.6			\$0.6		
53 Real Estate and Rental & Leasing	\$263.8	\$197.0	\$66.9			\$66.9		
54 Professional and Technical Services	\$1,112.9	\$1,001.2	\$111.7			\$111.7		
55 Mgmt of Companies & Enterprises	\$429.6	\$403.4	\$26.2			\$26.2		
56 Administrative and Waste Services	\$496.2	\$485.8	\$10.4		\$1.4	\$8.9		
61 Educational Services	\$85.4	\$85.4						
62 Health Care and Social Assistance	\$3,001.7	\$3,001.7						
71 Arts, Entertainment, and Recreation	\$74.2	\$74.2						
72 Accommodation and Food Services	\$609.9	\$609.9						
81 Other Services	\$417.9	\$398.8	\$19.1			\$19.1		
Total	\$17,439.5	\$14,445.8	\$2,993.7	\$1,645.9	\$540.0	\$233.4	\$327.8	\$246.6

*Estimated using relationships from previous employment evaluations by Job Service North Dakota (2013, 2014, 2015, 2016).

**Job Service North Dakota (2019).

Appendix Table D7. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2016

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,487	4,487						
21 Mining, Quarrying, Oil & Gas	15,303	2,051	13,252	*13,130	*122			
22 Utilities	3,845	3,133	712		712			
23 Construction	31,067	26,151	4,916		4,916			
31-33 Manufacturing	24,570	23,220	1,350	*386				*964
42 Wholesale Trade	24,416	*21,839	*2,577					*2,577
44-45 Retail Trade	49,160	49,160						
48-49 Transportation and Warehousing	16,412	11,261	5,151		758		4,393	
51 Information	6,631	6,631						
52 Finance and Insurance	18,026	*18,011	*15			*15		
53 Real Estate and Rental & Leasing	5,112	4,441	671			671		
54 Professional and Technical Services	16,362	14,773	1,589			1,589		
55 Mgmt of Companies & Enterprises	5,253	5,140	113			113		
56 Administrative and Waste Services	12,829	12,693	136		*13	*123		
61 Educational Services	2,521	2,521						
62 Health Care and Social Assistance	58,359	58,359						
71 Arts, Entertainment, and Recreation	4,469	4,469						
72 Accommodation and Food Services	34,825	34,825						
81 Other Services	12,084	11,748	336			336		
Total	345,731	314,913	30,818	13,516	6,521	2,847	4,393	3,541

Source: Job Service North Dakota (2017). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D8. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2016

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$190.6	\$190.6						
21 Mining, Quarrying, Oil & Gas	\$1,473.5	\$184.0	\$1,289.5	*\$1,281.1	*\$8.4			
22 Utilities	\$369.9	\$301.0	\$69.2		\$69.2			
23 Construction	\$2,005.1	\$1,572.0	\$433.1		\$433.4			
31-33 Manufacturing	\$1,253.8	\$1,150.0	\$103.8	*\$48.5				*\$55.3
42 Wholesale Trade	\$1,532.1	*\$1,323.4	*\$208.7					*\$208.7
44-45 Retail Trade	\$1,488.2	\$1,488.0	\$0.2					
48-49 Transportation and Warehousing	\$953.0	\$533.0	\$420.0		\$95.7		\$323.9	
51 Information	\$419.4	\$419.4						
52 Finance and Insurance	\$1,091.9	*\$1,091.0	*\$0.9			*\$0.9		
53 Real Estate and Rental & Leasing	\$247.7	\$195.0	\$52.3			\$52.3		
54 Professional and Technical Services	\$1,106.4	\$967.0	\$139.1			\$139.1		
55 Mgmt of Companies & Enterprises	\$404.6	\$394.0	\$10.7			\$10.7		
56 Administrative and Waste Services	\$468.9	\$461.0	\$7.9		*\$0.9	*\$7.0		
61 Educational Services	\$80.1	\$80.1						
62 Health Care and Social Assistance	\$2,894.1	\$2,894.1						
71 Arts, Entertainment, and Recreation	\$71.5	\$71.5						
72 Accommodation and Food Services	\$607.2	\$607.2						
81 Other Services	\$397.2	\$375.0	\$22.1			\$22.1		
Total	\$17,055.1	\$14,298.0	\$2,757.5	\$1,329.6	\$607.6	\$232.1	\$323.9	\$264.0

Source: Job Service North Dakota (2017). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D9. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2015

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,391	4,391						
21 Mining, Quarrying, Oil & Gas	23,248	2,064	21,184	*20,948	*236			
22 Utilities	3,830	3,199	631		631			
23 Construction	34,051	27,849	6,202		6,201			
31-33 Manufacturing	25,431	23,610	1,821	*400				*1,421
42 Wholesale Trade	26,660	*22,468	*4,192					*4,192
44-45 Retail Trade	50,724	50,724						
48-49 Transportation and Warehousing	20,393	10,968	9,425		885		8,540	
51 Information	6,605	6,605						
52 Finance and Insurance	17,929	*17,905	*24			*24		
53 Real Estate and Rental & Leasing	5,650	4,233	1,417			1,416		
54 Professional and Technical Services	17,042	14,673	2,369			2,369		
55 Mgmt of Companies & Enterprises	5,333	4,924	409			409		
56 Administrative and Waste Services	13,714	13,474	240		*25	*215		
61 Educational Services	2,368	2,368						
62 Health Care and Social Assistance	56,765	56,765						
71 Arts, Entertainment, and Recreation	4,303	4,303						
72 Accommodation and Food Services	36,124	36,124						
81 Other Services	12,596	12,138	458			458		
Total	367,157	318,785	48,372	21,348	7,978	4,891	8,540	5,613

Source: Job Service North Dakota (2016). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D10. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2015

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$185.5	\$185.5						
21 Mining, Quarrying, Oil & Gas	\$2,362.0	\$182.5	\$2,179.5	*\$2,162.4	*\$17.1			
22 Utilities	\$364.7	\$304.1	\$60.6		\$60.6			
23 Construction	\$2,211.8	\$1,670.8	\$541.0		\$541.0			
31-33 Manufacturing	\$1,301.7	\$1,161.1	\$140.6	*\$52.1				*\$88.5
42 Wholesale Trade	\$1,776.5	*\$1,394.2	*\$382.3					*\$382.3
44-45 Retail Trade	\$1,561.5	\$1,561.5						
48-49 Transportation and Warehousing	\$1,290.3	\$502.9	\$787.4		\$107.9		\$679.5	
51 Information	\$395.6	\$395.6						
52 Finance and Insurance	\$1,061.9	*\$1,060.5	*\$1.4			*\$1.4		
53 Real Estate and Rental & Leasing	\$320.5	\$190.6	\$129.8			\$129.8		
54 Professional and Technical Services	\$1,188.8	\$950.6	\$238.3			\$238.3		
55 Mgmt of Companies & Enterprises	\$434.3	\$396.0	\$38.2			\$38.2		
56 Administrative and Waste Services	\$478.7	\$460.8	\$17.9		*\$2.0	*\$15.9		
61 Educational Services	\$75.2	\$75.2						
62 Health Care and Social Assistance	\$2,805.0	\$2,805.0						
71 Arts, Entertainment, and Recreation	\$70.0	\$70.0						
72 Accommodation and Food Services	\$634.3	\$634.3						
81 Other Services	\$419.2	\$386.3	\$32.9			\$32.9		
Total	\$18,937.4	\$14,387.4	\$4,549.9	\$2,214.5	\$728.6	\$456.5	\$679.5	\$470.8

Source: Job Service North Dakota (2016). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D11. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2014

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,365	4,365						
21 Mining, Quarrying, Oil & Gas	29,836	2,044	27,792	*27,513	*279			
22 Utilities	3,709	2,990	719		719			
23 Construction	34,767	25,675	9,092		9,091			
31-33 Manufacturing	25,953	24,014	1,939	*352				*1,587
42 Wholesale Trade	27,322	*22,423	*4,899					*4,899
44-45 Retail Trade	50,581	50,581						
48-49 Transportation and Warehousing	22,113	9,917	12,196		865		11,331	
51 Information	6,832	6,832						
52 Finance and Insurance	17,624	*17,563	*61			*61		
53 Real Estate and Rental & Leasing	5,827	3,714	2,113			2,113		
54 Professional and Technical Services	16,734	13,833	2,901			2,902		
55 Mgmt of Companies & Enterprises	5,298	4,979	319			320		
56 Administrative and Waste Services	14,234	13,931	303		*29	*274		
61 Educational Services	2,246	2,246						
62 Health Care and Social Assistance	55,523	55,523						
71 Arts, Entertainment, and Recreation	4,256	4,256						
72 Accommodation and Food Services	36,206	36,206						
81 Other Services	12,642	12,035	607			607		
Total	376,068	313,127	62,941	27,865	10,983	6,277	11,331	6,486

Source: Job Service North Dakota (2015). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D12. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2014

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$180.1	\$180.1						
21 Mining, Quarrying, Oil & Gas	\$3,127.2	\$185.7	\$2,941.5	*\$2,920.4	*\$21.1			
22 Utilities	\$335.5	\$273.0	\$62.4		\$62.4			
23 Construction	\$2,257.5	\$1,468.6	\$788.9		\$788.8			
31-33 Manufacturing	\$1,291.9	\$1,155.1	\$136.8	*\$37.9				*\$98.9
42 Wholesale Trade	\$1,860.2	*\$1,369.3	*\$490.9					*\$490.9
44-45 Retail Trade	\$1,502.0	\$1,502.0						
48-49 Transportation and Warehousing	\$1,441.8	\$420.1	\$1,021.7		\$100.6		\$921.1	
51 Information	\$399.0	\$399.0						
52 Finance and Insurance	\$988.4	*\$985.0	*\$3.4			*\$3.4		
53 Real Estate and Rental & Leasing	\$350.4	\$142.4	\$208.0			\$208.0		
54 Professional and Technical Services	\$1,206.9	\$879.6	\$327.3			\$327.3		
55 Mgmt of Companies & Enterprises	\$405.1	\$376.7	\$28.4			\$28.4		
56 Administrative and Waste Services	\$484.8	\$463.5	\$21.3		*\$1.0	*\$20.3		
61 Educational Services	\$70.8	\$70.8						
62 Health Care and Social Assistance	\$2,594.1	\$2,594.1						
71 Arts, Entertainment, and Recreation	\$66.3	\$66.3						
72 Accommodation and Food Services	\$625.3	\$625.3						
81 Other Services	\$408.6	\$362.7	\$45.9			\$45.9		
Total	\$19,585.6	\$13,509.2	\$6,076.5	\$2,958.3	\$973.9	\$633.3	\$921.1	\$589.8

Source: Job Service North Dakota (2015). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D13. Statewide Private Employment, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2013

NAICS Sector Designation	Statewide Private Employment (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastructure Development	Professional Service	Transportation	Wholesale Trade & Manufacturing
11 Ag, Forestry, Fishing and Hunting	4,264	4,264						
21 Mining, Quarrying, Oil & Gas	26,196	1,961	24,235	*23,962	*273			
22 Utilities	3,591	3,026	565		566			
23 Construction	32,303	24,317	7,986		7,985			
31-33 Manufacturing	25,410	23,619	1,791	*292				*1,499
42 Wholesale Trade	26,403	*21,788	*4,615					*4,615
44-45 Retail Trade	49,005	49,005						
48-49 Transportation and Warehousing	20,349	9,488	10,861		688		10,173	
51 Information	6,810	6,810						
52 Finance and Insurance	17,105	*17,036	*69			*69		
53 Real Estate and Rental & Leasing	5,116	3,473	1,643			1,643		
54 Professional and Technical Services	15,565	13,186	2,379			2,379		
55 Mgmt of Companies & Enterprises	5,127	4,871	256			256		
56 Administrative and Waste Services	13,476	13,222	254		*29	*225		
61 Educational Services	2,182	2,182						
62 Health Care and Social Assistance	55,086	55,086						
71 Arts, Entertainment, and Recreation	4,114	4,114						
72 Accommodation and Food Services	35,074	35,074						
81 Other Services	12,239	11,756	483			483		
Total	359,415	304,278	55,137	24,254	9,541	5,055	10,173	6,114

Source: Job Service North Dakota (2014). *Values were estimated due to data suppression from Job Service analysis.

Appendix Table D14. Statewide Private Employment Wages and Salaries, All Sectors and Direct Employment in Petroleum Industry, North Dakota, 2013

NAICS Sector Designation	Statewide Private Employment Salaries and Wages (QCEW)			Industry Segments and Groupings				
	Total	Non Oil & Gas	Oil & Gas	Drilling, Extraction, Production & Refining	Infrastr- ucture Develop- ment	Professional Service	Transport- ation	Wholesale Trade & Manufact- uring
----- millions \$ -----								
11 Ag, Forestry, Fishing and Hunting	\$170.0	\$170.0						
21 Mining, Quarrying, Oil & Gas	\$2,568.3	\$160.4	\$2,407.9	*\$2,388.9	*\$19.0			
22 Utilities	\$310.5	\$265.5	\$45.0		\$45.0			
23 Construction	\$1,945.3	\$1,312.4	\$632.9		\$632.9			
31-33 Manufacturing	\$1,222.3	\$1,101.4	\$120.9	*\$32.6				*\$88.3
42 Wholesale Trade	\$1,723.4	*\$1,281.3	*\$442.1					*\$442.1
44-45 Retail Trade	\$1,387.8	\$1,387.8						
48-49 Transportation and Warehousing	\$1,244.2	\$385.0	\$859.2		\$74.6		\$784.6	
51 Information	\$380.0	\$380.0						
52 Finance and Insurance	\$921.2	*\$917.7	*\$3.5			*\$3.5		
53 Real Estate and Rental & Leasing	\$274.3	\$121.8	\$152.5			\$152.5		
54 Professional and Technical Services	\$1,047.4	\$785.2	\$262.3			\$262.3		
55 Mgmt of Companies & Enterprises	\$358.8	\$336.0	\$22.8			\$22.8		
56 Administrative and Waste Services	\$430.3	\$413.7	\$16.6		*\$0.9	*\$15.7		
61 Educational Services	\$65.5	\$65.5						
62 Health Care and Social Assistance	\$2,463.6	\$2,463.6						
71 Arts, Entertainment, and Recreation	\$62.9	\$62.9						
72 Accommodation and Food Services	\$574.2	\$574.2						
81 Other Services	\$368.0	\$334.0	\$34.1			\$34.1		
Total	\$17,518.0	\$12,518.1	\$4,999.8	\$2,421.5	\$772.4	\$490.9	\$784.6	\$530.4

Source: Job Service North Dakota (2014). *Values were estimated due to data suppression from Job Service analysis.

The graphic consists of a vertical dark blue bar on the left. A blue arrow points from this bar to the right, containing the text 'Appendix E'. To the right of the arrow is a large yellow rectangle with a light gray border. Inside this rectangle, the title for Appendix E is written in bold black text.

Appendix E

**Economic Impacts by Industry
Segments, Delineated by 2-Digit
NAICS Codes, Petroleum
Industry, North Dakota, 2017
and 2019**

Appendix Table E1. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- jobs -----			
11 Ag, Forestry, Fishing & Hunting	0	8	20	28
21 Mining	6,832	27	1	6,860
22 Utilities	0	14	21	35
23 Construction	0	192	36	228
31-33 Manufacturing	0	44	18	62
42 Wholesale Trade	0	440	127	567
44-45 Retail trade	0	72	1,009	1,081
48-49 Transportation & Warehousing	0	290	193	482
51 Information	0	84	77	161
52 Finance & insurance	0	1,081	389	1,470
53 Real Estate & Rental	0	422	245	667
54 Professional, Scientific & Tech Services	0	1,409	145	1,554
55 Management of Companies	0	165	27	192
56 Administrative & Waste Services	0	708	169	876
61 Educational Services	0	0	1,315	1,315
62 Health & Social Services	0	3	111	114
71 Arts, Entertainment & Recreation	0	37	173	210
72 Accommodation & Food Services	0	392	690	1,082
81 Other Services	0	236	571	807
92 Government	0	33	49	82
Totals	6,832	5,656	5,386	17,874

Appendix Table E2. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- 000s \$ -----			
11 Ag, Forestry, Fishing & Hunting	0	54	232	286
21 Mining	861,400	1,990	90	863,480
22 Utilities	0	2,138	3,149	5,288
23 Construction	0	10,301	1,865	12,167
31-33 Manufacturing	0	2,898	1,006	3,904
42 Wholesale Trade	0	37,972	10,280	48,253
44-45 Retail trade	0	2,842	28,323	31,165
48-49 Transportation & Warehousing	0	14,558	8,754	23,311
51 Information	0	5,826	5,805	11,630
52 Finance & insurance	0	56,174	22,749	78,923
53 Real Estate & Rental	0	17,432	3,021	20,452
54 Professional, Scientific & Tech Services	0	97,134	8,406	105,540
55 Management of Companies	0	18,720	3,061	21,781
56 Administrative & Waste Services	0	22,513	5,846	28,359
61 Educational Services	0	2	81,359	81,361
62 Health & Social Services	0	66	2,815	2,881
71 Arts, Entertainment & Recreation	0	354	2,576	2,930
72 Accommodation & Food Services	0	8,211	14,594	22,804
81 Other Services	0	10,675	18,808	29,483
92 Government	0	1,862	3,564	5,425
Total	861,400	311,719	226,303	1,399,422

Appendix Table E3. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- millions \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	0	2	3
21 Mining	3,844	16	0	3,860
22 Utilities	0	16	23	39
23 Construction	0	44	8	52
31-33 Manufacturing	0	19	6	25
42 Wholesale Trade	0	142	39	181
44-45 Retail trade	0	8	84	92
48-49 Transportation & Warehousing	0	40	23	63
51 Information	0	32	27	59
52 Finance & insurance	0	258	104	362
53 Real Estate & Rental	0	152	140	291
54 Professional, Scientific & Tech Services	0	214	20	235
55 Management of Companies	0	36	6	41
56 Administrative & Waste Services	0	59	15	74
61 Educational Services	0	0	163	163
62 Health & Social Services	0	0	6	6
71 Arts, Entertainment & Recreation	0	2	11	13
72 Accommodation & Food Services	0	26	44	70
81 Other Services	0	27	49	76
92 Government	0	6	14	19
Total	3,843.6	1,096.1	785.4	5,725.1

Appendix Table E4. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	145	975	1,120
21 Mining	1,582,712	8,341	166	1,591,218
22 Utilities	0	5,740	8,308	14,048
23 Construction	0	21,615	3,797	25,413
31-33 Manufacturing	0	6,235	1,689	7,924
42 Wholesale Trade	0	84,191	21,491	105,682
44-45 Retail trade	0	4,891	44,527	49,418
48-49 Transportation & Warehousing	0	23,773	13,329	37,103
51 Information	0	15,859	14,486	30,345
52 Finance & insurance	0	98,556	40,264	138,820
53 Real Estate & Rental	0	107,365	100,008	207,373
54 Professional, Scientific & Tech Services	0	126,247	11,668	137,915
55 Management of Companies	0	20,517	3,355	23,872
56 Administrative & Waste Services	0	32,110	8,119	40,229
61 Educational Services	0	2	96,026	96,028
62 Health & Social Services	0	85	3,308	3,393
71 Arts, Entertainment & Recreation	0	611	4,798	5,409
72 Accommodation & Food Services	0	12,791	22,532	35,323
81 Other Services	0	16,670	27,964	44,634
92 Government	0	-19,626	1,161	-18,465
Total	1,582,712	566,120	427,969	2,576,801

Appendix Table E5. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	4	37	40
21 Mining	11,626	20	2	11,647
22 Utilities	0	133	38	171
23 Construction	0	218	66	284
31-33 Manufacturing	0	62	34	96
42 Wholesale Trade	0	607	233	840
44-45 Retail trade	0	97	1,852	1,949
48-49 Transportation & Warehousing	0	896	353	1,250
51 Information	0	159	141	300
52 Finance & insurance	0	1,272	713	1,985
53 Real Estate & Rental	0	612	450	1,062
54 Professional, Scientific & Tech Services	0	2,488	266	2,754
55 Management of Companies	0	787	49	837
56 Administrative & Waste Services	0	936	309	1,246
61 Educational Services	0	0	2,412	2,412
62 Health & Social Services	0	4	202	206
71 Arts, Entertainment & Recreation	0	61	317	378
72 Accommodation & Food Services	0	354	1,266	1,620
81 Other Services	0	221	1,047	1,269
92 Government	0	189	91	279
Total	11,626	9,120	9,879	30,625

Appendix Table E6. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	36	427	462
21 Mining	1,376,058	1,621	166	1,377,844
22 Utilities	0	19,749	5,782	25,530
23 Construction	0	11,659	3,422	15,081
31-33 Manufacturing	0	4,167	1,847	6,013
42 Wholesale Trade	0	51,083	18,868	69,950
44-45 Retail trade	0	3,678	51,980	55,658
48-49 Transportation & Warehousing	0	99,513	16,060	115,573
51 Information	0	10,561	10,654	21,215
52 Finance & insurance	0	74,638	41,717	116,355
53 Real Estate & Rental	0	21,602	5,544	27,145
54 Professional, Scientific & Tech Services	0	166,372	15,415	181,787
55 Management of Companies	0	89,504	5,616	95,120
56 Administrative & Waste Services	0	32,690	10,720	43,409
61 Educational Services	0	2	149,235	149,237
62 Health & Social Services	0	88	5,145	5,234
71 Arts, Entertainment & Recreation	0	554	4,722	5,276
72 Accommodation & Food Services	0	7,484	26,772	34,256
81 Other Services	0	10,338	34,490	44,828
92 Government	0	14,314	6,542	20,856
Total	1,376,058	619,649	415,121	2,410,828

Appendix Table E7. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- millions \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	0	3	3
21 Mining	27,430	10	0	27,441
22 Utilities	0	138	27	165
23 Construction	0	50	9	59
31-33 Manufacturing	0	26	7	33
42 Wholesale Trade	0	191	46	236
44-45 Retail trade	0	10	98	108
48-49 Transportation & Warehousing	0	240	27	267
51 Information	0	58	31	89
52 Finance & insurance	0	349	120	469
53 Real Estate & Rental	0	200	161	361
54 Professional, Scientific & Tech Services	0	345	23	368
55 Management of Companies	0	170	7	177
56 Administrative & Waste Services	0	86	17	103
61 Educational Services	0	0	189	189
62 Health & Social Services	0	0	7	7
71 Arts, Entertainment & Recreation	0	3	12	16
72 Accommodation & Food Services	0	23	51	74
81 Other Services	0	26	57	83
92 Government	0	52	16	68
Total	27,430.3	1,978.8	907.5	30,316.5

Appendix Table E8. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	127	1,789	1,916
21 Mining	19,667,024	5,453	304	19,672,780
22 Utilities	0	50,698	15,251	65,949
23 Construction	0	24,452	6,967	31,418
31-33 Manufacturing	0	8,596	3,100	11,696
42 Wholesale Trade	0	111,941	39,442	151,384
44-45 Retail trade	0	6,396	81,717	88,114
48-49 Transportation & Warehousing	0	171,057	24,451	195,508
51 Information	0	26,929	26,591	53,520
52 Finance & insurance	0	138,079	73,846	211,925
53 Real Estate & Rental	0	134,443	183,483	317,926
54 Professional, Scientific & Tech Services	0	212,343	21,397	233,740
55 Management of Companies	0	98,097	6,155	104,251
56 Administrative & Waste Services	0	47,502	14,889	62,391
61 Educational Services	0	2	176,135	176,138
62 Health & Social Services	0	116	6,048	6,164
71 Arts, Entertainment & Recreation	0	996	8,801	9,797
72 Accommodation & Food Services	0	11,545	41,337	52,882
81 Other Services	0	16,057	51,280	67,337
92 Government	0	7,350	2,156	9,506
Total	19,667,024	1,072,178	785,138	21,524,340

Appendix Table E9. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- jobs -----			
11 Ag, Forestry, Fishing & Hunting	0	1	7	8
21 Mining	853	15	0	868
22 Utilities	0	60	7	67
23 Construction	0	255	12	267
31-33 Manufacturing	386	13	6	405
42 Wholesale Trade	114	39	43	196
44-45 Retail trade	0	73	338	411
48-49 Transportation & Warehousing	644	407	64	1,116
51 Information	0	25	26	51
52 Finance & insurance	0	100	130	230
53 Real Estate & Rental	0	71	82	153
54 Professional, Scientific & Tech Services	0	177	49	225
55 Management of Companies	0	70	9	79
56 Administrative & Waste Services	0	236	56	293
61 Educational Services	0	0	440	440
62 Health & Social Services	0	2	37	39
71 Arts, Entertainment & Recreation	0	8	58	66
72 Accommodation & Food Services	0	92	231	323
81 Other Services	0	122	191	313
92 Government	0	24	17	40
Total	1,997	1,790	1,803	5,589

Appendix Table E10. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- 000s \$ -----			
11 Ag, Forestry, Fishing & Hunting	0	14	78	92
21 Mining	54,314	1,314	30	55,658
22 Utilities	0	7,618	1,054	8,672
23 Construction	0	11,770	624	12,394
31-33 Manufacturing	31,417	763	337	32,517
42 Wholesale Trade	5,170	2,802	3,441	11,413
44-45 Retail trade	0	1,928	9,481	11,409
48-49 Transportation & Warehousing	63,216	34,007	2,930	100,152
51 Information	0	1,494	1,943	3,437
52 Finance & insurance	0	4,985	7,613	12,598
53 Real Estate & Rental	0	1,714	1,011	2,725
54 Professional, Scientific & Tech Services	0	10,284	2,813	13,097
55 Management of Companies	0	6,902	1,025	7,927
56 Administrative & Waste Services	0	7,043	1,956	8,999
61 Educational Services	0	1	27,230	27,230
62 Health & Social Services	0	40	941	981
71 Arts, Entertainment & Recreation	0	60	862	922
72 Accommodation & Food Services	0	1,690	4,884	6,574
81 Other Services	0	5,092	6,294	11,386
92 Government	0	1,576	1,193	2,769
Total	154,117	101,095	75,741	330,953

Appendix Table E11. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- millions \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	0	1	1
21 Mining	79	5	0	84
22 Utilities	0	59	8	66
23 Construction	0	50	3	52
31-33 Manufacturing	2,646	4	2	2,653
42 Wholesale Trade	47	11	13	71
44-45 Retail trade	0	7	28	35
48-49 Transportation & Warehousing	118	79	8	205
51 Information	0	8	9	17
52 Finance & insurance	0	21	35	56
53 Real Estate & Rental	0	17	47	63
54 Professional, Scientific & Tech Services	0	24	7	30
55 Management of Companies	0	13	2	15
56 Administrative & Waste Services	0	17	5	22
61 Educational Services	0	0	55	55
62 Health & Social Services	0	0	2	2
71 Arts, Entertainment & Recreation	0	0	4	4
72 Accommodation & Food Services	0	5	15	20
81 Other Services	0	11	17	28
92 Government	0	6	5	10
Total	2,890.3	335.4	262.9	3,488.6

Appendix Table E12. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2019

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	48	326	374
21 Mining	84,985	2,764	55	87,805
22 Utilities	0	23,233	2,781	26,015
23 Construction	0	27,469	1,271	28,740
31-33 Manufacturing	292,452	1,627	565	294,644
42 Wholesale Trade	50,117	7,252	7,194	64,562
44-45 Retail trade	0	4,258	14,905	19,163
48-49 Transportation & Warehousing	124,554	61,573	4,461	190,588
51 Information	0	4,579	4,850	9,428
52 Finance & insurance	0	9,562	13,475	23,037
53 Real Estate & Rental	0	11,804	33,474	45,278
54 Professional, Scientific & Tech Services	0	15,539	3,905	19,443
55 Management of Companies	0	8,415	1,123	9,537
56 Administrative & Waste Services	0	10,682	2,717	13,399
61 Educational Services	0	1	32,138	32,139
62 Health & Social Services	0	62	1,106	1,168
71 Arts, Entertainment & Recreation	0	130	1,606	1,736
72 Accommodation & Food Services	0	2,888	7,542	10,429
81 Other Services	0	8,236	9,358	17,594
92 Government	0	1,553	390	1,944
Total	552,107	201,674	143,243	897,024

Appendix Table E13. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- jobs -----			
11 Ag, Forestry, Fishing & Hunting	0	4	7	11
21 Mining	6,031	28	1	6,060
22 Utilities	0	13	10	23
23 Construction	0	225	29	254
31-33 Manufacturing	0	22	12	34
42 Wholesale Trade	0	255	97	352
44-45 Retail trade	0	42	621	664
48-49 Transportation & Warehousing	0	98	88	186
51 Information	0	71	44	115
52 Finance & insurance	0	609	233	842
53 Real Estate & Rental	0	207	151	358
54 Professional, Scientific & Tech Services	0	863	101	964
55 Management of Companies	0	192	19	211
56 Administrative & Waste Services	0	451	119	570
61 Educational Services	0	0	82	83
62 Health & Social Services	0	0	710	710
71 Arts, Entertainment & Recreation	0	26	82	107
72 Accommodation & Food Services	0	495	402	897
81 Other Services	0	103	361	464
92 Government	0	15	32	48
Totals	6,031	3,720	3,200	12,951

Appendix Table E14. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- 000s \$ -----			
11 Ag, Forestry, Fishing & Hunting	0	39	109	147
21 Mining	709,978	2,299	66	712,344
22 Utilities	0	1,825	1,315	3,139
23 Construction	0	11,355	1,470	12,825
31-33 Manufacturing	0	1,302	687	1,989
42 Wholesale Trade	0	18,592	7,086	25,678
44-45 Retail trade	0	1,414	17,875	19,289
48-49 Transportation & Warehousing	0	5,486	4,459	9,945
51 Information	0	4,522	3,011	7,533
52 Finance & insurance	0	26,184	12,284	38,468
53 Real Estate & Rental	0	8,607	1,400	10,007
54 Professional, Scientific & Tech Services	0	65,790	4,990	70,780
55 Management of Companies	0	18,122	1,822	19,945
56 Administrative & Waste Services	0	16,162	3,856	20,018
61 Educational Services	0	7	1,859	1,866
62 Health & Social Services	0	1	40,841	40,842
71 Arts, Entertainment & Recreation	0	210	1,211	1,421
72 Accommodation & Food Services	0	9,564	8,081	17,645
81 Other Services	0	4,667	9,925	14,592
92 Government	0	872	2,039	2,911
Total	709,978	197,018	124,386	1,031,382

Appendix Table E15. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	266	1,171	1,437
21 Mining	3,381,445	7,973	296	3,389,713
22 Utilities	0	16,060	11,493	27,553
23 Construction	0	39,431	5,141	44,572
31-33 Manufacturing	0	8,382	4,890	13,273
42 Wholesale Trade	0	65,665	25,026	90,692
44-45 Retail trade	0	3,963	55,748	59,711
48-49 Transportation & Warehousing	0	14,981	12,528	27,508
51 Information	0	23,193	14,769	37,962
52 Finance & insurance	0	117,128	51,775	168,903
53 Real Estate & Rental	0	84,739	80,871	165,610
54 Professional, Scientific & Tech Services	0	126,132	11,907	138,039
55 Management of Companies	0	39,906	4,013	43,919
56 Administrative & Waste Services	0	35,823	9,378	45,202
61 Educational Services	0	17	3,652	3,669
62 Health & Social Services	0	2	77,217	77,219
71 Arts, Entertainment & Recreation	0	1,057	5,549	6,605
72 Accommodation & Food Services	0	38,995	23,390	62,385
81 Other Services	0	14,076	24,775	38,851
92 Government	0	2,577	7,638	10,215
Total	3,381,445	640,366	431,227	4,453,037

Appendix Table E16. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Development, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	138	639	777
21 Mining	1,875,816	6,799	159	1,882,774
22 Utilities	0	5,940	4,314	10,254
23 Construction	0	21,338	2,665	24,002
31-33 Manufacturing	0	2,642	1,259	3,901
42 Wholesale Trade	0	46,207	17,610	63,817
44-45 Retail trade	0	2,466	33,144	35,609
48-49 Transportation & Warehousing	0	9,146	7,333	16,479
51 Information	0	10,295	7,167	17,462
52 Finance & insurance	0	45,559	22,790	68,350
53 Real Estate & Rental	0	64,556	54,580	119,136
54 Professional, Scientific & Tech Services	0	76,030	7,329	83,359
55 Management of Companies	0	20,968	2,108	23,076
56 Administrative & Waste Services	0	25,367	5,984	31,351
61 Educational Services	0	8	1,876	1,884
62 Health & Social Services	0	1	47,636	47,637
71 Arts, Entertainment & Recreation	0	334	2,273	2,606
72 Accommodation & Food Services	0	22,024	12,710	34,734
81 Other Services	0	10,185	16,541	26,725
92 Government	0	-5,973	-1,364	-7,337
Total	1,875,816	364,028	246,753	2,486,596

Appendix Table E17. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- jobs -----				
11 Ag, Forestry, Fishing & Hunting	0	3	30	33
21 Mining	10,286	17	3	10,306
22 Utilities	0	47	39	85
23 Construction	0	878	115	993
31-33 Manufacturing	0	33	47	79
42 Wholesale Trade	0	297	391	688
44-45 Retail trade	0	127	2,513	2,640
48-49 Transportation & Warehousing	0	439	358	796
51 Information	0	95	177	271
52 Finance & insurance	0	440	925	1,365
53 Real Estate & Rental	0	288	599	886
54 Professional, Scientific & Tech Services	0	801	409	1,210
55 Management of Companies	0	742	78	820
56 Administrative & Waste Services	0	357	484	841
61 Educational Services	0	1	352	352
62 Health & Social Services	0	0	2,864	2,864
71 Arts, Entertainment & Recreation	0	36	336	372
72 Accommodation & Food Services	0	291	1,626	1,917
81 Other Services	0	84	1,447	1,531
92 Government	0	57	128	185
Total	10,286	5,031	12,919	28,236

Appendix Table E18. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	35	440	475
21 Mining	1,273,783	1,398	268	1,275,449
22 Utilities	0	6,076	5,252	11,328
23 Construction	0	44,690	6,000	50,690
31-33 Manufacturing	0	1,962	2,788	4,750
42 Wholesale Trade	0	21,891	28,812	50,703
44-45 Retail trade	0	3,959	72,969	76,929
48-49 Transportation & Warehousing	0	51,944	18,239	70,182
51 Information	0	5,935	12,155	18,091
52 Finance & insurance	0	21,956	49,420	71,376
53 Real Estate & Rental	0	12,203	5,613	17,815
54 Professional, Scientific & Tech Services	0	57,187	20,479	77,666
55 Management of Companies	0	70,888	7,403	78,291
56 Administrative & Waste Services	0	13,869	15,814	29,684
61 Educational Services	0	10	8,027	8,037
62 Health & Social Services	0	1	164,553	164,554
71 Arts, Entertainment & Recreation	0	322	5,020	5,342
72 Accommodation & Food Services	0	5,732	32,955	38,687
81 Other Services	0	3,763	40,000	43,764
92 Government	0	3,831	8,159	11,990
Total	1,273,783	327,652	504,366	2,105,801

Appendix Table E19. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	266	3,322	3,588
21 Mining	22,214,571	5,300	834	22,220,705
22 Utilities	0	52,510	31,774	84,284
23 Construction	0	155,895	14,658	170,553
31-33 Manufacturing	0	11,029	13,744	24,773
42 Wholesale Trade	0	76,948	70,393	147,340
44-45 Retail trade	0	11,110	157,328	168,437
48-49 Transportation & Warehousing	0	117,101	35,665	152,766
51 Information	0	28,524	40,998	69,522
52 Finance & insurance	0	88,158	144,042	232,200
53 Real Estate & Rental	0	124,033	230,453	354,486
54 Professional, Scientific & Tech Services	0	111,400	33,995	145,395
55 Management of Companies	0	155,590	11,294	166,884
56 Administrative & Waste Services	0	33,183	26,798	59,981
61 Educational Services	0	27	11,009	11,035
62 Health & Social Services	0	2	216,463	216,466
71 Arts, Entertainment & Recreation	0	1,627	15,873	17,500
72 Accommodation & Food Services	0	21,944	66,317	88,261
81 Other Services	0	11,330	69,542	80,873
92 Government	0	14,243	21,163	35,407
Total	22,214,571	1,020,219	1,215,664	24,450,455

Appendix Table E20. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Production, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	136	2,605	2,741
21 Mining	18,383,825	3,974	641	18,388,439
22 Utilities	0	20,093	17,234	37,327
23 Construction	0	83,984	10,874	94,858
31-33 Manufacturing	0	3,588	5,105	8,692
42 Wholesale Trade	0	54,406	71,606	126,012
44-45 Retail trade	0	6,749	135,291	142,040
48-49 Transportation & Warehousing	0	83,689	30,037	113,725
51 Information	0	12,569	28,852	41,421
52 Finance & insurance	0	37,964	91,780	129,744
53 Real Estate & Rental	0	93,257	223,623	316,880
54 Professional, Scientific & Tech Services	0	67,841	30,091	97,932
55 Management of Companies	0	82,018	8,565	90,584
56 Administrative & Waste Services	0	21,156	24,555	45,711
61 Educational Services	0	12	8,082	8,094
62 Health & Social Services	0	1	192,318	192,319
71 Arts, Entertainment & Recreation	0	514	9,329	9,843
72 Accommodation & Food Services	0	12,309	51,829	64,137
81 Other Services	0	8,239	66,860	75,099
92 Government	0	1,600	-5,722	-4,121
Total	18,383,825	594,097	1,003,555	19,981,477

Appendix Table E21. Employment, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- jobs -----			
11 Ag, Forestry, Fishing & Hunting	0	0	4	4
21 Mining	0	1	0	1
22 Utilities	735	7	5	746
23 Construction	0	168	14	182
31-33 Manufacturing	288	7	6	300
42 Wholesale Trade	99	251	46	396
44-45 Retail trade	0	31	295	327
48-49 Transportation & Warehousing	644	335	42	1,021
51 Information	0	23	21	44
52 Finance & insurance	0	133	111	244
53 Real Estate & Rental	0	58	72	130
54 Professional, Scientific & Tech Services	0	221	48	269
55 Management of Companies	0	42	9	51
56 Administrative & Waste Services	0	157	57	214
61 Educational Services	0	1	39	40
62 Health & Social Services	0	0	338	338
71 Arts, Entertainment & Recreation	0	14	39	53
72 Accommodation & Food Services	0	63	191	254
81 Other Services	0	58	172	230
92 Government	0	11	15	26
Total	1,766	1,583	1,522	4,871

Appendix Table E22. Employment Compensation, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
	----- 000s \$ -----			
11 Ag, Forestry, Fishing & Hunting	0	5	50	55
21 Mining	0	95	31	125
22 Utilities	97,500	867	606	98,973
23 Construction	0	7,835	675	8,509
31-33 Manufacturing	57,701	333	316	58,349
42 Wholesale Trade	7,229	16,934	3,256	27,419
44-45 Retail trade	0	886	8,208	9,094
48-49 Transportation & Warehousing	91,452	29,289	2,047	122,787
51 Information	0	1,232	1,385	2,618
52 Finance & insurance	0	7,974	5,654	13,627
53 Real Estate & Rental	0	600	645	1,244
54 Professional, Scientific & Tech Services	0	11,071	2,289	13,361
55 Management of Companies	0	3,675	837	4,512
56 Administrative & Waste Services	0	4,617	1,769	6,387
61 Educational Services	0	30	846	875
62 Health & Social Services	0	0	18,792	18,792
71 Arts, Entertainment & Recreation	0	108	555	662
72 Accommodation & Food Services	0	1,186	3,711	4,897
81 Other Services	0	2,010	4,567	6,576
92 Government	0	655	939	1,594
Total	253,881	89,401	57,175	400,457

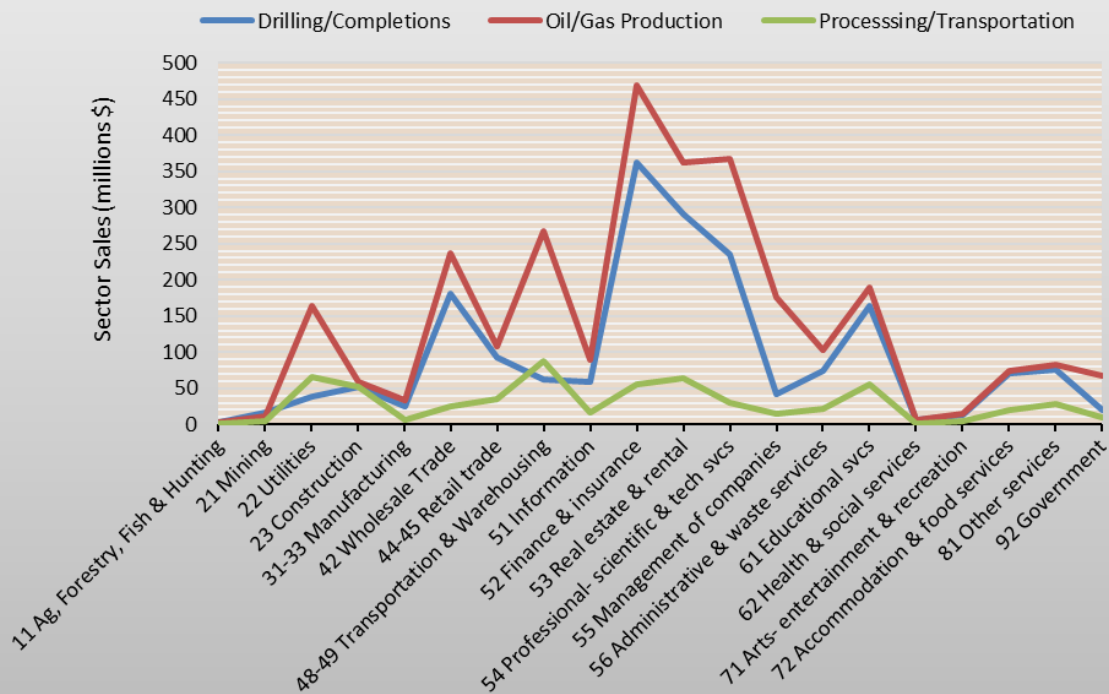
Appendix Table E23. Gross Business Volume, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	67	658	725
21 Mining	0	529	167	696
22 Utilities	348,748	9,170	6,476	364,394
23 Construction	0	32,713	2,887	35,600
31-33 Manufacturing	1,701,729	1,906	2,749	1,706,384
42 Wholesale Trade	25,533	71,915	14,062	111,510
44-45 Retail trade	0	3,004	31,306	34,310
48-49 Transportation & Warehousing	194,749	84,614	7,030	286,393
51 Information	0	6,736	8,314	15,050
52 Finance & insurance	0	32,615	29,150	61,765
53 Real Estate & Rental	0	14,219	45,381	59,600
54 Professional, Scientific & Tech Services	0	27,346	6,681	34,027
55 Management of Companies	0	9,729	2,255	11,984
56 Administrative & Waste Services	0	13,533	5,258	18,791
61 Educational Services	0	86	2,034	2,120
62 Health & Social Services	0	1	43,446	43,448
71 Arts, Entertainment & Recreation	0	611	3,112	3,723
72 Accommodation & Food Services	0	4,047	13,137	17,184
81 Other Services	0	7,880	13,936	21,816
92 Government	0	2,994	4,304	7,297
Total	2,270,758	323,715	242,343	2,836,816

Appendix Table E24. Value-added Activity, Direct, Indirect, and Induced Economic Effects, by Economic Sector, Oil and Gas Processing and Transportation, Petroleum Industry, North Dakota, 2017

NAICS Code and Economic Sector	Direct	Indirect	Induced	Total
----- 000s \$ -----				
11 Ag, Forestry, Fishing & Hunting	0	33	339	372
21 Mining	0	272	85	357
22 Utilities	132,008	3,224	2,296	137,528
23 Construction	0	16,789	1,414	18,203
31-33 Manufacturing	281,667	585	669	282,921
42 Wholesale Trade	17,967	47,995	9,348	75,310
44-45 Retail trade	0	1,716	17,583	19,299
48-49 Transportation & Warehousing	145,195	53,981	3,888	203,064
51 Information	0	2,742	3,811	6,552
52 Finance & insurance	0	15,666	12,116	27,782
53 Real Estate & Rental	0	9,481	28,938	38,418
54 Professional, Scientific & Tech Services	0	16,509	3,885	20,394
55 Management of Companies	0	4,848	1,119	5,968
56 Administrative & Waste Services	0	8,265	3,172	11,437
61 Educational Services	0	38	986	1,024
62 Health & Social Services	0	1	25,316	25,316
71 Arts, Entertainment & Recreation	0	190	1,205	1,394
72 Accommodation & Food Services	0	2,071	6,744	8,815
81 Other Services	0	5,432	8,789	14,221
92 Government	0	143	-720	-577
Total	576,836	189,980	130,980	897,796

Appendix Figure E1. Gross Business Volume, Indirect and Induced Activity, by 2-digit NAICS, North Dakota, 2019



Appendix Figure E2. Employment, Indirect and Induced Activity, by 2-digit NAICS, North Dakota, 2019

