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Petroleum Industry's Economic Contribution to North Dakota in 2011



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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, and processing in North Dakota in 2011. Expenditures made in North Dakota by oil companies represented the direct impacts of the industry. Secondary economic impacts result from the spending and responding of the direct impacts and were estimated using the North Dakota Input-Output Model.

Surveys were used to collect production, expenditure, and employment data for the petroleum industry in North Dakota. Oil operators (i.e., firms that own or operate oil wells) in the state were surveyed to obtain information on in-state expenses for oil and gas exploration, expenses for oil and gas extraction/production, general business expenditures, employment, oil and gas output, and information on leasing and drilling activity. A similar survey was conducted for firms engaged in pipeline transportation and processing of crude oil and natural gas in North Dakota. A third survey was conducted of firms providing services, inputs, and equipment in the oil fields. A fourth survey of leasing/brokerage firms was used to gather data on lease bonuses paid to in-state and out-of-state mineral owners.

The survey of oil operators produced financial data on 32 percent of North Dakota's oil and natural gas production in 2011. Secondary data, obtained from government agencies, were combined with survey data to estimate royalties, lease bonuses, and severance taxes.

Total in-state expenditures in 2011 for oil and gas exploration (e.g., seismic testing, well drilling, well completions) were estimated from survey data and statewide drilling statistics. A total of 1,271 wells were completed in 2011. Average expense per well for oil operators was estimated at \$9.1 million, yielding about \$11.6 billion in total financial outlays for well development. Financial data on expenses for well development were obtained from oil operators, and adjustments to the capital costs to drill and complete a well were performed to reflect specific inputs supplied by in-state sources. The net effect of removing expenses for those capital outlays revealed that about 48 percent of the cost to complete a well in North Dakota in 2011 represented economic leakage and was not included in the industry's direct economic impacts. The direct impact per well completed in the state was estimated at \$4.5 million. The combination of in-state expenses for exploration and lease bonuses resulted in \$6.1 billion in direct impacts in 2011. The secondary economic impacts associated with exploration activities were estimated at \$10.7 billion. The in-state gross business volume (direct and secondary impacts) of exploration/development activities was estimated at \$16.8 billion in 2011.

Estimates of oil and gas extraction/production expenses, general business expenses for oil operators, private and public mineral royalties, and state severance taxes were derived from survey data and secondary information obtained from various government agencies. The state had 5,555 producing wells (average monthly) which combined for nearly 153

million barrels of oil and 179 million mcf of natural gas in 2011. Those volumes of oil and gas production resulted in an estimated \$932 million for in-state expenditures for extraction/production, \$648 million for general business expenses, \$1.3 billion in state severance taxes, and a combined \$1.1 billion of in-state private and public oil and gas royalties. Total direct impacts for oil and gas production were estimated at \$4 billion in 2011. Total secondary economic impacts associated with production activities were estimated at \$4.7 billion. The in-state gross business volume of oil and gas extraction/production was estimated at \$8.6 billion in 2011.

In-state expenditures for transportation of crude oil, pipeline operation, crude oil rail loading facilities, natural gas processing, and crude oil refining were estimated to have a direct impact in North Dakota of \$475 million in 2011. Total secondary economic impacts associated with processing and transporting crude oil and natural gas were estimated at \$900 million. Processing and transporting crude oil and natural gas generated a gross business volume of \$1.4 billion in 2011.

The petroleum industry was estimated to have capital expenditures between \$2.5 billion to \$2.7 billion for infrastructure projects in the state in 2011. After adjustments for economic leakage (the portion of expenditures not captured in the North Dakota economy), it was estimated that about \$1.1 billion to \$1.2 billion were captured in the North Dakota economy. The gross business volume associated with infrastructure spending in North Dakota was estimated to range from \$3.4 to \$3.7 billion in 2011. Infrastructure spending, as defined in this report, would represent additional economic activity beyond that created by the exploration, production, and processing segments of the industry.

Industry-wide direct and secondary economic impacts from the petroleum industry were estimated at \$11.7 billion and \$18.7 billion, respectively. The gross business volume for the entire industry, including infrastructure spending, in North Dakota in 2011 was estimated at \$30.4 billion.

Additional measures of the petroleum industry's economic importance to the state include direct employment for 40,800 full-time jobs, economy-wide personal income of \$11.6 billion, statewide retail sales of \$7.4 billion, direct contributions to local and state government tax revenues of \$2.25 billion, indirect contribution of \$395 million in state government general tax collections, and secondary employment of 18,700 full-time equivalent jobs.

Comparing various production statistics between previous studies revealed that the number of producing wells, oil and gas production, and drilling activities all increased in the state. Oil and natural gas prices among the four studies were highest in 2011. From 2005 to 2011, expenditures for exploration (i.e., general exploration, well drilling, well completions, and lease bonuses) in the state increased 1,126 percent in real terms (i.e., correcting for

inflation). By comparison, expenditures for oil and natural gas production over the same period paralleled changes in oil and gas output and were estimated to increase by 289 percent in real terms. Processing and transportation activities also showed substantial growth over the period due to increased processing and transportation volumes and expansion of processing and pipeline capacities. Economic activity associated with the processing segment of the industry increased in real terms by 219 percent from 2005 to 2011. Overall, the gross business volume (i.e., direct and secondary economic effects) of the industry was estimated to increase 6-fold (511 percent) in real terms from \$4.4 billion in 2005 to \$26.9 billion in 2011 (excluding infrastructure spending). Infrastructure spending was not included in earlier assessments; however, when capital expenditures for infrastructure projects are added to the other segments of the industry, the gross business volume for the petroleum sector in 2011 was estimated at \$30.4 billion.

PETROLEUM INDUSTRY'S ECONOMIC CONTRIBUTION TO NORTH DAKOTA IN 2011

DEAN A. BANGSUND

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). Since that time, North Dakota has witnessed an unprecedented increase in oil production. As of 2012, North Dakota ranked second in oil production behind only Texas (U.S. Department of Energy 2012).

The expansion of oil development associated with shale formations that started in the mid 2000s has continued to garner local, state, and national headlines. No longer is the rapid development of the oil patch in North Dakota a phenomenon only visible to those working in the industry or living in western North Dakota. The economic value of the rapidly expanding

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petroleum industry is difficult to follow as the industry has grown and expanded beyond historical precedents. However as the state continues to adjust to an ever-expanding petroleum sector, policymakers, legislators, and business leaders would benefit from an understanding of the economic effects of the industry.

Determining the economic contribution of a given industry quantifies its importance to state and local economies. Not only can the economic impacts 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 exploration and production, demonstrate the economic dependence of the state on natural resource-based industries, and indicate the economic impacts 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 2012a). Of the 17 counties producing oil, production is concentrated in Billings, Dunn, Bowman, McKenzie, Mountrail and Williams Counties. Those counties accounted for 90 percent of state oil production in 2011 (North Dakota Department of Mineral Resources 2012a). Production in key counties has fluctuated over the last 50 years as new oil deposits are found and developed in various locations in the state (Figure 2). Since 2002, major increases in oil production have occurred in Bowman, McKenzie, Dunn, and Mountrail Counties.

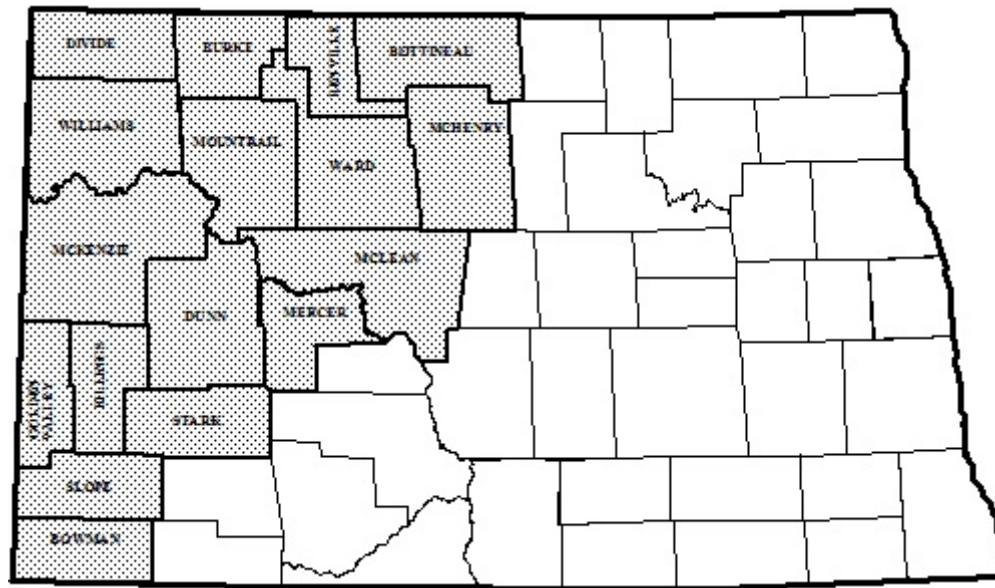


Figure 1. Oil Producing Counties, North Dakota

Nationally, North Dakota is ninth among all oil producing states based on cumulative crude oil production from 1981 through 2011 (Figure 3) (U.S. Department of Energy 2012). Based on crude oil production in 2011, North Dakota ranked fourth nationally among oil producing states. North Dakota accounted for about 9.7 percent of domestic crude oil (excluding federal off-shore) production in 2011.

North Dakota is less of a factor in domestic natural gas production. From 1981 through 2010, North Dakota accounted for only 0.37 percent of national production (U.S. Department of Energy 2012). North Dakota was ranked 19th in natural gas production in 2010.

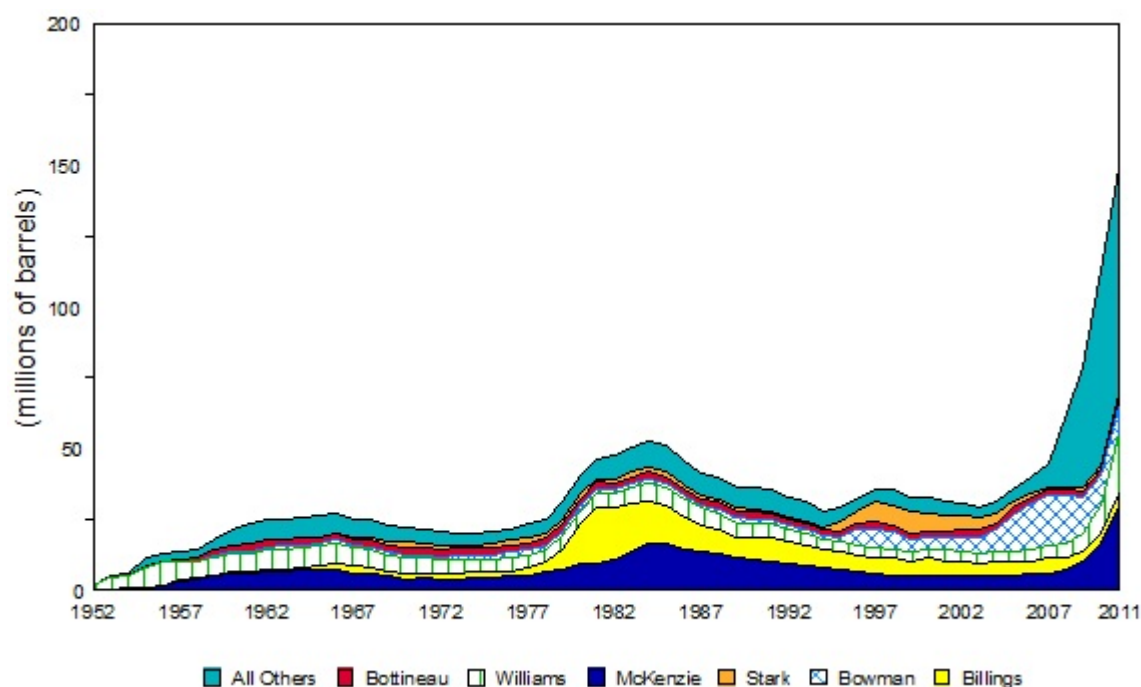


Figure 2. Historic Oil Production, Key Counties, North Dakota, 1952 through 2009
Source: North Dakota Department of Mineral Resources (2012a).

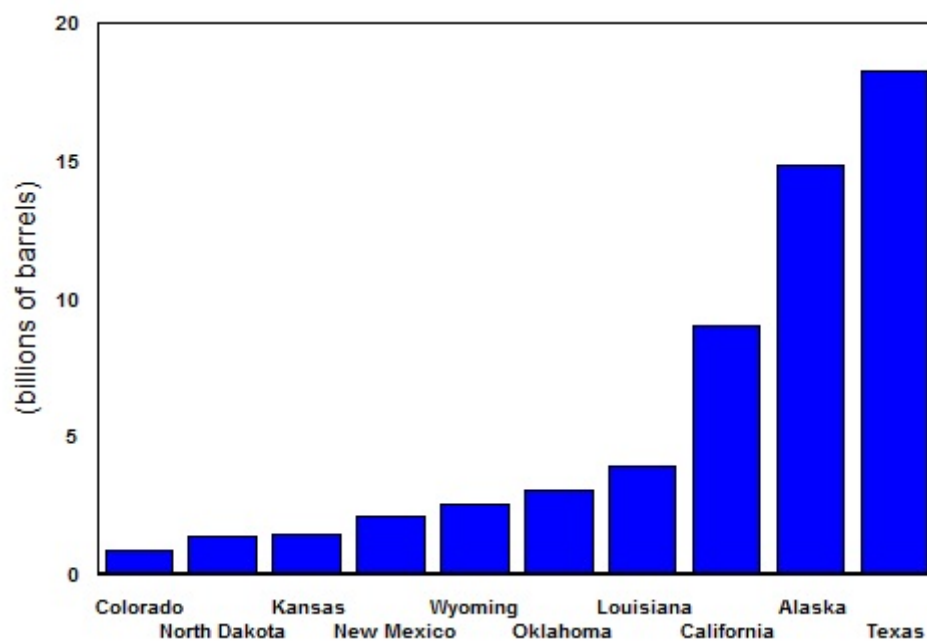


Figure 3. Top States in Cumulative On-Shore Crude Oil Production, United States, 1981 through 2011
Source: U.S. Department of Energy (2012).

Oil production in North Dakota has fluctuated substantially since commercial production began in the early 1950s (Figure 4). 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. Since 1994, oil production in the state has seen two periods of expansion and one period of declining production. Crude oil production in the state is currently rapidly increasing, and crude oil production has set all-time annual production records in 2008 and 2009.

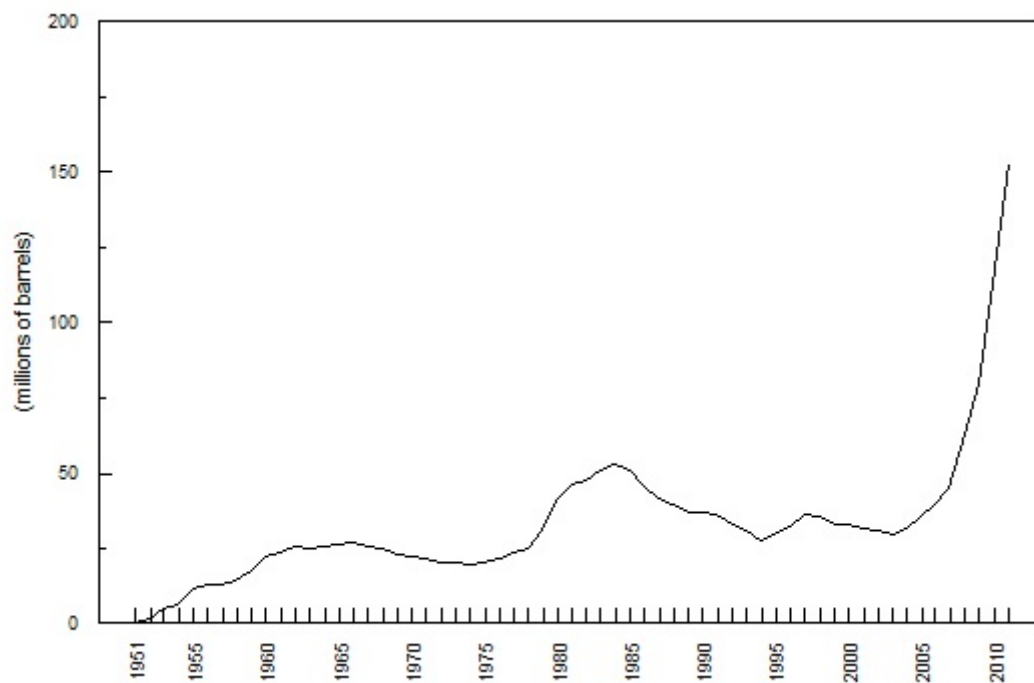


Figure 4. Crude Oil Production, North Dakota, 1951 through 2011

Source: North Dakota Department of Mineral Resources (2012a).

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 (2012a). The overall value of oil production in North Dakota, in nominal terms, has generally paralleled oil production despite price fluctuations over time (Figure 5). Nominal oil prices were converted to real dollars (2009) using the Gross Domestic Product-Implicit Price Deflator (U.S. Department of Commerce 2012). In real terms, from 1980 to 2000 the value of crude oil production in North Dakota largely declined (Figure 6). However, in both real terms and nominal terms, the value of crude oil production in the state has increased substantially since 2000 (Figure 6).

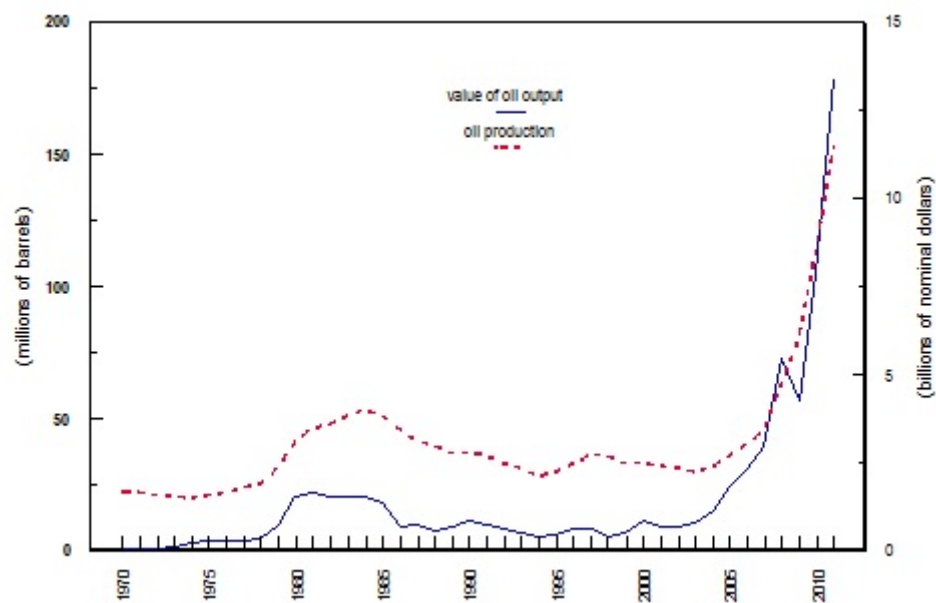


Figure 5. Production and Market Value of Crude Oil, North Dakota, 1970 through 2011
Source: North Dakota Department of Mineral Resources (2012a).

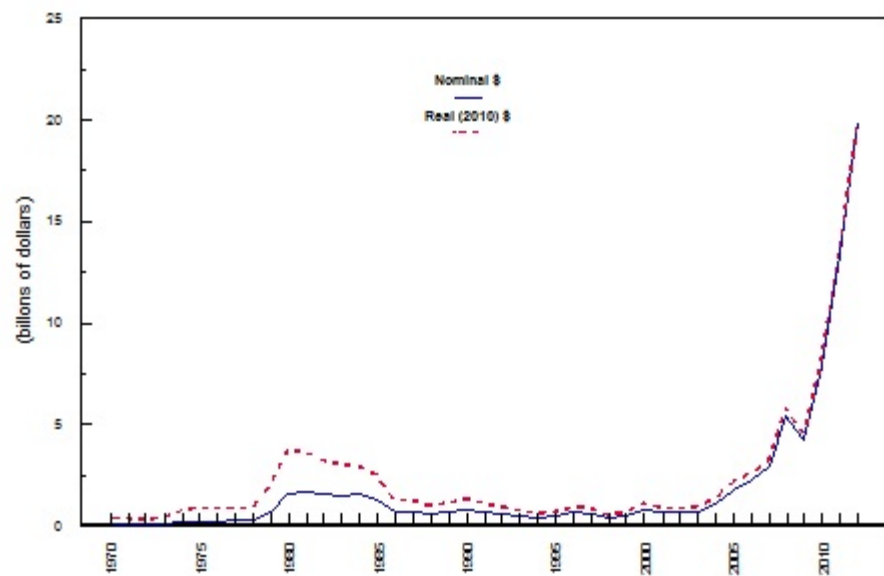


Figure 6. Value of Crude Oil Production in Nominal and Real Dollars, North Dakota, 1970 through 2011

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 Leistritz 1995a, 1995b, 1998, 1999, 2004, 2005, 2010; Coon et al. 2012a, 2012b).

Data Collection

Due to the complexities of how the oil and gas industry is structured, and that in-state effects (i.e., first round spending or direct impacts) from oil and gas production in any given year may not equal the market value of oil and gas production, an expenditure-based approach to measuring the economic size of the petroleum industry was used in this study. In this approach, 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. Four separate survey efforts were conducted for the study and provided the basis for most of the economic data needed to complete the study.

Oil Operators

Firms that own or operate oil wells in the state were surveyed to obtain information on expenses for oil and gas exploration and 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 names and addresses for 60 oil operators in the state. 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. After two mailings, dissemination of survey materials and solicitation of industry cooperation was deferred to the study sponsor.

The combination of two mailings and personal contacts of oil operators conducted by the study sponsor resulted in useable information from 10 firms. The firms' production from owned/operated wells represented 32 percent of the state's 2011 production of crude oil and natural gas (Table 1). An additional follow-up data request was initiated for companies participating in the study to obtain detailed financial data on well completion costs to delineate in-state versus out-of-state supplies for those inputs.

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

Table 1. Basic Production Statistics from Survey of Oil Operators, North Dakota, 2011

Number of firms responding with useful information	10
Number of wells owned or operated in North Dakota (10 firms)	2,161
Crude oil production in 2011 in North Dakota (10 firms)	46,861,655 barrels ^a
Natural gas production in 2011 in North Dakota (10 firms)	51,137,922 mcf ^a
Number of oil wells drilled in 2011 with financials (9 firms)	384

^a Output from wells operated or owned. Does not include production from working interests.

Pipelines and Processors

Another survey was conducted for firms engaged in pipeline transportation of crude oil and unprocessed natural gas produced in North Dakota and for 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 B). A mailing list of 12 firms operating pipelines, gas processing plants, and oil refineries were provided by the North Dakota Petroleum Council. The firms on the mailing list received two mailings, with some firms being contacted numerous times by industry representatives. A total of six firms provided useable information. While representative data for industry activities in this segment of the industry were obtained through the survey, a breakout of survey data for crude oil pipelines, natural gas processing plants and pipelines, and crude oil refineries is not possible due to confidentiality reasons. Firms operating pipelines for the transport of refined or processed petroleum products were not included in the study.

Service and Support

A third survey was used to obtain information from firms that provide service and support to oil operators in the state. The survey solicited information on the type and extent of involvement in the petroleum industry, in-state expenditures, and employment in North Dakota (Appendix C). The mailing list was obtained from lists of contractors or vendor lists provided by firms responding to the oil operator survey and from a list of oil servicing firms provided by the North Dakota Petroleum Council. Oil operators were asked to provide lists of firms with whom they contract for the provision of various exploration, extraction/production, and transportation services in North Dakota. The vendor or contractor lists provided by the oil operators and the list of service firms provided by the North Dakota Petroleum Council were processed to remove the names of oil operators, government offices/agencies, pipeline firms, and processors, as well as firms without complete addresses. A total of 498 firms were randomly selected from a final list of 825 firms. Undeliverable

addresses were present on 15 of the 498 firms. An initial mailing and a follow-up postcard mailing resulted in 54 firms responding, with 49 firms providing useable information.

Leasing and Brokerage

A survey of companies providing leasing services to petroleum sector firms was conducted to obtain information on oil leasing activities in North Dakota. A questionnaire was developed to obtain information necessary to estimate the amount of lease bonuses on private land in North Dakota (Appendix D). The study sponsor distributed the questionnaire to eight firms. The survey resulted in obtaining useable financial information from four firms. Lease bonuses for government mineral ownership were obtained by contacting the appropriate federal and state agencies. An additional information request was placed by the North Dakota Petroleum Council to oil operators participating in the study to obtain data on total in-state and out-of-state oil and gas royalty payments from North Dakota wells. Data obtained from the operators represented 43 percent of oil and gas output in the state, and revealed an average, weighted by dollar volumes, in-state royalty payment percentage of 43.74 percent. The in-state payment percentage for private royalties was used with the data from the survey of lease/brokerage firms to estimate in-state lease bonus payments.

Estimation Techniques

The survey of oil operators, survey of processors/pipeline operators, and survey of oil firms providing services and contract work in the oil fields provided data for two critical aspects of the study. First, data from the oil operator and processor surveys were used to set the level of spending in North Dakota. In other words, the data were used to determine the number of dollars spent in the state. Second, data from all three surveys (i.e., operators, processors, service firms) were used to determine the distribution of spending among various sectors of the North Dakota economy.

The survey of oil operators provided financial data on about 32 percent of all oil and gas production in the state in 2011. In addition, survey respondents provided information on exploration expenses, wells drilled, and leasing data. Benchmark expenses for extraction/production, transportation, and operational expenses (e.g., general administrative costs) were estimated per barrel of oil equivalent (BOE). Total state production in 2011, expressed in BOE, was then used with survey estimates of in-state expenditures per BOE to generate state-level estimates for production, transportation, and administrative spending. In-state employment by oil operators was estimated in a similar manner. Benchmark expenses for exploration were estimated on a per-well completed basis and were used with data on the number of wells completed in North Dakota in 2011. Data from the survey of oil lease/brokerage firms were used with data from the North Dakota State Land Department to estimate lease bonus payments for private mineral leases. Other economic components of the petroleum industry's direct impacts, such as severance taxes, public lease bonuses, and

royalty revenues represented a combination of survey data, state-level statistics, and information obtained from various state and federal governmental agencies.

The survey of service and support firms for oil and gas production in North Dakota provided estimates of in-state spending by various types of expenses (e.g., salaries/wages, utilities, office supplies, business services) (Appendix C). The percentage of spending in various categories by firms responding to the survey was used to allocate state-level expenditures for exploration and extraction to various economic sectors of the North Dakota Input-Output Model. The amount of spending was determined using data from the survey of oil operators, while the survey of service and support firms provided insights on how those dollars impacted various sectors of the North Dakota economy.

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 (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and respending within the economy. This process of spending and respending is sometimes termed the multiplier process, and the resultant secondary effects are sometimes referred to as multiplier effects (Leistritz and Murdock 1981).

Input-output (I-O) analysis is an economic tool that traces linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985). The North Dakota I-O Model has 17 economic sectors, is closed with respect to households (households are included in the model), and was developed from primary (survey) data from firms and households in North Dakota.

Empirical testing has shown the North Dakota Input-Output Model is sufficiently accurate in estimating gross business volume, personal income, retail activity, and gross receipts in major economic sectors in North Dakota. Over the period 1958-2011, estimates of statewide personal income derived from the model averaged within 10 percent of comparable values reported by the U.S. Department of Commerce (Coon et al. 2013, Bureau of Economic Analysis 2013). Coon et al. (2013) measured the statistical differences between the estimates of personal income from the two sources and found the absolute average difference was 7.0 percent, mean difference was -4.63 percent, and Theil's U_1 coefficient was 0.0400 for the 1958 to 2011 period.

ECONOMIC IMPACTS

The economic contribution of the petroleum industry was primarily based on estimates of in-state expenditures from exploration, extraction, transportation, and processing of crude oil and natural gas. Estimates of in-state expenditures were combined with estimates of oil and gas royalties, state severance taxes, and lease bonuses to determine total direct impacts. Subsequently, the direct impacts were applied to the North Dakota Input-Output Model to estimate the secondary impacts. Secondary impacts result from the respending of direct impacts within the economy. The following section is divided into six major parts: (1) direct impacts, (2) secondary impacts, (3) employment, (4) tax revenue, (5) infrastructure spending, and (6) total economic impacts.

Direct Impacts

From an economic perspective, direct impacts are those changes in economic output, employment, or income that represent the initial or first-round effects of a project, program, or activity. The direct impacts from the petroleum industry in North Dakota included expenditures for (1) oil and gas exploration, (2) oil and gas extraction/production, (3) transportation of crude oil and unprocessed gas, and (4) processing crude oil and natural gas. Direct impacts also included various revenue streams originating from either oil and gas exploration, such as lease bonuses, or oil and gas production, such as severance taxes and royalty payments. The following sections describe these direct economic impacts.

Exploration/Development

The economic effects of exploration come from expenditures within North Dakota for a variety of activities that involve searching and discovering viable oil and gas resources. Exploration 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).

Estimates of total in-state expenditures in 2011 for exploration were derived from the survey of oil operators and used with drilling statistics from the North Dakota Department of Mineral Resources (2012a). Gross expenditures for exploration, drilling, and well completion were estimated at about \$9.1 million per well drilled in North Dakota in 2011. The petroleum industry completed 1,271 wells in North Dakota in 2011, yielding about \$11.6 billion in total financial outlays for well development. Financial data on expenses for well development were obtained from oil operators. 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 represented economic leakage. Therefore, the \$9.1 million completion cost per well in North Dakota in 2011 was adjusted to reflect about \$4.5 million of expenses captured in the North Dakota economy.

Lease bonuses retained or paid to in-state entities were estimated at \$427.5 million in 2011, which included \$100 million for state leases, \$5.1 million for federal leases (Office of Natural Resources Revenue 2012, U.S. Forest Service 2012), and about \$321 million for private mineral leases. The \$5.1 million in federal lease bonuses represented the portion of those leases that were returned to the North Dakota state government. 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. Total payments for oil leases tied to private land in North Dakota were estimated at \$736 million; however, data from the survey of lease/brokerage firms and data on in-state mineral royalty payments obtained from oil operators suggest that about 43.7 percent (\$321.9 million) was paid to in-state addresses.

The combination of in-state well completion expenses and lease bonuses resulted in \$6.1 billion in direct impacts in 2011 (Table 2). In-state expenditures for general exploration and well drilling/completion were allocated to various economic sectors of the North Dakota Input-Output Model using information from the survey of service and support firms (Table 2). State and federal lease bonuses were allocated to the *Government* sector and private lease bonuses were allocated to the *Households* (economy-wide personal income) sector.

Table 2. Direct Impacts from General Exploration, Drilling Activities, and Lease Bonuses, North Dakota, 2011

Economic Sector	In-state Expenditures (000s \$)
Construction	29,668
Communications and Public Utilities	63,111
Retail Trade	1,173,764
Finance, Insurance, and Real Estate	230,250
Business and Personal Services	396,868
Professional and Social Services	197,939
Households (personal income)	3,604,474
Government	444,962
Total	6,141,054

Extraction/Production

The economic effects of extraction/production come from expenditures for a variety of activities that involve 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, were included as direct impacts in the extraction/production segment of the petroleum industry. Collections from state severance taxes, which include the gross production tax and extraction tax, also were included in the direct impacts.

Estimates of total in-state expenditures in 2011 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 & gas production expenses were specific to expenses paid to entities within North Dakota.

North Dakota produced 153,015,266 barrels of oil and 155,424,007 mcf of natural gas in 2011 (North Dakota Department of Mineral Resources 2012a). Those volumes of oil and gas production resulted in an estimated \$932 million for in-state expenditures for extraction/production and \$648 million for general business expenses. State oil and gas royalties were about \$145 million (North Dakota State Land Department 2012). Total federal royalties returned to North Dakota were about \$157 million, which includes an estimated \$117 million in tribal royalties (Office of Natural Resources Revenue 2012, U.S. Forest Service 2012).

Private royalties were based on production data obtained from the survey of oil operators and information on the distribution of in-state and out-of-state mineral payments. Total royalties reported by oil operators were estimated at 17.58 percent and 17.35 percent of well output for oil and gas, respectively. The total value of oil and gas production was estimated at \$13.767 billion using data obtained from the North Dakota Department of Mineral Resources (2012a) and the North Dakota Office of State Tax Commissioner (2012b). 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. Private royalties (i.e., both in-state and out-of-state mineral owners) from oil and gas production in North Dakota in 2011 were estimated to be \$2.052 billion. In-state payments of private royalties were estimated by applying the percentage of in-state versus out-of-state mineral owners royalty payments (43.7 percent) to the estimated total private royalties (\$2.052 billion). The in-state percentage of mineral ownership was estimated from private royalty payments made by oil operators in the state. Data obtained from oil operators on mineral payments was used with data from the Rocky Mountain Oil Journal (2012) to estimate that 43 percent (i.e., on a BOE basis) of the total oil and gas production in the state was represented by the survey data. In-state private royalties in 2011 were estimated at \$897.8 million (without adjustments for severance taxes) or \$798.1 million 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 2011 were about \$623.4 million and \$672.7 million, respectively (North Dakota Office of State Tax Commissioner 2012a). Those tax collections were included in the extraction/production segment of the petroleum industry.

Total direct impacts in the extraction/production segment of the petroleum industry in North Dakota in 2011 were estimated at \$4 billion (Table 3). Data from the survey of firms

providing oil field services and data obtained from the survey of oil operators were used to allocate the in-state expenditures for oil production to various sectors of the North Dakota Input-Output Model. Direct impacts for general business expenses for oil operators, royalties, and state severance taxes also were allocated to various sectors of the North Dakota Input-Output Model (Table 3).

Table 3. Direct Impacts from Oil and Gas Extraction and Production Activities, North Dakota, 2011

Economic Sector	In-state Expenditures (000s \$)
Construction	32,635
Transportation	15,230
Communications and Public Utilities	31,658
Manufacturing	162,531
Retail Trade	216,584
Finance, Insurance, and Real Estate	100,276
Business and Personal Services	116,406
Professional and Social Services	45,494
Households (personal income)	1,522,159
Government	1,733,645
Total	3,976,618

Processing

The processing 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, and crude oil refining were obtained from the

survey of processors. Results from the survey of processors were combined with state statistics to estimate state-level expenditures.

Direct impacts included \$206.7 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, and crude oil refining were estimated to have in-state expenditures of \$268.3 million. One-time spending for infrastructure by processors was included in processing expenditures in previous industry assessments; however, infrastructure spending was estimated separately in this study. Processors were directed to omit any infrastructure spending in their operational expenditures (Appendix C). Total direct impacts of \$475 million were allocated to the North Dakota Input-Output Model (Table 4). To avoid double counting of potential impacts, in-state purchases of crude oil and unprocessed natural gas by processors were excluded in the study.

Table 4. Direct Impacts from Oil and Gas Processing, North Dakota, 2011

Economic Sector	In-state Expenditures (000s \$)
Construction	55,942
Transportation	212,330
Communications and Public Utilities	52,729
Manufacturing	13,352
Retail Trade	8,357
Finance, Insurance, and Real Estate	11,951
Business and Personal Services	37,231
Professional and Social Services	2,053
Households (personal income)	61,680
Government	19,382
Total	475,007

Total Direct Impacts

Direct impacts are defined as the initial or first-round effects of a project, program, or activity. The petroleum industry in North Dakota was divided into several segments or components for purposes of reporting study results. Total direct impacts for the petroleum industry included in-state expenditures for oil and gas exploration/development, oil and gas extraction/production, transportation of crude oil and unprocessed gas, processing crude oil and natural gas, lease bonuses, severance taxes, and royalty payments.

Total direct impacts from the petroleum industry in North Dakota in 2011 were estimated at \$10.6 billion (Table 5). Exploration (i.e., primarily well drilling and well completion) accounted for 58 percent of the industry's direct impacts and was the largest segment of the industry. Extraction/production accounted for nearly 38 percent of all direct impacts. Processing and transportation accounted for the remaining 4 percent of the industry's direct impacts.

Expenditures and revenues which constitute the petroleum industry's direct impacts were allocated to various economic sectors of the North Dakota Input-Output Model. The sectors of the North Dakota economy that received the greatest direct impacts were *households* (economy-wide personal income) (\$5.2 billion), *government* (tax collections and public royalties) (\$2.2 billion), *retail trade* (\$1.4 billion), *business and personal services* (\$550 million), and *finance, insurance, and real estate* (\$342 million) (Table 5).

Table 5. Total Direct Impacts, Petroleum Industry, North Dakota, 2011

Economic Sector	Industry Component			Totals
	Exploration	Extraction	Processing	
	----- 000s \$ -----			
Construction	29,668	32,635	55,942	118,245
Transportation		15,230	212,330	227,560
Communications and Public Utilities	63,111	31,658	52,729	147,498
Manufacturing		162,531	13,352	175,883
Retail Trade	1,173,764	216,584	8,357	1,398,705
Finance, Insurance, and Real Estate	230,250	100,276	11,951	342,477
Business and Personal Services	396,886	116,406	37,231	550,523
Professional and Social Services	197,939	45,494	2,053	245,486
Households (personal income)	3,604,474	1,522,159	61,680	5,188,313
Government	444,962	1,733,645	19,382	2,197,989
Total	6,141,054	3,976,618	475,007	10,592,679

Secondary Impacts

Secondary economic impacts result from subsequent rounds of spending and responding within an economy. Input-output (I-O) analysis traces linkages (i.e., the amount of spending and responding) among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985). An economic sector is a group of similar economic units (e.g., communications and public utilities, retail trade, construction).

This process of spending and responding can be explained by using an example. A single dollar from an in-state wheat producer (*Households* sector) may be spent for a loaf of bread at the local store (*Retail Trade* sector); the store uses part of that dollar to pay for the next shipment of bread (*Transportation* and *Agricultural Processing* sectors) and part to pay the store employee (*Households* sector) who shelved or sold the bread; the bread supplier uses part of that dollar to pay for the grain used to make the bread (*Agriculture-Crops* sector) ... and so on (Hamm et al. 1993).

Secondary economic impacts were estimated separately for exploration, production, and processing components of the petroleum industry. Results from the North Dakota Input-Output Model revealed that secondary economic impacts from exploration in North Dakota in 2011 would be about \$10.7 billion (Table 6). The \$4 billion in direct impacts for oil and gas extraction (production) activities produced an estimated \$4.7 billion in secondary economic impacts. Finally, the transportation and processing segment of the petroleum industry was responsible for about \$895 million in secondary economic impacts. Total secondary economic impacts from all components of the petroleum industry were estimated at \$16.3 billion. Across all three major components of the petroleum industry, considerable secondary impacts were generated in the *retail trade* (\$5.2 billion), *households* (economy-wide personal income) (\$5 billion), *finance, insurance, and real estate* (\$1.2 billion), and *communications and public utilities* (\$800 million) sectors (Table 6).

Table 6. Total Secondary Impacts, Petroleum Industry, North Dakota, 2011

Economic Sector	Industry Component			Totals
	Exploration	Extraction	Processing	
	----- 000s \$ -----			
Construction	425,747	176,673	26,535	628,955
Transportation	56,318	22,411	4,411	83,140
Communications and Public Utilities	548,332	222,449	40,404	811,185
Agricultural Processing and Miscellaneous Manufacturing	238,264	206,872	22,929	468,065
Retail Trade	3,511,886	1,478,342	244,630	5,234,858
Finance, Insurance, and Real Estate	786,782	331,266	54,836	1,172,884
Business and Personal Services	290,728	123,060	20,708	434,496
Professional and Social Services	449,690	186,471	26,074	662,235
Households (personal income)	3,300,326	1,364,322	334,318	4,998,966
Government	516,191	218,412	75,412	810,015
Other sectors ^a	573,279	342,368	44,814	960,461
Total	10,697,543	4,672,646	895,071	16,265,260

^a Includes various agricultural and mining sectors.

Employment

The petroleum industry is responsible for creating and supporting direct and secondary employment. Direct employment is a measure of the number of full-time jobs within an industry. Secondary jobs are an estimate of employment outside of an industry, but employment that is created from the industry's economy-wide economic activity.

Direct Employment

Direct employment is a term used to describe jobs that are considered to be a 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.

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 to 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.

Four independent estimates of employment are presented in this report (Table 7). An estimate of employment in the industry was generated from the survey data collected from oil operators, service and support firms, and processors. Another estimate was provided by Job Service North Dakota and represented employment based on North American Industry

Classification System (NAICS) listings. Another estimate was generated from data obtained from North Dakota Workforce Safety and Insurance. A final estimate was provided by using a model developed by Bangsund and Hodur (2012) that uses employment coefficients from the Oil and Gas Division of the North Dakota Department of Mineral Resources.

Survey Data

Estimates of direct employment were generated from the survey of oil operators and processors, and from key parameters obtained from the survey of service and support firms. The survey of oil operators and processors specifically asked for the number of full-time jobs in North Dakota (Appendices A and B). Employment figures from the survey of oil operators were extrapolated to state totals based on a BOE basis, while employment data from the survey of processors was extrapolated based on state-level statistics for those operations (e.g., processing volumes). Thus, estimating full-time employment by oil operators, pipeline firms, and processors in North Dakota was relatively straightforward.

Oil operators (firms owning or operating wells) contract much of the work of exploration and production of oil and gas to firms that specialize in various aspects of the those processes. While some of the work in the oil fields is performed by firms located in other states, much of the work is performed by firms located in close proximity to production. One of the difficulties of estimating employment in the service and support capacities is determining those jobs that are fully supported versus those jobs that are only partially supported by the petroleum industry. An additional complexity is to only attribute full-time employment to the petroleum activities located in North Dakota. For many firms located in the oil producing region of North Dakota, the obvious possibility is that some employment by those firms could be partially or wholly supported by petroleum activities in Montana, Canada, or possibly in other states.

The questionnaire used in the service and support survey was designed to address the degree of job support from the petroleum industry and the level of job support attributable to only petroleum activities in North Dakota (Appendix C). Total state employment for work in the oil field was then estimated based dividing estimates of total spending by oil operators by the gross revenue per full-time equivalent (FTE) jobs from the survey data.

Employment in North Dakota by oil operators in 2011 was estimated at 2,269 FTE positions. Employment in the processing segment of the industry, which included some pipeline employment, was estimated at 850 FTE jobs. Total employment in the oil field for contract work, which includes exploration and production segments of the industry, was estimated at 37,737 FTE jobs. The petroleum industry², as defined and evaluated in this study, was estimated to create and support 40,856 FTE positions in North Dakota in 2011 (Table 7).

² The petroleum industry in this study did not include employment associated with transportation of processed petroleum products, marketing, or retail sales. In many cases, those downstream components of the industry generate substantial employment.

Table 7. Estimates of Direct Employment, North Dakota Petroleum Sector, 2003 Through 2011

Source	Estimates of Direct Employment in Petroleum Sector ^a								
	2011	2010	2009	2008	2007	2006	2005	2004	2003
<u>NDSU Survey Data^b</u>	40,856	na	18,328	na	11,812	na	5,051	na	na
<u>Job Service North Dakota</u>									
Statewide NAICS code 211 (oil and gas extraction)	1,167	844	704	544	432	427	474	445	443
Statewide NAICS code 213 (support activities for mining) ^c	<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	14,926	8,963	5,312	5,195	3,535	3,115	2,564	2,050	1,777
Regional NAICS code 21 (extraction and support activities) ^d	15,193	9,208	5,554	5,369	3,756	3,374	2,811	2,281	1,989
Regional NAICS code 23 (construction) ^d	8,407	5,475	4,278	4,045	3,679	3,391	2,466	2,975	2,743
Regional NAICS code 31-33 (manufacturing) ^d	3,092	2,960	2,948	3,002	2,843	2,765	2,587	2,515	2,478
Regional NAICS code 42 (wholesale trade) ^d	6,484	5,234	4,581	4,347	4,226	4,136	4,000	3,881	3,797
Regional NAICS code 48-49 (transportation) ^d	<u>6,501</u>	<u>3,788</u>	<u>2,511</u>	<u>2,304</u>	<u>1,813</u>	<u>1,637</u>	<u>1,497</u>	<u>1,454</u>	<u>1,412</u>
Total	39,677	26,665	19,872	19,067	16,317	15,303	13,361	13,106	12,419
<u>Workforce Safety and Insurance^e</u>									
Oil and Gas Operations (WSI code 1320)	7,188	3,954	2,622	2,100	1,496	1,063	957	1,003	na
Oil Refining-Synthetic Fuels Mfg (WSI code 4740)	1,064	1,003	994	981	953	919	896	821	na
Oil and Gas Development-Drilling (WSI code 6203)	12,039	8,147	4,867	4,256	2,914	2,000	1,738	1,175	na
Oil and Gas Well Suppliers/Equip. Dealers (WSI code 6204)	2,642	1,609	954	640	423	316	254	186	na
Oil Well Trucking (WSI code 6205)	10,162	4,085	2,076	1,565	908	672	492	337	na
Oil Well Servicing (WSI code 6206)	12,557	5,691	2,977	2,747	1,780	1,487	1,266	1,043	na
Oil and Gas Instrument Logging (WSI code 6208)	1,682	435	263	226	171	113	104	87	na
Geologists and Scouts(WSI code 8605)	148	103	49	62	47	29	24	29	na
Professional and Business Representatives (WSI code 8747)	1,948	1,516	1,153	889	761	722	589	622	na

- continued -

Table 7. Continued

Source	Estimates of Direct Employment in Petroleum Sector ^a								
	2011	2010	2009	2008	2007	2006	2005	2004	2003
<u>Workforce Safety and Insurance^e</u> (continued)									
Clerical Office Employees (WSI code 8805)	<u>2,173</u>	<u>1,257</u>	<u>924</u>	<u>856</u>	<u>737</u>	<u>662</u>	<u>601</u>	<u>561</u>	na
Total	51,603	27,800	16,879	14,322	10,190	7,983	6,921	5,864	na
<u>Oil and Gas Division, Dept. of Mineral Resources, Petroleum Sector Coefficients^f</u>									
	32,709	25,618	14,153	16,548	10,959	9,996	7,662	6,507	6,116

na=not available.

^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.

^b Industry-wide employment, including estimates for employment in manufacturing, construction, wholesale trade, transportation, and self-employed individuals. Based on data collected from surveys of oil operators, processing firms, pipeline companies, and businesses that provide products and technical services in the petroleum industry in North Dakota.

^c Support activities for mining include drilling oil and gas wells, support activities for oil and gas operations, support activities for coal mining, support activities for metal mining, and support activities for nonmetallic minerals mining.

^d Regional assessment included Adams, Billings, Bottineau, Bowman, Burke, Divide, Dunn, Golden Valley, Hettinger, McHenry, McKenzie, Mountrail, Pierce, Renville, Slope, Stark, Ward, and Williams Counties. Contained within NAICS codes 31-33 would be employment for crude oil and natural gas processing activities. Contained within NAICS codes 48-49 would be employment for crude oil and natural gas pipelines, as well as trucking jobs for a number of oil development and production activities. Construction would include employment for oil and gas pipeline and related structures, road building, and well site development. Wholesale trade would include employment for the distribution of some oil and gas production related equipment. The percentage of employment in the manufacturing, construction, wholesale trade, and transportation sectors that can be considered part of the petroleum industry in the selected counties is unknown. Employment estimates do not include sole proprietors or self-employed individuals.

^e Represents a head count of employees (not full-time equivalent jobs) for fiscal years. Some duplication of employee counts exists in the data. Employee counts for the Professional and Business Representatives and Clerical Office Employees categories represent a strong connection to companies working in the petroleum sector. Employee counts in all categories only include sole proprietors and self-employed individuals who voluntarily opt to participate in workers' compensation system.

^f The Oil and Gas Division of the North Dakota Department of Mineral Resources recently compiled employment coefficients for various activities in the oil and gas industry in North Dakota. Bangsund and Hodur (2012) describe the use of those coefficients to provide estimates of direct employment in the petroleum sector. Estimates of direct employment in the oil and gas industry, using Oil and Gas Division coefficients, were part of a research project to forecast employment, housing, and population for the Williston Basin (Bangsund and Hodur 2013). Oil and Gas Division coefficients do not include petroleum refining.

Sources: Job Service North Dakota (2012, 2011, 2010, 2009, 2008, 2007, 2006, 2005, 2004), North Dakota Workforce Safety and Insurance (2012), Bangsund and Hodur (2012), and Bangsund and Hodur (2013).

Job Service North Dakota

Job Service North Dakota reports employment and wages/salaries by county, multi-county region, and for the state using the North American Industry Classification System (NAICS). The NAICS is a federal standard for measuring, collecting, and reporting business activity in the United States. The classification system consists of specific codes, aggregated into 20 broad industry groupings (e.g., Utilities, Construction, Education, Health Care, Finance and Insurance, Manufacturing, Wholesale Trade).

While each broad industry grouping contains numerous specific industry/business activities, Job Service North Dakota reports employment and wage information for only the largest aggregated categories in the NAICS (Job Service North Dakota 2012). The NAICS starts with various broad categories of employment by industry or sector, and then continues to refine those categories into ever more specific and detailed categories. For example, code 21 is for All Mining, Quarrying, and Oil and Gas Extraction. Code 21 is further defined to include code 211 (oil and gas extraction), 212 (mining), and 213 (support activities for mining). Within code 211, there are specific codes for oil and gas extraction (2111), which is further broken into code 211111 (crude petroleum and natural gas extraction) and 211112 (natural gas liquid extraction). Similarly, code 213 (support activities for mining) is further broken into codes 213111 (drilling oil and gas wells), 213112 (support activities for oil and gas operations), 213113 (support activities for coal mining), 213114 (support activities for metal mining), and 213115 (support activities for nonmetallic minerals mining). Therefore, the broader the industrial code the less specific employment estimates will be for any particular business activity.

To avoid combining employment from other industries (e.g., code 21 includes oil and gas production and coal mining), the use of NAICS either requires using less aggregated codes (e.g., code 2111) or requires counting employment from geographic areas that are known to only contain the industries in question (e.g., McKenzie County has oil and gas production but not coal mining). Since Job Service North Dakota generally reports employment using broader categories of the NAICS, one strategy to estimate employment for the petroleum sector would be to add up employment from selected geographic areas in the state that have petroleum sector activities but do not have coal sector activities. This strategy is possible because the petroleum industry generally operates in different counties than the coal industry. However, specific rules govern the disclosure of employment data and county-level estimates of employment are often omitted to avoid violating disclosure rules. Therefore, only using county-level data will underestimate employment in the petroleum sector due to reporting omissions for some counties.

An additional concern with using aggregated NAICS codes is that a number of specific business activities which are part of the petroleum industry are contained in the NAICS codes for other industries. For example, code 23 (construction) contains oil and gas pipeline and related structures construction (code 23712). Other examples include codes 31 through 33

(manufacturing) which include codes 324110 (petroleum refineries), 324191 (petroleum lubricating oil and grease manufacturing), and 324199 (all other petroleum and coal products manufacturing). The same situation also exists for codes 48 and 49 (transportation and warehousing), which include all of the activities associated with crude oil and unprocessed natural gas pipelines. Of course, each of these aggregated NAICS codes contain employment that would be classified as being part of the petroleum sector but is not listed specifically within the category. For example, some manufacturing and metal fabrication is petroleum sector based but would not be listed with a separate NAICS code. Similarly, employment transporting fracking water and crude oil by truck is currently measured as transportation employment but represents petroleum sector employment. Another example would include classification of construction employment that is used to build private roads and drill sites. Those petroleum sector jobs would not be listed separately from overall employment in those other industries.

Job Service North Dakota does not track sole proprietors or self-employed individuals. Therefore, the number of jobs reported by industry code will not contain employment by self-employed individuals.

Job Service North Dakota can provide several estimates of employment in the petroleum sector in North Dakota (Job Service North Dakota 2012). The first figure would be a statewide estimate of employment using NAICS codes 211 (oil and gas extraction) and 213 (support activities for mining) (Table 7). The other would be a regional summary of jobs using code 21 (all mining, quarrying, and oil and gas extraction)³. Another employment estimate would actually represent a regional summation of jobs in both the petroleum sector-specific code 21 and employment in related industries of manufacturing (codes 31-33), construction (code 23), wholesale trade (code 42), and transportation (code 48-49). However, not all employment in manufacturing, construction, wholesale trade, or transportation in the oil producing regions of North Dakota would qualify as petroleum sector employment. As such, actual petroleum sector employment would be expected to be less than the summation of regional employment in those industries.

Workforce Safety and Insurance

Workforce Safety and Insurance (WSI) manages and regulates the workers' compensation system in North Dakota. As part of that system, WSI tracks employees in North Dakota. Workforce Safety and Insurance uses a classification system for defining employment that consists of 142 categories based on the type of work activity performed. Several of those categories are specific to various activities in the petroleum sector. The classifications directly attributable to the petroleum sector include Oil and Gas Operations (code 1320), Oil Refining - Synthetic Fuels Manufacturing (code 4740), Oil and Gas Development - Drilling (code 6203), Oil

³ Employment by more detailed NAICS codes were not available for multi-county employment estimates by Job Service North Dakota (2010, 2009, 2008, 2007, 2006, 2005, 2004).

and Gas Well Suppliers or Equipment Dealers (code 6204), Oil Well Trucking (code 6205), Oil Well Servicing (code 6206), Oil and Gas Instrument Logging (6208), Geologists and Scouts (code 8605). Some petroleum sector employment can be traced through Professional and Business Representatives (code 8747) and Clerical Office Employees (code 8805). Other employment classifications contain petroleum sector employees but are not distinguished or credited as being part of the petroleum sector.

Workforce Safety and Insurance does not provide measures of full-time employment but rather tracks the number of employees by job classification. The subtle difference between tracking a job versus an employee is that if an employee has more than one employer during the year that individual is counted twice. Further, if an employee works at any time during the year that individual is included within the WSI data even if the position or duration of work was temporary. Therefore, the head-count data from WSI can include temporary work and can include duplications from those who worked for more than one employer during the year.

The WSI data has some employees placed in job classifications that are not attributable to the petroleum sector, even if those activities occur within the petroleum sector. Examples of those classifications include Street and Road Construction (code 6042), Sewer-Water-Gas-Pipeline Construction (code 6301), and Trucking and Hauling - Interstate and Intrastate (code 7215). Further, employment that would remain unmeasured would include employees performing repairs, consulting, or other professional functions within the petroleum industry as those positions fall within other employment codes. WSI information also does not count self-employed or sole proprietors, unless they are required to report to WSI or voluntarily contribute to the workers' compensation system.

Based on WSI data, the petroleum sector had over 51,600 employees working in the petroleum sector during fiscal year 2011 (Table 7) (North Dakota Workforce Safety and Insurance 2012). The greatest number of employees was found in oil well servicing activities (12,557 individuals), oil well drilling activities (12,039 individuals), oil well trucking (10,162 individuals), oil and gas operations (7,188 individuals), and oil and gas well suppliers (2,642 individuals). Those categories collectively accounted for 86 percent of the workers in the petroleum sector in North Dakota in fiscal year 2011.

Workforce Safety and Insurance employee data were obtained back to fiscal year 2004, which represents an approximate beginning period for the current oil shale development in the state (Table 7) (Workforce Safety and Insurance 2012). From Fiscal Year (FY) 2004 to FY2011, the number of employees working in the petroleum sector increased by 780 percent. A regional analysis of employment in the core activities of the petroleum sector (NAICS codes 211 and 213) by Job Service North Dakota showed similar levels of employment change over the period; a 628 percent increase from 2004 to 2011 (Table 7). By comparison, overall production of crude oil in the state has increased by 390 percent from 2004 to 2011. It would appear that direct employment in the petroleum sector has increased slightly greater than the overall change in oil

production over the period. The substantial increases in employment have resulted from disproportionately greater increases in drilling activities in 2011.

Oil and Gas Division Coefficients

The Oil and Gas Division of the North Dakota Department of Mineral Resources has conducted an examination of the labor requirements for various segments of the oil and gas industry (North Dakota Department of Mineral Resources 2012c). That effort produced details on the amount and type of labor required for drilling, fracking, construction of oil field gathering systems, well operations, well maintenance, oil and gas transportation, and associated processing activities. The coefficients are expressed as a labor requirement per unit of activity (e.g., employment per drilling rig, service employment per well).

Using those coefficients, along with historic estimates of rig counts and operating wells, can produce estimates of employment in the petroleum sector. Bangsund and Hodur (2012) describe the use and application of those coefficients in a model that embodies the Oil and Gas Division coefficients. Output from that model shows similar trends and levels of employment as found with estimates from Job Service North Dakota (Table 7). However, the use of Oil and Gas Division coefficients produces a lower estimate of direct employment than the methods used in this study and provides a lower measure of employment obtained from Workforce Safety and Insurance data. Differences may be attributable to the interpretation of what constitutes direct employment in the industry. Other differences may be related to the degree of well servicing employment in the early periods of Bakken/Three Forks wells.

This study uses a fairly broad definition of direct employment that crosses over a wide range of service and support activities in the oil fields. Some of those service and support jobs are not likely counted in the Oil and Gas Coefficients. Also, jobs associated with crude oil processing are included in the survey data but not included in the Oil and Gas Division coefficients. Finally, Oil and Gas Division coefficients likely underestimate the degree of well servicing employment in the early periods of Bakken/Three Forks wells. Nevertheless, direct employment, as measured by using employment coefficients, shows similar overall rates of change in employment in the petroleum sector (Table 7).

Secondary Employment

Secondary employment is a term used to describe jobs that are created and supported by the volume of business activity generated by an industry, but does not include jobs that are part of the industry. Direct employment and secondary employment are two distinctly different measures.

Due to recent examinations of the rate of secondary job creation in the Williston Basin by Bangsund and Hodur (2012), estimates of secondary employment for the petroleum industry in this study were modified from the methods used in previous industry assessments. To arrive at estimates of state-level secondary job creation by the petroleum industry, the analysis was divided into two components. Estimates of statewide secondary job creation were developed from North Dakota's economic base data set (Coon et al. 2013) for a 15-year period prior to 2005. Those estimates were generated using traditional methods associated with productivity ratios⁴ and secondary business volume. Secondary business volume was generated using the North Dakota Input-Output Model with petroleum sector Sales to Final Demand from North Dakota's economic base data set (Coon et al. 2013). The economic base data set does not contain estimates of in-state expenditures associated with oil and gas exploration. Adjustments to employment estimates were performed to account for the missing expenditures associated with oil exploration in the state over the period. Further, the economic base data set assigns estimates of oil and gas royalties and lease bonus payments to the Households sector (economy-wide personal income). The secondary job creation resulting from net in-state oil and gas royalties and in-state lease bonuses over the period also were estimated. Therefore, historic estimates of secondary job creation, using North Dakota's economic base data set, were estimated using techniques consistent with recent economic contribution analyses (Bangsund et al. 2012; Coon et al. 2012a, 2012b; Bangsund et al. 2011; Bangsund and Leistritz 2010). Estimates of secondary employment created by the petroleum sector from 2000 to 2004 were averaged and represent a traditional level of secondary job support in the North Dakota economy.

The second portion of the analysis relied on recent observations that traditional methods of estimating secondary employment are overestimating job creation in the state (Bangsund and Hodur 2012). To account for the incremental change in secondary job creation attributable to the industry since 2005, the methods developed by Bangsund and Hodur (2012) to assign employment coefficients to direct employment in the industry were used in this study. Estimates of direct employment prior to 2005 were obtained from an employment model developed by Bangsund and Hodur (2012) that combines historical data on drilling rigs and well counts in combination with employment coefficients from the Oil and Gas Division of the Department of Mineral Resources. Average employment prior to 2005 was subtracted from estimates of direct employment in 2005, 2007, 2009, and 2011 (years for which economic contribution analyses were performed). The net gain in direct employment within the industry was then multiplied by secondary job coefficients (multipliers) to estimate the incremental increase in secondary job creation above historical observations. The combination of the incremental change in secondary job creation and historical observations for secondary job creation represent a state-wide estimate of total secondary job support attributable to the industry. The industry was expected to have supported 18,700 full-time secondary jobs in North Dakota in 2011.

⁴A measure of the amount of business activity needed in an economic sector to support one full-time job.

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 \$2.25 billion in government revenues that were directly attributable to the petroleum industry in North Dakota in 2011 (Table 8). Exploration/development, extraction/production, and processing segments of the industry were responsible for about 20, 79, and 1 percent, respectively, of the total government revenues from the petroleum industry in North Dakota.

Severance taxes accounted for 57 percent of all government revenues from the petroleum industry in North Dakota in 2011. The second largest source was the most common general taxes (i.e., property, personal income, sales and use, and corporate income) at 20 percent, followed by royalties at 13 percent. The remainder of government revenues represented lease bonuses, permits/fees/licenses, and miscellaneous revenues.

In addition to the government revenues that were included as direct impacts, collections from personal income and sales and use taxes were estimated based on the secondary economic activity generated by the petroleum industry. Secondary economic impacts in the *Retail Trade* sector were used to estimate revenue from sales and use taxes. Economic activity in the *Households* sector (which represents economy-wide personal income) was used to estimate personal income tax collections. Total collections of personal income and sales and use taxes arising from secondary economic activity were estimated at \$395 million (Table 8).

Government revenues included in the direct impacts represent revenues to county governments, tribal governments, and the state government. The amount of government revenues flowing to local, state, and tribal governments was estimated to help identify the relative split in industry revenues. North Dakota Office of State Treasurer (2012) estimated that in 2011, local governments (i.e., counties, cities, school districts) received distributions of state severance taxes totaling over \$105 million. Total collections from state severance taxes in 2011 was estimated at

nearly \$1.3 billion. Local governments' share of severance taxes was just over 8 percent of total collections over the period and distributions of the state severance taxes to tribal governments were estimated at \$43.9 million.

However, time periods for distributions and collections do not match. Distributions lag collections, and therefore dividing distributions by collections in the same period is not a true representation of the actual percentage of revenues that local governments can expect to receive from collections over any given period. Unfortunately, data to synchronize distributions from the time periods when collections were made were not readily available.

Data from the U.S. Forest Service (2012) indicated that distributions of royalties and lease bonuses to local governments in North Dakota totaled \$14.1 million in 2011. Total distributions of royalties and lease bonuses from federal minerals to local and state governments in North Dakota were estimated at \$28.4 million (Office of Natural Resources Revenue 2012). Federal mineral royalties returned to local governments through the U.S. Forest Service primarily represent revenues from acquired minerals. The Office of Natural Resources Revenue (ONRR) re-distributes revenues from federal acquired minerals and public domain minerals back to the North Dakota state government. ONRR distributes federal mineral royalties to tribal governments but does not disclose the amount.

Given the information available, local governments were estimated to have received at least \$14.1 million of the \$42.5 million in federal mineral royalties distributed to North Dakota (excluding tribal royalties). Local governments would be expected to collect property taxes for use by county and city governments and school districts. Collections of property tax revenue attributable to the petroleum industry were estimated at \$114 million.

Overall, local governments were estimated to receive \$114 million in property taxes, \$14.1 million in federal mineral re-distributions, and \$105 million in re-distributions from state severance taxes. Excluding licenses, permits, fees, and charitable donations, approximately 12.3 percent of all government revenues estimated for the petroleum industry were received by local governments. Data to estimate the split in revenues for state and local governments for permits, fees, and licenses and for undetermined taxes were unavailable.

Table 8. State and Local Government Revenues Attributable to the Petroleum Industry, North Dakota, 2011

Revenue Type	Revenue included as part of direct impacts	Revenue estimated from secondary economic impacts
	----- 000s \$ -----	
Sales and Use Taxes	42,137	242,374
Property Taxes	113,916	not applicable
Personal Income Tax	21,152	152,809
Corporate Income Tax	20,823	not available
Royalties	302,986	not applicable
Severance Taxes	1,296,106	not applicable
Lease Bonuses	105,546	not applicable
Licenses, Permits, Fees	85,732	not available
Charitable Donations	8,521	not available
Undetermined Taxes ^a	255,733	not applicable
Total	2,252,652	395,183

^a Represents general in-state taxes paid to local and state government that were not specifically identified by survey respondents.

Infrastructure Spending

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, frac 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 expenditures have focused on expenditures associated with well drilling/completion, oil and gas production, transportation, and processing operations.

Separate surveys of oil operators, processors/shippers, and oil field service companies included a standardized set of questions specific to various categories of infrastructure development and capital expenditures in North Dakota (Appendices A, B, and C). The surveys were explicit in that expenditures were to represent projects in North Dakota for calendar year 2011.

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 in 2011 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 2011 while completion may not occur until 2012 or later). Survey data represented expenditures made for project(s) in 2011, while various secondary estimates of capital expenditures represent total costs for specific projects that might involve spending over extended periods. Therefore, the first task was to reconcile secondary data on infrastructure costs 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 2011.

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; Leistritz 1995).

Two problems exist with current infrastructure spending. The portion of those capital expenditures captured in the North Dakota economy is unknown. Also, the distribution of in-state capital expenditures among various economic sectors is unknown. The survey questionnaires did not solicit information on the above issues. cursory information on those details was obtained from conversations with industry officials. For purposes of this study, it was assumed that labor represented two-thirds of capital expenditures while equipment/materials represented the other one-third. Within that split, an additional assumption was made regarding the approximate portion that was retained or circulated within the North Dakota economy. About 60 percent of labor was expected to be captured in North Dakota and 10 percent of material and equipment was captured in North Dakota. The adjustments resulted in about 44 percent of capital expenditures circulating in the North Dakota economy. Leistritz (1995) found that in-state capture of labor and materials associated with the ProGold corn processing plant in the Red River Valley was 43 percent.

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 between \$2.5 billion to \$2.7 billion on infrastructure projects in the state in 2011 (Table 9). After adjustments for economic leakage (the portion of expenditures not captured in the North Dakota economy), it was estimated that about \$1.1 billion to \$1.2 billion were captured in the North Dakota economy (Table 9).

The gross business volume associated with infrastructure spending in North Dakota was estimated to range from \$3.4 to \$3.7 billion in 2011 (Table 10). 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.

Table 9. Infrastructure Investment Spending, Petroleum Industry, North Dakota, 2011

			Capital Expenditures ^a			
Category/Projects	Company	Description ^b	Incurred in 2011		Retained in North Dakota	
			Low	High	Low	High
			----- millions \$ -----			
Gas Processing Plants			940.9	982.5	407.7	425.7
Stateline I Gas Plant	ONEOK	100 mmcfd				
Stateline II Gas Plant	ONEOK	100 mmcfd				
Garden Creek Gas Plant	ONEOK	100 mmcfd				
Belfield Gas Plant	Whiting	30 mmcfd				
Robinson Lake Gas Plant (expansion)	Whiting	45 mmcfd				
Watford City Gas Plant	Hiland Partners	50 mmcfd				
Little Missouri/W. City Gas Plant	Saddle Butte	45 mmcfd				
Tioga Gas Plant (expansion)	Hess	130 mmcfd				
Midstream Gas Projects (excluding gas processing plants)			246.6	259.1	106.9	112.3
Gas gathering systems	ONEOK	not available				
Gas gathering (Watford City plant)	Hiland Partners	8" pipe 5.1 miles				
Gas gathering (Watford City plant LNG)	Hiland Partners	4" pipe 10 miles				
Gas gathering (Watford City plant butane/propane)	Hiland Partners	4" pipe 10 miles				
Ethane Pipeline	Vantage	43,000-57,000 bpd				

Table 9. Continued

			Capital Expenditures ^a			
Category/Projects	Company	Description ^b	Incurred in 2011		Retained in North Dakota	
			Low	High	Low	High
----- millions \$ -----						
Midstream Gas Projects (excluding gas processing plants) (continued)						
Bakken, Ft. Buford (pipeline expansion)	Williston Basin Interstate Pipeline	30 mmcfd				
Prairie Rose pipeline	Pecan	100 mmcfd				
Crude Oil Pipelines			379.9	385.7	164.6	167.1
Mainline capacity expansion	Enbridge	23,500 bpd				
Mainline capacity expansion	Enbridge	25,500 bpd				
Mainline capacity expansion	Enbridge	25,500 bpd				
Bakken North	Plains	75,000 bpd				
Four Bears Pipeline	Bridger	100,000 bpd				
Crude Oil Rail Loading Facilities			252.4	273.4	109.4	118.5
New Town station	Dakota Plains	20,000 bpd				
Epping station	Rangeland COLT	120,000 bpd				
Tioga station	Hess	60,000 bpd				

Table 9. Continued

			Capital Expenditures ^a			
Category/Projects	Company	Description ^b	Incurred in 2011		Retained in North Dakota	
			Low	High	Low	High
----- millions \$ -----						
Crude Oil Rail Loading Facilities (continued)						
Dickinson/Eland station	Bakken Express	100,000 bpd				
Trenton station	Savage Services	90,000 bpd				
Berthold station	Enbridge	10,000 bpd				
Fryburg station	Great Northern Midstream	60,000 bpd				
Dore station	Musket	60,000 bpd				
Ross/Manitou station	Plains	20,000 bpd				
Van Hook/New Town station	US Development Group	35,000 bpd				
Crude Oil Gathering Systems ^{c,d}			213.6	229.4	92.6	99.4
Water Re-cycling Facilities ^{c,d}			30.7	35.7	13.3	15.5
Housing and Lodging ^{c,d}			222.8	259.0	107.7	125.2

Table 9. Continued

Category/Projects			Capital Expenditures ^a			
			Incurred in 2011		Retained in North Dakota	
			Low	High	Low	High
Company			Description ^b			
			----- millions \$ -----			
Office and Other Facilities ^{c,d}			170.8	198.4	82.5	95.9
Other (miscellaneous) ^{c,d,e}			46.5	54.1	19.4	22.5
Total			2,504.3	2,677.3	1,104.1	1,182.1

^a Represent an estimate of capital expenditures spent in calendar year 2011. Capital expenditures in 2011 will not necessarily equal the total estimated cost of any particular project. Dollars retained in North Dakota represent estimates of the portion of capital expenditures captured and circulated in the North Dakota economy (i.e., local and regional suppliers of labor, materials, and equipment).

^b mmcf/d = million cubic feet per day. bpd = barrels per day.

^c Estimated based on extrapolation of survey data.

^d Only includes expenditures for firms surveyed as part of the oil and gas industry.

^e Based on survey of firms providing service and support in the oil fields, and represented miscellaneous or unclassified infrastructure investments.

Sources: North Dakota Pipeline Authority (2012), Energy Policy Research Foundation, Inc. (2012), North Dakota Department of Mineral Resources (2012a), North Dakota Public Service Commission (2012), and confidential survey data.

Table 10. Total (Direct and Secondary) Economic Impacts, Infrastructure Spending, Petroleum Industry, North Dakota, 2011

Economic Sector	Range of Impacts ^a		
	Low	High	Average
	----- 000s \$ -----		
Construction	185,869	200,551	193,210
Transportation	11,701	12,531	12,116
Communications and Public Utilities	120,842	129,293	125,067
Manufacturing	48,911	52,327	50,619
Retail Trade	708,899	758,578	733,738
Finance, Insurance, and Real Estate	457,794	489,555	473,674
Business and Personal Services	266,805	285,283	276,044
Professional and Social Services	87,782	93,913	90,847
Households (personal income)	1,344,498	1,438,421	1,391,459
Government	107,100	114,587	110,843
Other sectors ^b	100,588	107,677	104,127
Gross Business Volume	3,440,789	3,682,706	3,561,747

^a Based on range of expenditures captured in North Dakota economy (see Table 9).

^b Includes various agricultural and mining sectors.

Total Economic Impacts

The total economic effect of an industry on a local, state, or regional economy can be measured by estimating the total amount of business activity generated by that industry. Total business activity, sometimes called gross business volume, is generally defined as a combination of direct and secondary economic impacts. Direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of a project, program, policy, or activity. Secondary impacts (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and respending within an economy. This process of spending and respending is sometimes termed the multiplier process, and the resultant secondary effects are sometimes referred to as multiplier effects. Further, additional economic measures, such as personal income, tax revenue, and employment, are often used to measure the relative size of an industry.

The petroleum industry in North Dakota was defined to include exploration/well development, extraction/production, transportation, and processing of crude oil and natural gas. Direct impacts were based on in-state expenditures, private and public royalties, taxes, lease bonuses, and expenditures retained in North Dakota for infrastructure development. Direct impacts were allocated to various sectors of the North Dakota Input-Output Model to generate estimates of the secondary economic impacts.

The direct impact of exploration/development in 2011 was estimated at \$6.1 billion. Total secondary economic impacts associated with well drilling and completion activities were estimated at \$10.7 billion. The in-state gross business volume of exploration activities was estimated at \$16.8 billion in 2011 (Table 11).

The direct impact of extraction/production in 2011 was estimated at \$4 billion. Total secondary economic impacts associated with extraction and production activities were estimated at \$4.7 billion. The in-state gross business volume of oil and gas extraction was estimated at \$8.6 billion in 2011 (Table 11).

The transportation and processing component of the petroleum industry was estimated to have a direct impact in North Dakota of \$475 million. Total secondary economic impacts associated with processing and transporting crude oil and natural gas were estimated at \$895 million. The in-state gross business volume of processing and transporting crude oil and natural gas was estimated at \$1.4 billion in 2011 (Table 11).

About \$1.1 billion to \$1.2 billion of infrastructure spending were captured in the North Dakota economy after adjusting total capital expenditures for economic leakage (the portion of expenditures not captured in the North Dakota economy). The gross business volume associated with infrastructure spending in North Dakota was estimated to range from \$3.4 to \$3.7 billion in 2011. Infrastructure spending, as defined in this report, would represent additional economic activity beyond that created by the exploration/development, extraction/production, transportation, and processing segments of the industry.

Industry-wide direct impacts from the petroleum industry were estimated at \$11.7 billion in 2011. Total secondary economic impacts associated with the industry were estimated at \$18.7 billion. The gross business volume for the petroleum industry in North Dakota in 2011 was estimated at \$30.4 billion (Table 11).

Additional measures of the petroleum industry's economic importance to the state include direct employment for 40,856 full-time jobs, economy-wide personal income of \$11.6 billion, statewide retail sales of \$7.4 billion, direct contributions to local and state government revenues of \$2.25 billion, indirect contribution of \$395 million in state government tax collections, and secondary employment of 18,703 full-time equivalent jobs. For every dollar spent in the state by the petroleum industry, another \$1.59 in additional business activity was generated.

Some generic or average impact figures can be produced for basic oil and gas production statistics. Based on a gross business volume of \$26.9 billion for the petroleum industry (not including infrastructure spending), total economic effects in North Dakota would be about \$150 per BOE, or if impacts were only evaluated for crude oil production, total effects would be \$175 per barrel. Based on active wells in the state, the overall economic effect (direct and secondary impacts from all segments of the industry) per well (averaged for all producing wells) would be about \$4.8 million annually.

Table 11. Total (Direct and Secondary) Economic Impacts, Petroleum Industry, North Dakota, 2011

Economic Sector	Industry Component				Totals
	Exploration	Extraction	Processing	Infrastructure ^a	
	----- 000s \$ -----				

Construction	455,415	209,308	82,477	193,210	940,410
Transportation	56,318	37,641	216,741	12,116	322,816
Communications and Public Utilities	611,443	254,107	93,133	125,067	1,083,751
Manufacturing	238,264	369,403	36,281	50,619	694,567
Retail Trade	4,685,650	1,694,926	252,987	733,738	7,367,302
Finance, Insurance, and Real Estate	1,017,032	431,542	66,787	473,675	1,989,036
Business and Personal Services	687,614	239,466	57,939	276,044	1,261,063
Professional and Social Services	647,629	231,965	28,127	90,847	998,569
Households (personal income)	6,904,800	2,886,481	395,998	1,391,459	11,578,739
Government	961,153	1,952,057	94,794	110,843	3,118,848
Other sectors ^b	573,279	342,368	44,814	104,128	1,064,589
Gross Business Volume	16,838,597	8,649,264	1,370,078	3,561,748	30,419,687

^a Represents an average of a low estimate (\$3.4 billion) and a high estimate (\$3.7 billion) of the gross business volume of infrastructure spending in the state.

^b Includes various agricultural and mining sectors.

COMPARISON OF PREVIOUS INDUSTRY ASSESSMENTS

The first comprehensive economic evaluation of the petroleum industry in North Dakota was conducted in 2006 and was reflective of conditions present in the industry in calendar year 2005 (Bangsund and Leistritz 2007). A second assessment was conducted two years later and was reflective of conditions present in the industry during calendar year 2007 (Bangsund and Leistritz 2009). A third study was conducted in 2010 analyzing industry activity in 2009 (Bangsund and Leistritz 2010). The results reported in this study were based on conditions present in the industry in calendar year 2011.

Comparing various production statistics between 2005, 2007, 2009, and 2011 revealed that the industry has dramatically increased the number of producing wells, oil and gas production, and drilling activities in the state (Table 10). Nominal oil and gas prices in 2005, 2007, and 2009 were adjusted for inflation using the Gross Domestic Product-Implicit Price Deflator. Crude oil prices over the 2005 to 2009 period were similar, but prices in 2011 were considerably higher than observed in the previous periods. Prices received for natural gas have decreased over the 2005 to 2011 period. Oil production has increased over 329 percent from 35 million barrels to 153 million barrels over the period. Gas production jumped from around 58 million mcf in 2005 to over 155 million mcf in 2011. In addition to increases in oil and gas production, exploration/development activities in the state continued to increase as the number of wells completed in the state went from 240 in 2005 to 1,271 in 2011 (Table 12).

Methods and data sources between the four studies were largely unchanged, although refinements in data collection and estimation techniques have been implemented 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. By comparison, lease bonuses on private land in 2005 were based on information obtained from the survey of oil operators and data on well drilling activity. Firms providing oil field services were not surveyed in the 2007 study, but those firms were surveyed in the 2005, 2009, and 2011 studies. Several refinements were implemented in the 2011 study. Detailed data on well drilling and well completion costs were obtained from oil operators to examine economic leakage associated with well drilling and well completion activities. Also, estimation of in-state mineral royalty revenues was 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.

Table 12. Oil and Gas Production Statistics, North Dakota, 2005, 2007, 2009, and 2011

Measures of Industry Output	Calendar Year 2005	Calendar Year 2007	Calendar Year 2009	Calendar Year 2011	Percent Change	
					2005 - 2011	2009 - 2011
Crude oil (barrels)	35,659,583	45,057,874	79,706,495	153,015,266	329.1	92.0
Natural gas produced (mcf)	57,970,459	70,799,663	92,491,011	155,424,007	168.1	68.0
Natural gas sold (mcf)	50,695,691	55,094,857	65,077,431	98,216,881	93.7	50.9
Number of operating/active wells (monthly average)	3,391	3,759	4,190	5,555	63.8	32.6
Number of wells completed	240	336	522	1,271	429.6	143.5
Average annual price per barrel of crude oil in North Dakota*	\$51.41 nominal	\$65.10 nominal	\$54.03 nominal	\$87.69 nominal	70.6	62.3
	\$55.65 real	\$66.75 real	\$54.03 real	\$87.69 real	51.6	56.1
Average annual price per mcf of natural gas in North Dakota*	\$8.57 nominal	\$6.69 nominal	\$3.75 nominal	\$3.56 nominal	-58.4	-63.0
	\$9.28 real	\$6.86 real	\$3.75 real	\$3.56 real	-4.9	-8.5

* Nominal dollars adjusted to real (2011) dollars using the Gross Domestic Product-Implicit Price Deflator.

Source: Oil and Gas Division, North Dakota Industrial Commission (2012).

In 2005, the survey of oil operators resulted in obtaining information from 17 firms representing about 19 percent of oil and gas production in the state (Table 13). In 2007, the survey of oil operators obtained information from 14 firms representing about 34 percent of oil and gas production (i.e., BOE) in the state. In 2009, 13 firms provided useable information representing about 43 percent of state production. In 2011, 10 firms provided useable information representing about 31 percent of state production. Overall, firms responding to the survey have averaged just under one-third of state production (Table 13). The survey of processors in the three studies resulted in nearly identical survey participation by industry representatives (data not presented).

Table 13. Summary of Oil Operator Surveys, North Dakota, 2005, 2007, 2009, and 2011

Description	2005	2007	2009	2011
Number of firms surveyed (first mailing)	135	140	84	60
Number of firms responding with useful information (2 or more mailings)	19	14	13	10
Number of wells owned/operated by survey respondents	1,633	1,897	2,105	2,161
Share of state totals	49%	50%	50%	39%
Crude oil production by survey respondents	8,062,219	13,503,595	34,480,312	46,861,655
Share of state totals	23%	30%	43%	31%
Natural gas production by survey respondents	10,289,325	34,360,934	51,011,755	51,137,922
Share of state totals	18%	48%	54%	33%
Barrel of Oil Equivalent (BOE)	9,777,106	19,230,418	42,982,271	57,089,239
Share of state totals	22%	34%	45%	32%
Number of wells completed by survey respondents	75	126	274	384
Share of state totals	29%	37%	52%	30%

Several notable changes were observed with oil and gas exploration/development between 2005 and 2011 (Table 14). The number of wells completed increased from 240 per year in 2005 to 1,271 per year in 2011. The average cost to drill and complete a well in the state increased in real terms from \$1.7 million in 2005 to \$9.1 million in 2011. The result of both an increase in the number of wells drilled and the change in the cost to complete oil wells increased exploration/development expenditures by the industry by about 2,740 percent from 2005 to 2011. However, well completion costs were evaluated for economic leakage, which adjusted total in-state expenditures. Those adjustments indicated that in-state expenditures per well completions went from \$1.7 billion in 2005 to \$4.5 million in 2011, an 164 percent increase.

The gross business volume (direct and secondary economic effects) associated with exploration/development went from around \$1.4 billion in 2005 to about \$16.8 billion in 2011, which reflect adjustments to the in-state capture of well drilling and completion expenses. The amount of direct expenditures for only exploration/development activities in 2007, 2009, and 2011 exceeded the sum of direct expenditures for all other segments (i.e., production, processing, and transportation) of the industry (see Tables 14 and 15).

Table 14. Comparison of Economic Estimates, Exploration Component of Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

Category	2005*	2007*	2009*	2011	Percent Change	
					2005 - 2011	2009 - 2011
Number of wells drilled & completed in the state	240	336	522	1,271	430	144
----- 000s \$ -----						
Average total cost per well completed	1,701	4,555	4,869	9,114	436	87
In-state expenditures per well completed	1,701**	4,555**	4,869**	4,495	164	-7.7**
Lease bonuses						
Net federal and state	19,291	9,507	157,284	105,546	447	-33
Private***	73,186	97,532	214,313	272,756	273	27
Direct Impacts						
Well Drilling****	408,348	1,530,498	2,541,579	5,713,594	1,299	125
Lease Bonuses	92,477	107,039	371,597	427,458	362	15
Total Direct	500,824	1,637,538	2,913,176	6,141,052	1,126	111
Secondary Impacts	872,000	2,900,000	4,914,000	10,697,543	1,127	118
Gross Business Volume	1,373,000	4,538,000	7,827,000	16,838,597	1,127	115

* Nominal 2005, 2007, and 2009 dollars adjusted for inflation using Gross Domestic Product-Implicit Price Deflator and reflect 2011-equivalent dollars.

** Per-well expenses in the 2005, 2007, and 2009 studies were based on reported total costs to complete a well in North Dakota. The 2011 study refined the estimate to consider economic leakage associated with purchases of inputs primarily supplied by out-of-state firms.

*** Estimation techniques for private lease bonuses in North Dakota differed between the 2005 study and the subsequent studies. Private lease bonuses were not adjusted for in-state mineral ownership in the 2005 study, and were based primarily on data obtained from the survey of oil operators. Private lease bonuses represented only payments to in-state mineral owners in the 2007, 2009, and 2011 studies and were based primarily on a survey of oil lease/brokerage firms and in-state and out-of-state royalty payments reported by oil operators.

**** Numbers in 2011 reflect economic leakage associated with well drilling and completion activities.

Changes in oil and gas production have implications on the gross business volume of the industry in the state. Based on the reported expenses associated with oil and gas production, volume of production has a greater effect than the expenses per unit of output (i.e., in-state expenditures per BOE) (Table 15). Also, increases in the overall royalty rates paid on mineral ownership have contributed to increased royalty payments, which were considered a direct impact in the estimation of gross business volume. Likewise, collections of severance taxes, also considered a direct impact, increased substantially, reflecting an increase in the overall value of oil and gas production in the state. From 2005 to 2011, total direct expenditures for oil and gas production increased by about 289 percent. As expected, the gross business volume from oil production also increased by a similar percentage over the period (Table 15).

The processing sector of the petroleum industry also showed substantial increase in expenditures over the 2005 to 2011 period (Table 16). Some of the increase came from expansion of pipeline capacity and expansion of natural gas processing capacity in the state. Some change in expenditures was a result of greater processing volumes, pipeline shipments, and growth in rail shipments. The other change came from a substantial increase in transportation expenses reported by oil operators. Overall, the change in direct expenditures in this segment of the industry reflected an increase in processing/transporting volumes and an increase in transportation expenses. The gross business volume for the processing and transportation component of the petroleum industry increased by about 229 percent from 2005 through 2011 (Table 16).

Table 15. Comparison of Economic Estimates, Oil and Gas Extraction/Production Component of Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

Category	2005*	2007*	2009*	2011	Percent Change	
					2005 - 2011	2009 - 2011
Oil and gas production (BOE terms)	45,321,000	56,858,000	95,122,000	178,919,267	295	88
Production and General Business Expense per BOE	\$13.64	\$16.37	\$11.51	\$9.99	-26.8	-13.2
Royalties**						
Oil	13.0	14.9	16.6	17.6	34.8	6.1
Gas	13.3	14.2	16.7	17.4	30.7	3.9
----- 000s \$ -----						
Direct Impacts						
Production Expenditures	342,456	468,584	621,532	932,099	172	50
General Business Expenses	245,579	386,371	401,322	647,957	164	62
Royalties						
Net federal and state	42,134	59,073	71,908	302,336	618	320
Private***						
Total	221,631	393,526	674,416	2,052,524	826	204
In-state	na	211,759	367,057	798,121	na	117
Total Royalties	263,766	270,833	438,965	1,100,456	317	151
Severance Taxes	171,594	266,802	408,459	1,296,106	655	217
Total Direct Impacts	1,023,000	1,395,000	1,870,000	3,976,618	289	113
Secondary Impacts	1,585,000	2,085,000	2,553,000	4,672,646	195	83
Gross Business Volume	2,608,000	3,480,000	4,423,000	8,649,000	232	96

* Nominal 2005, 2007, and 2009 dollars adjusted for inflation using Gross Domestic Product-Implicit Price Deflator and reflect 2011-equivalent dollars.

** Average percentage of production. Data obtained from oil operator survey and based only on owned/operated wells.

*** Direct comparisons between the 2005 and later studies are difficult. Private royalties in the 2005 study were not adjusted for in-state versus out-of-state mineral ownership. As such, private royalties in 2005 represented a gross measure of payments. Total payments of private royalties in 2007, 2009, and 2011 were adjusted for in-state mineral ownership. Private royalties in 2011 were net of severance taxes. Severance tax adjustments were not performed on 2007 and 2009 net private in-state royalties.

Table 16. Comparison of Economic Estimates, Processing Component of Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

Category	2005*	2007*	2009*	2011	Percent Change	
					2005 - 2011	2009 - 2011
----- 000s \$ -----						
Direct Impacts						
Transportation	30,000	73,900	72,000	206,700	589	187
Processing and Pipeline Activities	119,100	205,100	251,100	268,300	125	7
Total Direct Impacts	149,100	279,000	323,100	475,000	219	47
Secondary Impacts	267,900	474,800	588,700	895,100	234	52
Gross Business Volume	417,000	753,800	911,800	1,370,100	229	50

* Nominal 2005, 2007, and 2009 dollars adjusted for inflation using Gross Domestic Product-Implicit Price Deflator and reflect 2011-equivalent dollars.

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 in the state has been from severance taxes. Overall, not all sources of government revenues changed in equal proportion over the period; however, collectively governmental revenues from the petroleum industry increased by \$2.25 billion or 596 percent in real terms over the period (Table 17). The largest single increase (\$1.1 billion) comes from changes in the collection of severance taxes which went from \$172 million in 2005 to \$1.3 billion in 2011.

Table 17. Estimates of State and Local Government Revenues Generated by Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

					Percent Change	
State and Local Government Revenues	2005*	2007*	2009*	2011	2005 - 2011	2009 - 2011
----- 000s \$ -----						
Included as Direct Impacts						
Sales and Use, Property, and Income taxes	41,600	110,500	124,100	198,000	376	60
Royalties**	42,800	59,400	72,300	303,000	608	319
Severance Taxes	171,600	266,800	408,500	1,296,100	655	217
Lease Bonuses (net federal and state)	19,300	9,500	157,300	105,500	447	-33
Licenses, Fees, Permits, Donations, and undetermined taxes	40,700	107,900	92,000	350,000	760	280
Totals	316,000	555,000	854,200	2,252,700	613	164
Estimated from Secondary Economic Activity						
Sales and Use	40,300	78,900	120,000	242,374	501	102
Personal Income	22,100	49,000	75,800	152,809	591	101
Direct and Secondary Estimates of State and Local Government Revenues						
	378,400	681,900	1,049,900	2,648,000	600	152

* Nominal 2005, 2007, and 2009 dollars adjusted for inflation using Gross Domestic Product-Implicit Price Deflator and reflect 2011-equivalent dollars.

** Net federal and state royalties from oil and gas production, and included royalties from processing activities returned to North Dakota entities by the U.S. Department of Interior, Office of Natural Resources Revenue (2012).

Employment in the industry also showed substantial change from 2005 through 2011. While employment has increased in all segments of the industry, the greatest increase in employment has been observed by the firms providing service and support in the oil patch (Table 17). These firms provide construction, drilling, transportation, repairs, well maintenance, and a host of other service-based operations in the oil patch. Overall, total direct employment within the industry was estimated to increase by nearly 35,800 FTE jobs from 2005 to 2011 (Table 18). Compared to the 2005 and 2007 studies, this study provided three additional estimates of employment in the petroleum sector using data obtained from Job Service North Dakota, North Dakota Workforce Safety and Insurance, and an employment model using Oil and Gas Division employment coefficients. The fourth estimate of direct employment used a model that adopts employment coefficients developed by the Oil and Gas Division of the Department of Mineral Resources (2012b). Estimates of employment from Job Service North Dakota and North Dakota

Workforce Safety and Insurance showed changes in industry employment that were similar in magnitude to estimates generated from survey data (see Table 7).

Table 18. Direct and Secondary Employment, Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

Category	2005	2007	2009	2011	Percent Change	
					2005 - 2011	2009 - 2011
Direct Employment						
Oil Operators	1,118	1,402	1,668	2,269	103	36
Service and Support	3,463	9,831	15,911	37,737	990	137
Processing and Pipelines	471	579	748	850	80	14
Totals	5,051	11,812	18,328	40,856	709	123
Secondary Employment	15,171	17,612	17,729	18,703	23	5

All segments of the industry showed substantial gains in direct and secondary economic impacts (Table 19). The causes for those increases varied by segment of the industry. In exploration, the increase in drilling activity combined with an increase in the cost per well resulted in substantial changes in gross business volume. Gross business volume associated with extraction/production was largely similar to changes in oil and gas production. After correcting for inflation, natural gas prices decreased over the period while oil prices showed little change from 2005 through 2009, but increased substantially from 2009 through 2011. An increase in transportation expenses, expansions of industry infrastructure (i.e., gas plants and pipeline capacities), and increased processing volumes contributed to an increase in the gross business volume for the processing/transportation segment of the industry.

The petroleum industry in North Dakota showed real growth in each of the four studies. The exploration segment of the industry increased in real terms by over 1,116 percent, and was the primary reason for the magnitude of the increases in the industry's gross business volume. In real terms, direct impacts from exploration/development in 2011 were greater than the entire industry's direct impacts in 2009. The difference in gross business volume for exploration/development in 2005 and 2011 was nearly \$15.3 billion. The gross business volume for extraction/production segment of the industry increased by \$5.5 billion or by 211 percent from 2005 to 2011. Economic activity associated with the processing and transportation segment of the industry increased by over \$950 million over the same period. The gross business volume for the entire industry increased almost 6-fold over the period from \$4.4 billion in 2005 to \$26.2 billion in 2011 (excluding

infrastructure spending) (Table 19). Other notable increases included direct employment expanding by over 700 percent and government revenues rising by nearly 600 percent.

Table 19. Key Economic Values, Petroleum Industry, North Dakota, 2005, 2007, 2009, and 2011

Category	2005*	2007*	2009*	2011**	Percent Change	
					2005 - 2011	2009 - 2011
----- 000s \$ -----						
<u>Direct Impacts</u>						
Exploration/Development	500,800	1,637,500	2,913,200	6,141,000	1,126	111
Extraction/Production	1,023,400	1,394,600	1,870,300	3,977,000	289	113
Processing/Transp.	149,100	279,000	323,100	475,000	219	47
All Segments	1,673,300	3,311,100	5,106,500	10,593,000	533	107
Infrastructure Spending	na	na	na	1,143,000	---	---
Grand Total	1,673,300	3,311,100	5,106,500	11,736,000	---	---
<u>Secondary Impacts</u>						
Exploration/Development	871,900	2,900,600	4,914,200	10,698,000	1,127	118
Extraction/Production	1,584,700	2,085,100	2,552,400	4,673,000	195	83
Processing/Transp.	267,900	474,800	588,700	895,000	234	52
All Segments	2,724,500	5,460,600	8,055,300	16,265,000	497	102
Infrastructure Spending	na	na	na	2,419,000	---	---
Grand Total	2,724,500	5,460,600	8,055,300	18,684,000	---	---
<u>Gross Business Volume</u>						
Exploration/Development	1,372,800	4,438,200	7,827,300	16,839,000	1,127	115
Extraction/Production	2,608,100	3,479,800	4,422,700	8,649,000	232	96
Processing/Transp.	417,000	753,700	911,800	1,370,000	229	50
All Segments	4,397,800	8,771,700	13,161,800	26,858,000	511	104
Infrastructure Spending	na	na	na	3,562,000	---	---
Grand Total	4,397,800	8,771,700	13,161,800	30,420,000	---	---
Governmental Revenues	378,000	682,000	1,050,000	2,648,000	600	152
Industry-wide Employment	5,051	11,812	18,328	40,856	709	123

na = not available.

* Nominal 2005, 2007, and 2009 dollars adjusted for inflation using Gross Domestic Product-Implicit Price Deflator and reflect 2011-equivalent dollars.

** Infrastructure spending represented average of a low and high estimate.

SUMMARY

The purpose of this study was to estimate the economic contribution of the petroleum industry in North Dakota in 2011. 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. Exploration 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. 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. Transportation was limited to the movement of oil and gas from wells to collection points, and then onto processing facilities located either in-state or out-of-state. Petroleum processing in North Dakota included refining of crude oil and natural gas processing.

Due to the complexities of how the oil and gas industry is structured, and that in-state effects (i.e., first round spending or direct impacts) from the petroleum industry in any given year may not equal the market value of oil and gas production, an expenditure-based approach to measuring the economic size of the petroleum industry was used in this study. In this approach, 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. In addition to in-state expenditures for exploration/development, extraction/production, transportation, and processing activities, private and public royalties, lease bonuses, and severance taxes also were included as direct impacts. Secondary economic impacts result from the spending and respending of the direct impacts and were estimated using the North Dakota Input-Output Model.

Three separate surveys were used to collect production, expenditure, and employment data for the petroleum industry in North Dakota. Firms that own or operate oil wells in the state were surveyed to obtain information on in-state expenses for oil and gas exploration, oil and gas extraction/production, general business expenses, expenditures for infrastructure projects, employment, oil and gas production, and drilling activity. A similar survey was conducted for firms engaged in pipeline transportation of crude oil and unprocessed natural gas and included firms involved with processing of crude oil and natural gas in North Dakota. A third survey was conducted to obtain expenditure patterns and capital outlays for infrastructure projects associated with businesses that supply services and inputs to the oil fields. A fourth survey involved lease/brokerage firms and was used to obtain information on leasing activity in the state.

The survey of oil operators produced financial data on about 32 percent of North Dakota's oil and gas production in 2011. Also, financial data were collected on pipeline transportation, gas

processing, and crude oil refining. The survey of lease/brokerage firms and data obtained from oil operators were used to estimate leasing activity on private lands in the state. Secondary data, obtained from government agencies, were combined with survey data to estimate royalties, lease bonuses, and severance taxes. Secondary data also were used in estimating project-based capital costs for selected infrastructure projects in the state (e.g., gas plants, pipeline expansions).

Estimates of total in-state expenditures in 2011 for oil and gas exploration/development were derived from the survey of oil operators and used with drilling statistics from the North Dakota Department of Mineral Resources. A total of 1,271 wells were completed in 2011. Average expense per well for oil operators was estimated at \$9.1 million, yielding about \$11.6 billion in total financial outlays for well development. Financial data on expenses for well drilling and completion were obtained from oil operators, and adjustments to the capital costs to drill and complete a well were performed to reflect specific inputs supplied by in-state sources. The net effect of removing expenses for those capital outlays revealed that about 48 percent of the cost to complete a well in North Dakota in 2011 represented economic leakage that was not included in the industry's direct economic impacts. The direct impact per well completed in the state was estimated at \$4.5 million. The combination of in-state expenses for exploration and lease bonuses resulted in \$6.1 billion in direct impacts in 2011. The secondary economic impacts associated with exploration activities were estimated at \$10.7 billion. The in-state gross business volume (direct and secondary impacts) of exploration activities was estimated at \$16.8 billion in 2011 (Figure 7).

Estimates of oil and gas extraction/production expenses, general business expenses for oil operators, private and public royalties, and state severance taxes were derived from survey data and secondary information obtained from various government agencies. The state averaged 5,555 active wells per month in 2011 that produced 153 million barrels of oil and over 155 million mcf of natural gas. Total direct impacts for oil and gas production were estimated at \$4 billion in 2011. Total secondary economic impacts associated with oil and gas production were estimated at \$4.7 billion. The in-state gross business volume of oil and gas extraction/production was estimated at \$8.6 billion in 2011 (Figure 7).

The processing component of the petroleum industry was estimated to have a direct impact in North Dakota of \$475 million. Total secondary economic impacts associated with processing and transporting crude oil and natural gas were estimated at \$895 million. The in-state gross business volume of processing and transporting crude oil and natural gas was estimated at \$1.4 million in 2011 (Figure 7).

The petroleum industry was estimated to have spent between \$2.5 billion to \$2.7 billion on infrastructure projects in the state in 2011. After adjustments for economic leakage (the portion of expenditures not captured in the North Dakota economy), it was estimated that about \$1.1 billion to \$1.2 billion were captured in the North Dakota economy. The gross business volume associated with infrastructure spending in North Dakota was estimated to range from \$3.4 to \$3.7 billion in 2011. 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.

Industry-wide direct impacts from the petroleum industry were estimated at \$10.6 billion in 2011 (not including infrastructure spending). Total secondary economic impacts associated with the industry were estimated at \$16.3 billion. The gross business volume for the petroleum industry in North Dakota in 2011 was estimated at \$26.9 billion (Figure 7). When including in-state expenditures for infrastructure projects, the petroleum industry was estimated to have \$11.7 billion, \$18.7 billion, and \$30.4 billion in direct impacts, secondary impacts, and gross business volume, respectively.

Additional measures of the petroleum industry's economic importance to the state include direct employment for 40,800 full-time jobs, economy-wide personal income of \$11 billion, statewide retail sales of \$7.2 billion, direct contributions to local and state government revenues of \$2.25 billion, indirect contribution of \$395 million in state government tax collections, and secondary employment of 18,703 full-time equivalent jobs. For every dollar spent in the state by the petroleum industry, another \$1.59 in additional business activity was generated.

A number of comparisons to information collected and estimated for 2005, 2007, and 2009 was made to similar figures for 2011. While energy prices were not directly used in the study to generate estimates of industry activity, prices directly influence some measures of industry output, such as tax collections and royalties. Oil prices increased from 2005 to 2007 in real terms by 26 percent to around \$65 per barrel, but decreased to 2005 levels in 2009. Prices in 2009 remained well below the extreme price spikes observed in 2008; however, prices in 2011 increased above annual values for 2005, 2007, and 2009. Gas prices, both in nominal and real terms, decreased by 58 percent from 2005 to 2011. Oil production increased from 35 million barrels to 153 million barrels over the period. Gas production jumped from around 58 million mcf in 2005 to over 155 million mcf in 2011. In addition to increases in oil and gas production, exploration/development activities continued to increase as the number of wells completed in the state went from 240 in 2005 to 1,271 in 2011.

North Dakota Petroleum Industry

Key Segments of the Industry

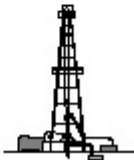

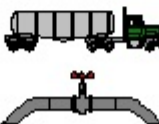

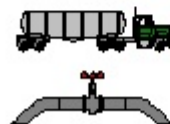
	Exploration	Extraction	Transportation	Processing	Distribution	Retail
	drilling and locating oil reserves 	bringing oil and gas to the surface 	moving oil and gas from pumps to processing centers 	oil refining and natural gas processing 	moving products from processors to retail markets 	selling petroleum products to end users
Direct Impacts	\$6.141 billion	\$3.978 billion	\$475.0 million		not included	
Secondary Impacts	\$10.698 billion	\$4.673 billion	\$895.0 million			
Gross Business Volume	\$16.839 billion	\$8.649 billion	\$1.370 million			
Direct Employment	40,000 full-time equivalent jobs		850 full-time equivalent jobs			
Secondary Employment	18,700 full-time equivalent jobs					
Direct Government Revenues	\$444 million	\$1.780 billion	\$29 million			

Figure 7. Economic Effects of Key Segments of the North Dakota Petroleum Industry, 2011

All segments of the industry showed substantial gains in direct and secondary economic impacts over the period. In exploration, the increase in drilling activity combined with an increase in the cost per well resulted in substantial changes in gross business volume. Changes in gross business volume associated with extraction/production were largely similar to changes in oil and gas production. An increase in transportation expenses, expansions of industry infrastructure (i.e., gas plants and pipeline capacities), and increased processing volumes all contributed to an increase in the gross business volume for the processing/transportation segment of the industry.

The exploration segment of the industry increased in real terms by over 1,127 percent from 2005 to 2011, and had the greatest effect on the growth in the overall gross business volume for the entire industry. In real terms, direct impacts from exploration/development in 2011 exceeded the entire industry's direct impacts in 2009. The difference in gross business volume for exploration/development from 2005 to 2011 was nearly \$15.5 billion. The gross business volume for extraction/production segment of the industry increased by \$6 billion or by 232 percent. Economic activity associated with the processing and transportation segment of the industry increased by \$953 million over the period. The gross business volume for the entire industry increased by nearly 511 percent in real terms over the period from \$4.2 billion in 2005 to \$26.9 billion in 2011 (Table 16). Other notable increases included direct employment expanding by 700 percent and government revenues rising by 600 percent.

The petroleum industry was estimated to have spent between \$2.5 billion to \$2.7 billion on infrastructure projects in the state in 2011. After adjustments for economic leakage (the portion of expenditures not captured in the North Dakota economy), it was estimated that about \$1.1 billion to \$1.2 billion were captured in the North Dakota economy. Combining exploration, production, transportation, processing, and infrastructure spending revealed the petroleum sector had a \$30.4 billion gross business volume in the state in 2011.

CONCLUSIONS

Changes in energy prices, drilling activity, and oil and gas production in North Dakota have made the petroleum industry the one of largest single basic-sector industries in the state. Comparisons of the industry's economic importance in 2011 with previous estimates from 2005, 2007, and 2009 reveal the industry has increased 6-fold (495 percent) in economic size in six years (i.e., 2005 to 2011). While some of that increase can be directly attributable to an increase in the number of producing wells, which has led to increased oil and gas production, the primary reason for the substantial increase has been due to expenditures for oil drilling and well completion activities.

The economic contribution of the petroleum industry was measured based on factors present in the industry in 2011. As such, the figures presented in this report represent a snapshot in time, and will not necessarily reflect the future economic impact of the industry. The economic importance of the industry will increase and decrease with changes in a host of factors that affect petroleum exploration, extraction/production, and processing levels. The fact that the economic importance of the industry is subject to change was readily apparent when comparisons were made between economic output in 2005, 2007, 2009, and 2011. The gross business volume associated with exploration increased by over 1,100 percent in real terms over the period. A combination of a substantial increase in the number of oil wells drilled and increases in the cost per well completed were the reasons for the change. Other comparisons between 2005, 2007, 2009, and 2011 reveal that changes in impacts from oil and gas extraction/production more closely mirrored changes in output, while increases in economic activity associated with the processing sector of the industry were tied to both increases in state oil and gas production, but also to expanded capacity of the industry's infrastructure, and increased transportation activity.

The industry was estimated to have capital expenditures for infrastructure-related projects in the state ranging from \$2.5 to \$2.7 billion in 2011. The industry is expanding infrastructure to meet the current and future anticipated needs associated with increased crude oil and natural gas production, well counts, and workforce. Considering that this study only examined one year of capital expenditures for petroleum-sector infrastructure, the level of investment by the industry to expand capabilities in the Williston Basin reinforces the expected future value of developing the Bakken and Three Forks Formations.

Few other basic-sector industries in North Dakota, outside of various agricultural industries and the lignite industry, have had similar comprehensive assessments of their economic importance. The figures reported in this study are substantial, and comparisons to other basic-sector industries may be helpful in placing results from this study in context. The wheat industry and the coal industry are two examples of large basic-sector industries that have had economic assessments performed to measure their economic contribution to North Dakota's economy. From 2001 through 2003, the production, transportation, handling, and processing of wheat in North Dakota was

estimated to produce a gross business volume of \$4.4 billion (in 2011 dollars) annually. In 2011, the coal industry in North Dakota was estimated to generate over \$2.9 billion in gross business volume (Coon et al. 2012b). Estimates of the gross business volume, in real terms, for the petroleum industry were \$4.4 billion in 2005, nearly \$8.8 billion in 2007, \$13.2 billion in 2009, and \$30.4 billion in 2011 (including infrastructure impacts). Direct employment figures for the wheat industry would not be comparable to those in this study; however, direct employment in the coal industry was estimated at 4,087 FTE positions, compared to around 40,800 FTE jobs in the petroleum industry in 2011.

Several studies were released in 2012 that identified potential long-term growth in well counts and oil and gas production in North Dakota (Bentek Energy 2012, North Dakota Department of Mineral Resources 2012c, KLJ 2012 [see Bangsund and Hodur {2013} for projections from the KLJ study]). All of these independent assessments, while not necessarily agreeing on the exact path or future size of the industry, confirm expectations that the petroleum sector in North Dakota will continue to grow over the next two decades, and will be considerably larger (i.e., well counts, oil and gas output) in the future. This study demonstrates the economic benefits of expanding oil production in the state, and the economic value that oil and gas development can have on the state's economy. Of particular interest from a policy perspective is the potential to capture economic activity from the anticipated growth in the development of the Bakken/Three Forks Formations. Shale oil development is now occurring in numerous locations in North America and given that most oil operators in the state also are active in other shale plays across the continent, the economic opportunity of developing the Bakken/Three Forks Formations in North Dakota should not be taken for granted. North Dakota has an enormous potential for economic stability in its economy that can come from the continued development of the oil fields in the state.

Regardless of the economic measure used, currently the petroleum industry is one of the largest basic-sector industries in North Dakota. Considering that the industry's direct impacts (i.e., first round of spending) are concentrated geographically in the western portion of the state, the economic health of western North Dakota is perhaps tied more to the petroleum industry than any other single industry. Yet, despite the strong influence of the petroleum industry in western North Dakota, the magnitude of the contributions to both the state and local governments and the sheer volume of secondary economic effects in nearly all sectors of the North Dakota economy would suggest that the economic effects of the industry are felt statewide. Current activity levels in the petroleum industry clearly make it one of the key forces in the North Dakota economy.

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APPENDIX A

**Questionnaire, Oil Operators,
North Dakota, 2011**

Contribution of the Petroleum Industry to the North Dakota Economy

Survey of Oil Operators

Department of Agribusiness and Applied Economics
North Dakota State University
and
North Dakota Petroleum Council

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 2011 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 2011.
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.
6. Please complete the survey by **July 27th** and mail the questionnaire in the return envelope.
7. 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 58105-5636

Part I - - General Information

Business Name:

Mailing Address:

Contact Person:

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

Number of producing oil wells in ND in 2011 for which your company was the operator

	Oil	Gas
Total production from your operated wells in 2011	_____ 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 2011 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 2011
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	\$
Oil and gas royalties	\$
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 IV. Leasing and Drilling Activity in North Dakota. Please summarize your company's lease expenditures and drilling activities over the past year. Lease expenditures and drilling activities should be for North Dakota operations only.

Leasing	2011
Total lease expenditures (\$)	
Private leases	
State leases	
Federal leases	
Total acres leased	
Private land	
State land	
Federal land	
Drilling	2011
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 V. 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.

[illegible]

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 Watts 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 2012.

APPENDIX B

**Questionnaire, Processors,
North Dakota, 2011**

Contribution of the Petroleum Industry to the North Dakota Economy

Survey of Processors

Department of Agribusiness and Applied Economics
North Dakota State University
and
North Dakota Petroleum Council

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 2011 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. Only include expenditures made to businesses, governments, or individuals in North Dakota.
5. If you cannot identify whether an expenditure was made in North Dakota or in another state, indicate this on the form.
6. Definitions for some expenditure items and their corresponding Standard Industrial Classification (SIC) code listing are included to help in determining allocation of expenditures.
7. We would prefer to have the questionnaire completed and returned by **August 28, 2012**.

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 58105-5636

Part I - - General Information

Business Name: _____

Mailing Address: _____

Contact Person: _____

Total MCF of gas processed in the last year for operations and facilities located
in North Dakota (if applicable) _____

Percent of gas processed that was from North Dakota sources _____

Percent of gas processed that was from sources in other states _____

Percent of gas processed that was from Canadian sources _____

Total MCF of gas transported in the last year for operations and facilities located
in North Dakota (if applicable) _____

Percent of gas transported that was from North Dakota sources _____

Percent of gas transported that was from sources in other states _____

Percent of gas transported that was from Canadian sources _____

Number of employees in North Dakota (full-time equivalents) in 2011 _____

Part II: Annual Expenses

The following expenditures should represent expenses paid only to North Dakota entities. Please refer to the accompanying sheet for definitions and clarification of what expenses should be included in the expenditure categories.

<u>Operating Expenses in 2011</u>	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	\$
Purchases of gas (from ND sources)	\$
Transportation	\$
Retail Trade	\$
Research and Development	\$
North Dakota Taxes	\$
Property	\$
Income	\$
Sales and Use	\$
Other expenses (please specify)	\$
	\$
	\$

Definitions for Expenditure Categories

The following definitions are derived from the 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, pipeline transportation of petroleum, 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 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 in Part II that may have already been included in your annual operating expenses. Please report total expenditures in 2011 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 2011
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	\$

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 Watts 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>

Study results should be available in the fall of 2012.

APPENDIX C

**Questionnaire, Service and Support Firms,
North Dakota, 2011**

Contribution of the Petroleum Industry to the North Dakota Economy

Survey of Firms Providing Service and Support in the North Dakota Petroleum Industry

Department of Agribusiness and Applied Economics
North Dakota State University
and
North Dakota Petroleum Council

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 and gas industry to the North Dakota economy. The goal is to determine how much money is spent 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 for activities in 2011.
2. If you are unsure of a specific figure please use your best estimate. Remember, your best estimate is going to be better than our best guess!!
3. When answering questions pertaining to spending patterns, please remember that we are only interested in information on expenditures made to businesses, governments, or individuals in North Dakota.
4. If you cannot determine if a particular expense was incurred in North Dakota or if the expense was made to another company or individual in a different state, please indicate this on the form.
5. Please return the questionnaire by September 30, 2012.
6. If you have questions, please contact:

Dean Bangsund
701-231-7471
Email: d.bangsund@ndsu.edu

or

Nancy Hodur
701-231-7357
Email: nancy.hodur@ndsu.edu
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, ND 58108-6050

General Information

Business Name: _____

Mailing Address: _____

Contact Person: _____

Part I - Activity in the Petroleum Sector

What percent of your company's overall business comes from the petroleum industry?

- a) 1 to 20%
- b) 21 to 40 %
- c) 41 to 60%
- d) 61 to 80%
- e) 81 to 100%

Of the revenues your company receives from work in the petroleum industry, what percent of those revenues come from activities in North Dakota?

- a) 1 to 20%
- b) 21 to 40 %
- c) 41 to 60%
- d) 61 to 80%
- e) 81 to 100%

How many total employees does your business have? _____ full-time equivalents

How many employees work in North Dakota? _____ full-time equivalents

(For part-time, seasonal, or temporary workers, please estimate how many full-time equivalents their jobs would account for. E.g., 4 part-time workers employed for 3 months each would equal 1 full-time job).

Part II - Revenues Spent in North Dakota

The next three sections ask for information on your company's spending patterns in North Dakota.

Please Note:

It is important for our study that we be able to distinguish the difference between revenues earned in North Dakota versus expenditures made in North Dakota. This holds for both firms headquartered out-of-state and firms that are headquartered in North Dakota.

When answering the following question, we want you to think about only your business activities in North Dakota and how much your company spends (expenses and costs) in the state relative to your gross revenues from North Dakota sources.

Please estimate (make an educated guess if needed) what percent of your company's gross revenues associated with the petroleum industry in North Dakota are spent in North Dakota.

_____ percent

Part III - Infrastructure Spending in North Dakota

This section relates to your company's expenses associated with infrastructure development in North Dakota in 2011. 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 2011
Oil Field Gathering Systems Expenditures for the 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 crew camps, lodging facilities at work sites, and construction of other housing projects (e.g., company owned apartments and houses). NOTE: do not include lodging expenses for actual housing of workers (motel rooms, meals, other arrangements).	\$
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 - Estimates of Business Expenditures in North Dakota

To avoid double counting, do not include any expenditures here that you reported in the infrastructure categories in the previous section.

Please think about your company's business expenses in North Dakota. We would like you to estimate (or guess if needed) the approximate level of business expenses your company had in 2011.

General estimates for these figures are sufficient (e.g., \$2,000 in supplies, \$100,000 in services).

Types of Expenditures in North Dakota	Estimated Expenditures in North Dakota in 2011
Wages and Salaries	\$
Office expense (<i>e.g., computers, software, photocopying, paper, postage, other supplies, office rent/lease, office equipment, subscriptions for magazines and periodicals</i>)	\$
Interest and Insurance (<i>examples include bank expenses, loan interest, liability and casualty premiums</i>)	\$
Communications and Utilities (<i>examples include phone, Internet, electricity, water, natural gas, sewer, garbage, etc</i>)	\$
Supplies and Equipment (<i>examples include vehicles, industrial equipment, specialized machinery, fuel, lubricants, tires, tools, hardware, building materials, replacement parts, and miscellaneous inputs</i>)	\$
Services (<i>examples include repairs and maintenance, tax preparation, construction work, legal, meals, lodging, snow removal, shipping and transportation, and any miscellaneous business service</i>)	\$
North Dakota Taxes	\$
Property taxes	
Other taxes (<i>income, unemployment</i>)	\$
Licenses, Permits, and Government Fees	\$
Other Expenses (<i>please specify the expense</i>)	\$

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 Watts 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>

Study results should be available in December of 2012.

APPENDIX D

**Questionnaire, Leasing/Brokerage Firms,
North Dakota, 2011**

Contribution of the Petroleum Industry to the North Dakota Economy

Department of Agribusiness and Applied Economics
North Dakota State University
and
North Dakota Petroleum Council

Confidential Survey of Oil Leasing Firms

Company _____
Contact Person _____

Total bonus payments paid out for oil leases in North Dakota in 2011 \$ _____

Of the total above, what percentage went to:

% _____ In-state residents (North Dakota addresses only)

% _____ Federal agencies

% _____ ND State agencies

Total net lease acres made by your firm in North Dakota in 2011 _____

Of the total above, what percentage was represented by:

% _____ Private acreage

% _____ Federal acreage

% _____ State acreage

Thank you for completing this questionnaire. The material you provide is kept strictly confidential and will be averaged with data from other firms.

Please mail your completed questionnaire to:

Dean Bangsund
Dept of Agribusiness and Applied Economics
North Dakota State University
NDSU Dept 7610
PO Box 6050
Fargo, ND 58108-6050

Please call or e-mail Dean Bangsund, NDSU, for any questions regarding this survey or the study of the Petroleum Industry in North Dakota.

Ph. 701-231-7471

E-mail: d.bangsund@ndsu.edu

