JOBS & ECONOMIC BENEFITS OF MIDSTREAM INFRASTRUCTURE DEVELOPMENT

US Economic Impacts Through 2035

PREPARED FOR:

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15 FEBRUARY 2012

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B&V PROJECT NO. 175464

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Executive Summary

The purpose of this study is to estimate the economic impact of the $200 billion (2011 dollars) in midstream investments that will be required to accommodate the development of natural gas, oil and natural gas liquid (NGL)[1] resources from 2012 through 2035. Near-term estimates through 2013 and through 2016 also are developed. The estimated economic impact of these investments is measured in terms of employment creation, income generation, output, taxes generated and value added to the US economy and study regions.

MIDSTREAM INVESTMENTS IN THE LOWER 48 STATES OF $200 BILLION THROUGH 2035

Midstream natural gas, oil, and NGL investments evaluated in this study include expenditures for the following:

- Gathering pipe
- Lateral pipelines
- Mainline pipeline
- Compression equipment
- Processing facilities
- Natural gas storage facilities

The base information for this report is the 2011 INGAA Foundation report *North American Midstream Infrastructure Through 2035 – A Secure Energy Future* (the *2035 Midstream Report*).[2] The study found that, in 2010 dollars, natural gas midstream infrastructure capital investment in North America for the next 25 years is estimated to be over $205 billion with an additional $46 billion in capital investment for NGL and oil pipeline infrastructure. As a result of this investment, an average of 2,000 miles of new natural gas transmission lines and laterals are anticipated to be added each year through 2035 in combination with more than 200,000 horsepower of compression, 24 billion cubic feet (Bcf) of gas storage capacity and 1.3 Bcf per day (Bcf/d) of annual processing capacity additions. An additional 1,300 miles of oil and NGL transmission pipeline would also be constructed each year, on average.

In the current study, the data was narrowed to include only the US lower 48 states and offshore Gulf of Mexico investments, which were divided into six regions. The starting year of the study was changed to 2012, and expenditures were converted to 2011 dollars. When adjusted to 2011 dollars, total investments in the selected US regions will total just over $200 billion from 2012 through 2035.

The largest expenditure category ($90 billion) will be for natural gas mainline pipeline. This is large diameter pipeline (20" to 42") that is projected to have an all-in average installed cost per mile of $2.8 million in the *2035 Midstream Report*. This expenditure category is followed in dollars spent by expenditures for small diameter (0.5" to 6") gathering pipeline ($29 billion) and lateral pipeline (6" to 24" diameter, $26 billion) pipeline. These pipelines are estimated to have an all-in average installed cost per mile of approximately $100,000 (for gathering pipeline) and $2.2 million (for lateral pipeline).

[1] NGLs are widely used as feedstock in the petrochemical industry. See Section 2 for more discussion.

[2] *North American Midstream Infrastructure Through 2035 – A Secure Energy Future*, ICF International, June 28, 2011.

TOTAL MIDSTREAM ECONOMIC IMPACTS THROUGH 2035

The economic impacts through 2035 include those impacts associated with construction as well as those impacts associated with operation and maintenance (O&M). These impacts are presented separately below and then combined.

Total Midstream Investment and Benefit Projections Through 2035

Based on an economic impact analysis of the midstream infrastructure investments, the results for the 2012 through 2035 period are summarized in Table ES-1 and include (all in 2011 dollars):

- The $200 billion investment in 2012 through 2035 midstream projects will help support an annual average of 104,579 jobs.[3]
- The cumulative 2012 through 2035 midstream investments are estimated to create $141 billion in labor income (which includes wages and benefits) at an average of $56,300 per job across all impacted industries. This compares to an average US average of approximately $53,100 per job in 2011.[4]
- The cumulative 2012 through 2035 midstream investments in the US are estimated to contribute nearly $218 billion in value added. Value added for a firm is their sales revenue less the costs of goods and services purchased. The sum of value added in all industries is the gross domestic product (GDP), or the total value of all final goods and services produced in the nation.[5]
- The cumulative 2012 through 2035 midstream investments in the US are estimated to account for nearly $425 billion in total economic output, which is the total value of production from all industries impacted by the midstream investment expenditures. Virtually all industries will be impacted by midstream investments; some (e.g., pipeline and compressor manufacturers) will directly supply equipment and materials for midstream construction and other industries (e.g., fast food and tourism) as workers spend their income on goods and services.[6]
- Total state and local taxes generated due to 2012 through 2035 investment activity will be $16.8 billion and total federal tax revenues generated will be $30.9 billion.

[3] The annual average job figures used in this study are calculated as the total job-years created during the study period as determined by IMPLAN, divided by the years in the study period. IMPLAN's glossary of terms defines a "job" as "the annual average of monthly jobs in that industry" but also points out that this can be "one job lasting 12 months" or "two jobs lasting six months each" or "three jobs lasting four months each" and also explains that "a job can be either full-time or part-time."

[4] Labor income includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. See Section 5.1.1 for an explanation of how the average US figure is derived.

[5] The IMPLAN glossary defines "value added" as "the difference between an industry's or an establishments total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported)." As a simplified example, if a pipeline manufacturer purchased a steel plate for $10,000 then transformed this into a pipeline segment that was then sold for $50,000 then the value added would be $40,000 (ignoring other intermediate inputs and their costs).

[6] The IMPLAN glossary defines "output" as "the value of industry production…in producer prices. For manufacturers this would be sales plus/minus change in inventory. For service sectors production = sales…." As explained more fully in Section 4 of this report, output in this study includes the direct production of goods and services associated with pipeline and other facility construction, the indirect impacts arising from increased production by industries providing inputs during the construction phase, and the increased production in virtually all industries impacted by the expenditure of income by project workers, called induced impacts. This study does not measure the value of natural gas, oil, and NGL that will flow through the pipelines.

Total Midstream Operations and Maintenance Projections Through 2035

Added to the investment impacts at the national level are those from O&M expenditures once the midstream facilities are placed into operation. This study estimates that midstream O&M expenditures over the 2012 through 2035 study horizon will be $28.9 billion, which will generate the following (all in 2011 dollars):

- The cumulative $28.9 billion expenditure for O&M in the 2012 through 2035 period for new investments will help support an annual average of 20,760 jobs.
- The cumulative 2012 through 2035 O&M expenditures are estimated to create $29.7 billion in labor income (an average of nearly $60,000/job across all sectors).
- The cumulative 2012 through 2035 midstream O&M expenditures in the US are estimated to contribute $43.1 billion in value added.
- The cumulative 2012 through 2035 midstream O&M expenditures in the US are estimated to account for $87.0 billion in total output.
- Total state and local taxes generated due to cumulative 2012 through 2015 O&M activity will be $3.3 billion and total federal tax revenues generated will be $6.0 billion.

Combined Investment and O&M Expenditures

The $229.1 billion in combined midstream investment and O&M expenditures in the 2012 through 2035 study period will result in the following benefits:

- An annual average of 125,339 jobs.
- $171.0 billion in cumulative labor income.
- $260.7 billion in cumulative value added and $511.5 billion in cumulative output.
- Cumulative state and local tax revenue of $20.1 billion
- Cumulative federal tax revenues of $36.9 billion.

NATURAL GAS IMPACTS DOMINATE

Investments and economic benefits in natural gas projects will account for approximately 83 percent of the 2012 through 2035 US total, while oil investments will account for approximately 10 percent and NGL investments will account for approximately 7 percent of the US total. The results in Table ES-2 indicate that natural gas investments and O&M expenditures alone will account for:

- An annual average of 103,029 jobs.
- $140.6 billion in cumulative labor income.
- More than $214 billion in cumulative value added.
- More than $420 billion in cumulative total output.
- Cumulative state and local tax revenue of $16.5 billion.
- Cumulative federal tax revenues of more than $30 billion.

Table ES-1 US Midstream Investment Impact Summary for the 2012-2035 Period (Cumulative Impacts in Billions of 2011 Dollars, Employment is Average Annual Jobs Supported)

MIDSTREAM INVESTMENTS		MIDSTREAM O&M EXPENDITURES		COMBINED IMPACT	
US Investment	$200.2	Total O&M Expenditures	$28.9	Expenditures	$229.1
Results		**Results**		**Results**	
Avg. Annual Employment	104,579	Avg. Annual Employment	20,760	Avg. Annual Employment	125,339
Income	$141.3	Income	$29.7	Income	$171.0
Value Added	$217.6	Value Added	$43.1	Value Added	$260.7
Output	$424.5	Output	$87.0	Output	$511.5
State and Local Taxes	$16.8	State and Local Taxes	$3.3	State and Local Taxes	$20.1
Federal Taxes	$30.9	Federal Taxes	$6.0	Federal Taxes	$36.9

Table ES-2 **US Midstream Investment and O&M Expenditures by Energy Type, Impact Summary for the 2012-2035 Period (Cumulative Impacts in Billions of 2011 Dollars, Employment is Average Annual Jobs Supported)**

NATURAL GAS INVESTMENT PLUS O&M IMPACTS		OIL INVESTMENT PLUS O&M IMPACTS		NATURAL GAS LIQUIDS (NGL) INVESTMENT PLUS O&M IMPACTS		TOTAL
Investment, $ Billions (Lower 48)	$190.3	Investment $ Billions (Lower 48)	$22.7	Investment $ Billions (Lower 48)	$16.1	$229.1
Results		**Results**		**Results**		**Results**
Avg. Annual Employment	103,029	Avg. Annual Employment	12,659	Avg. Annual Employment	9,651	125,339
Income	$140.6	Income	$17.3	Income	$13.2	$171.1
Value Added	$214.3	Value Added	$26.3	Value Added	$20.1	$260.7
Output	$420.4	Output	$51.7	Output	$39.4	$511.5
State and Local Taxes	$16.5	State and Local Taxes	$2.0	State and Local Taxes	$1.6	$20.1
Federal Taxes	$30.3	Federal Taxes	$3.7	Federal Taxes	$2.8	$36.8

WIDESPREAD AND SIGNIFICANT REGIONAL BENEFITS

The benefits materializing through the 2035 time frame will be divided among all six of the Energy Information Administration (EIA) US regions studied. Regions having high levels of investment (such as the Northeast) and having a strong employment base in the natural gas sector (such as the Southwest) will benefit the most from midstream investments. Yet, the economic impact will be widespread due to the economic linkages between natural gas and oil pipeline companies and suppliers of materials and services (pipe, compressors, etc.).

Figure ES-1 shows the projected anticipated value of total output projected for the six EIA regions due to midstream construction and O&M expenditures. Figure ES-2 shows the anticipated total number of jobs created by these expenditures. These results demonstrate that the combined effect of midstream investment and O&M expenditures on the US economy will have a significant and beneficial impact on the national economy and all US regions over many decades.

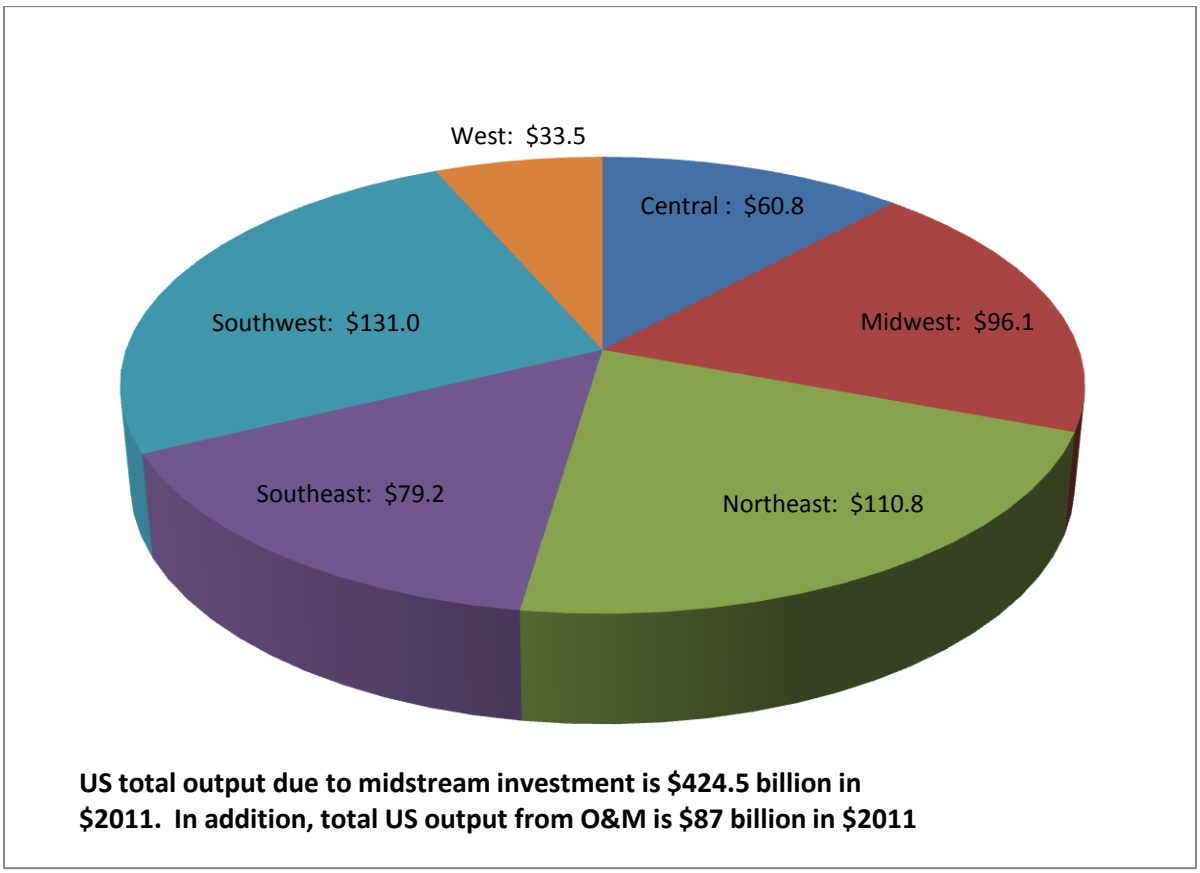

Figure ES-1 Total Value of Regional Output Due to Midstream Investments and O&M, 2012-2035 (in Billions of $2011)

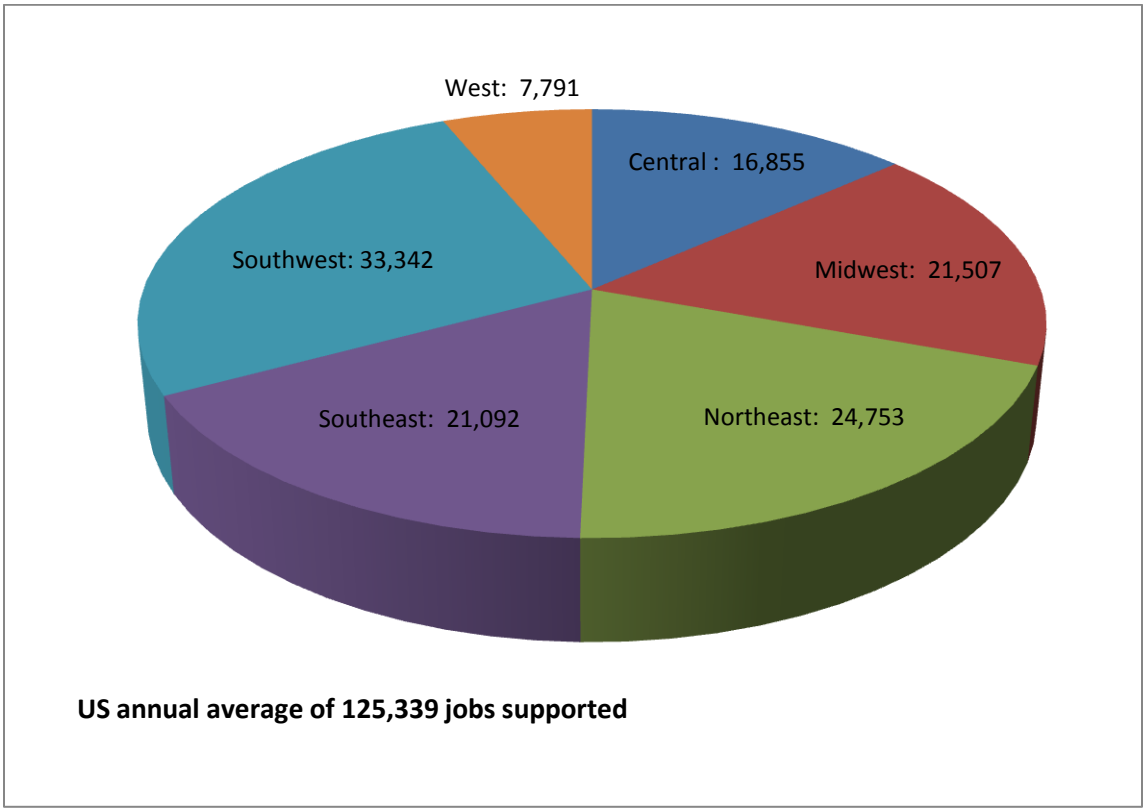

Figure ES-2 Annual Average Job Supported in Each Region Due to Midstream Investments and O&M Expenditures, 2012-2035

NEAR-TERM BENEFITS IN THE 2012-2013 AND 2012-2016 TIME FRAMES

The near-term effects over the 2012 through 2013 time frame and the 2012 through 2016 time frame are a subset of the overall impacts through 2035, and the near-immediate boost these impacts will have on the current economy are important. Table ES-3 lists the average annual job impacts of project investments and O&M expenditures over the two-year and five-year time frame. In the 2012 through 2013 period, an annual average of 159,653 jobs will be supported and $18.4 billion in cumulative worker income will be generated, as will $55.2 billion in output and $6 billion in combined federal, state, and local taxes. In the 2012 through 2016 period, an annual average of 135,633 jobs will be supported and $38.3 billion in cumulative worker income will be generated, as will $114 billion in cumulative output and more than $13 billion in combined federal, state, and local taxes.

OTHER CONSIDERATIONS

While economic impact studies consistently have found large benefits associated with natural gas development, they have received some criticism for failing to directly address certain issues of concern such as the socioeconomic impact and disruption to local communities when projects are constructed. Specific concerns include a "boom to bust" impact and harm done to local roadways, especially during the well drilling phase. While input-output models are not designed to specifically address such issues, such concerns serve as a call for local decision makers to recognize that natural gas development will have local impacts that can require mitigation efforts. It is clear from the impact analysis that there will be substantial tax revenues generated at the federal, state

Table ES-3 US Midstream Investment Impact Summary: 2012-2013 and 2012-2016 Period Results (All Impacts in Billions of 2011 Dollars, Employment is the Number of Jobs Supported)

MIDSTREAM INVESTMENTS		MIDSTREAM O&M EXPENDITURES		COMBINED INVESTMENT PLUS O&M IMPACTS	
2012-2013 EXPENDITURES AND IMPACTS					
US Investment	$26.8	Total O&M Expenditures	$.1	Total US Investment plus O&M	$26.9
Results		**Results**		**Results**	
Avg. Annual Employment	158,730	Avg. Annual Employment	923	Avg. Annual Employment	159,653
Income	$18.33	Income	$.11	Income	$18.44
Value Added	$28.15	Value Added	$.16	Value Added	$28.31
Output	$54.90	Output	$.33	Output	$55.23
State and Local Taxes	$2.13	State and Local Taxes	$.01	State and Local Taxes	$2.14
Federal Taxes	$3.84	Federal Taxes	$.02	Federal Taxes	$3.86
2012-2016 EXPENDITURES AND IMPACTS					
US Investment	$56.8	Total O&M Expenditures	$1.0	Total US Investment plus O&M	$57.9
Results		**Results**		**Results**	
Avg. Annual Employment	132,190	Avg. Annual Employment	3,443	Avg. Annual Employment	135,633
Income	$37.29	Income	$1.02	Income	$38.31
Value Added	$57.24	Value Added	$1.48	Value Added	$58.72
Output	$111.08	Output	$3.00	Output	$114.08
State and Local Taxes	$4.53	State and Local Taxes	$.12	State and Local Taxes	$4.65
Federal Taxes	$8.41	Federal Taxes	$.21	Federal Taxes	$8.62

and local levels as upstream and midstream investments occur. With proper coordination and timing, it is possible that local impacts can be minimized through the allocation of development-induced tax revenue to impacted areas.

Another criticism of input-output studies is they fail to predict the timing of the economic impacts and rounds of spending associated with investment. This is true, as models such as IMPLAN provide an "all at once" mathematical solution. While the timing of impacts is not projected by input-output models, economic theory and practical experience tell us that the impact of a construction project is not permanent and a construction project likely will generate the vast

majority of economic impacts in a three- to four-year period. What is interesting about the projected upstream and midstream investments, however, is that the number and magnitude of projects projected to be built through 2035 are so large (and projects are generally contiguous) that, as a whole, the construction of upstream and downstream projects will tend to have a fairly steady impact on the national economy and many regions will experience sizable expenditures for new projects for decades to come.

The long-term nature of such projects impacts imply that state and local governments could further benefit by teaming with private industry and local institutions to ensure that an increased share of local workers have training opportunities for the well-paying jobs associated with future natural gas development. Employment of local workers will help local populations benefit directly from regional development. Similarly, if regions with the large natural gas plays can attract new natural gas and oil related industry and supplier investment, the ripple effects shown for any region in this analysis would increase over the projections made in this study.

CONCLUSIONS

The results of the impact analysis are explained in more detail in the main body of the report. Even with this short summary, however, it is clear that there will be short-term and long-term benefits associated with midstream facility construction and operation. Indeed, every region of the US stands to realize substantial economic benefits as the midstream investments unfold. Benefits and impacts will be greatest for those regions containing large gas plays that will be economical to develop, but this analysis also shows that there will be significant economic benefits to those regions having an industrial base that supplies the midstream natural gas and oil pipeline industries with goods and materials such as pipe, compressors, etc. Given the competitive advantage of being in close proximity to natural gas investment locations, midstream infrastructure development presents an opportunity for suppliers of materials used in such investments to reverse or at least slow the decades-long decline seen in most manufacturing in the US.

In addition to the economic impacts quantified in this study, other studies have concluded that there will be other national benefits in the form of lower prices for energy, increased energy security, and lower emissions from natural gas fired power plants and industrial processes. These benefits can be brought quickly to the marketplace to benefit, by direct and indirect means, the entire US economy.

Key Findings

This study examines the economic impacts in the lower 48 states that will arise from natural gas, natural gas liquids (NGL[7]) and crude oil midstream infrastructure investment and development. These midstream investments include expenditures for gathering and transmission pipelines, compressors, natural gas storage and natural gas processing facilities through 2035.

The economic impact estimates were based on the projections for future US midstream pipeline, storage and processing investments as published in the 2011 INGAA Foundation study: *North American Midstream Infrastructure Through 2035.*[8] In the lower 48 United States plus the offshore Gulf area, the INGAA Foundation projects that a total of just over $200 billion (2011 dollars) in new investment in midstream facilities will occur between 2012 and 2035.

NATURAL GAS MIDSTREAM

Table KF-1 presents the impacts of natural gas investments and related O&M expenditures independent of the oil and NGL impacts during the study's three evaluation periods. It is shown that, through 2035, natural gas impacts alone will account for:

- An annual average of 103,029 jobs supported.
- Nearly $141 billion in cumulative labor income.
- More than $214 billion in cumulative value added.
- More than $420 billion in total output.
- Cumulative state and local tax revenue of $16.5 billion and federal tax revenues of $30.3 billion.

These represent more than 82 percent of the combined natural gas, oil and NGL impacts through 2035. During the 2012 through 2016 period, natural gas impacts will account for more than 70 percent of total expenditures and impacts, and during the 2012 through 2013 period, natural gas expenditures and impacts are approximately 62 percent of the total expenditures and impacts.

Table KF-1 Natural Gas Investment and O&M Expenditure Impact Summary (In Billions of 2011 Dollars, Employment in Average Annual Jobs Supported)

2012-2035		2012-2013		2012-2016	
Investment	$190.3	Investment	$16.7	Investment	$40.7
Results		**Results**		**Results**	
Avg. Annual Employment	103,029	Avg. Annual Employment	98,985	Avg. Annual Employment	95,621
Income	$140.6	Income	$11.4	Income	$27.0
Value Added	$214.3	Value Added	$17.6	Value Added	$41.4
Output	$420.4	Output	$34.2	Output	$80.4
State/Local Taxes	$16.5	State/Local Taxes	$1.3	State/Local Taxes	$3.3
Federal Taxes	$30.3	Federal Taxes	$2.4	Federal Taxes	$6.1

[7] NGLs are widely used as feedstock in the petrochemical industry; see Section 2 for more discussion.

[8] *"North American Midstream Infrastructure Through 2035 – A Secure Energy Future"*, ICF International, June 28, 2011.

TOTAL MIDSTREAM ECONOMIC IMPACTS FROM 2012-2035

When natural gas investments are added to NGL and crude oil midstream investments, the total impacts through 2035 are projected to include:

- The support of an annual average of 125,339 jobs.[9]
- Nearly $171 billion in cumulative labor income.[10]
- Approximately $261 billion in cumulative value added.[11]
- More than $511 billion in total output.[12]
- Cumulative state and local tax revenue generation of more than $20 billion.
- Cumulative federal tax revenue generation of nearly $37 billion.

TOTAL MIDSTREAM ECONOMIC IMPACTS IN 2012-2013

Near-term impacts also will be significant. In the 2012 through 2013 period alone, the direct expenditure of nearly $27 billion on midstream infrastructure and related O&M will:

- Support an annual average of 159,653 jobs and $18.4 billion in cumulative income.
- Generate more than $55 billion in total output.
- Generate approximately $6 billion in combined federal, state, and local taxes.

TOTAL MIDSTREAM ECONOMIC IMPACTS FROM 2012-2016

By 2016, when cumulative, direct midstream investments and O&M expenditures rise to $57.8 billion, the combined construction and O&M expenses will:

- Support an annual average of 135,633 jobs and generate more than $38 billion in cumulative worker income.
- Generate $114 billion in total output.
- Generate more than $13 billion in combined federal, state, and local taxes.

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[9] Calculated as the total job-years from IMPLAN over the planning period divided by the number of years in the study period. The IMPLAN glossary of terms defines a "job" as "the annual average of monthly jobs in that industry" but also points out that this can be "1 job lasting 12 months" or"2 jobs lasting 6 months each" or "3 jobs lasting 4 months each" and also explains that "a job can be either full-time or part-time."

[10] Labor income includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income.

[11] The IMPLAN glossary defines "value added" as "The difference between an industry's or an establishment's total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported)."

[12] The IMPLAN glossary defines "output" as "the value of industry production…in producer prices. For manufacturers this would be sales plus/minus change in inventory. For service sectors production = sales…." As explained more fully in Section 4 of this report, output includes the direct production of goods and services associated with pipeline construction, the indirect impacts arising from increased production by industries providing inputs during the construction phase, and the increased production in virtually all industries impacted by the expenditure of income by project workers, called induced impacts. This study does not measure the value of natural gas, oil, and NGL that will flow through the pipelines.

OTHER ECONOMIC IMPACTS

This study, completed by Black & Veatch, does not directly analyze the additional economic impacts that will be observed due to investments in exploration and production activities to find and develop needed hydrocarbon resources (upstream impacts), nor the impacts on households and manufacturers who will benefit from lower natural gas, oil, and NGL prices (downstream impacts). However, a sampling of recent studies evaluating these upstream and downstream impacts is provided. Providing a summary of these impacts helps to paint a full picture of the economic benefits associated with the future development of abundant, low cost, and clean domestic energy resources.

1.0 Introduction

1.1 PURPOSE OF STUDY

In June 2011, the INGAA Foundation released a study examining the anticipated investments in midstream infrastructure for natural gas, natural gas liquids (NGL) and oil in response to market opportunities for these commodities. The market opportunities largely have arisen due to technological advances in hydraulic fracturing and horizontal completions that have enabled large shale resource plays to be developed at a low cost. As a result, nearly 4,000 trillion cubic feet (Tcf) of economically recoverable shale gas reserves are now estimated to exist in North America, and more than 3,100 Tcf of this is located in the US.[13]

Concurrently, a multitude of environmental and regulatory actions on the horizon are driving a shift from coal use to natural gas use in power generation. Natural gas demand for power generation is estimated to grow to as much as 30 Bcf/d by 2035.[14] Significant development of infrastructure is needed to support this growth in the supply of and demand for natural gas. Infrastructure to transport NGL produced in 'wet' gas shale plays and oil infrastructure also will contribute to the total anticipated midstream infrastructure investments through 2035.

In addition to supporting the growth of domestic supplies and increasing energy security, the midstream infrastructure investment is expected to spur economic activity and benefits in the form of GDP growth, government revenues and job creation. This study was commissioned to estimate these economic benefits. The study does not directly analyze the additional economic impacts that will be observed due to the investment in exploration and production activities to find and develop hydrocarbon resources (upstream impacts), nor the impacts on households and manufacturers who will benefit from lower natural gas prices (downstream impacts). However, a sampling of recent studies evaluating these upstream and downstream impacts is provided to help paint a full picture of the economic benefits associated with the future development of low cost and clean natural gas and other domestic energy resources.

1.2 ORGANIZATION OF REPORT

This report is organized into seven sections as follows:

- **Section 1.0: Introduction**.
- **Section 2.0: The Natural Gas and Industry and the Role of Midstream Infrastructure** – Includes a discussion of the role of midstream infrastructure in delivering natural gas and fossil fuel to end users and discusses how these facilities are constructed and operated.
- **Section 3.0: Economic Impacts of New Expenditures** – Provides a brief discussion of how multiplier impacts arise and the use of input-output models to quantify the impacts.
- **Section 4.0: Developing Impact Analysis Models for Midstream Investments and O&M Expenditures** – Details the key assumptions used to construct the impact analysis models for midstream investments and O&M.

[13] "*North American Midstream Infrastructure Through 2035 – A Secure Energy Future*", ICF International, June 28, 2011, p. 16.

[14] *Energy Market Perspective Fall 2011*, Black & Veatch. Also see *North American Midstream Infrastructure Through 2035 – A Secure Energy Future*, for a separate projection of increased use of natural gas in the power sector.

- **Section 5.0: Results of the Midstream Infrastructure Models for the US and by Region** – Details the results of the impact analysis models by region and for the US.
- **Section 6.0: Additional Benefits and Impacts –** Discusses additional benefits and issues not directly studied but that are associated with development and operational activities, so that the results of this study can be seen in view of the multifaceted economic benefits of continued development of domestic natural gas, oil, and NGL supplies.
- **Section 7.0: Conclusions**.

2.0 The Natural Gas Industry and the Role of Midstream Infrastructure

2.1 INTRODUCTION

North America's substantial natural gas resource base is an integral part of the US economy. Natural gas consists primarily of naturally occurring methane and is used to heat homes and fuel industrial processes, as feedstock to make materials and products, and to generate electricity used by all sectors of the economy. Due to developments in oil and natural gas drilling and completion technology that makes the natural gas resource base increasingly economical to recover, the importance of natural gas in the economy will increase even further through 2035 and beyond. The benefits of this increased natural gas supply and use will include lower energy prices, air quality improvements associated with the displacement of coal-based power generation, reduced reliance on imported fuel, and the economic impacts, including job creation, associated with the construction and operation of natural gas wells, processing facilities, pipelines, storage and distribution networks. To develop natural gas resources and realize these benefits, investment in natural gas processing facilities and pipelines will be required. In addition, oil and NGL resources that are associated with many natural gas reserve finds, or plays, will produce economic benefits and will require processing and pipeline investments.

The purpose of this study is to estimate the economic impact of future investments in midstream activities required to accommodate the development and use of natural gas, oil, and NGL through 2035. Natural gas midstream investments include the installation of gathering pipeline, lateral pipeline, and mainline pipe needed to gather and transport fuel, and also include the compression equipment needed to operate the pipelines, processing facilities, and natural gas storage facilities. In the oil sector, new investments in oil and NGL pipelines also are studied. The economic impact of these midstream investments will be measured in terms of employment impacts, income generation, taxes, economic output and value added to the US economy.[15] The analysis quantifies these impacts arising from expenditures in the 2012 through 2035 time frame, and also quantifies the two-year (2012 through 2013) and five-year (2012 through 2016) impacts. Finally, O&M impacts also are quantified for all three time horizons.

Other economic studies evaluating the impacts of natural gas investments were reviewed and summarized in this report. While most of these studies have focused on the impact of drilling for natural gas and installing new gas production wells, a subject beyond the scope of this report, the summaries of the studies reviewed bolster an overall understanding of the enormous economic benefit that continued investment in all phases of natural gas development will have on the US economy.

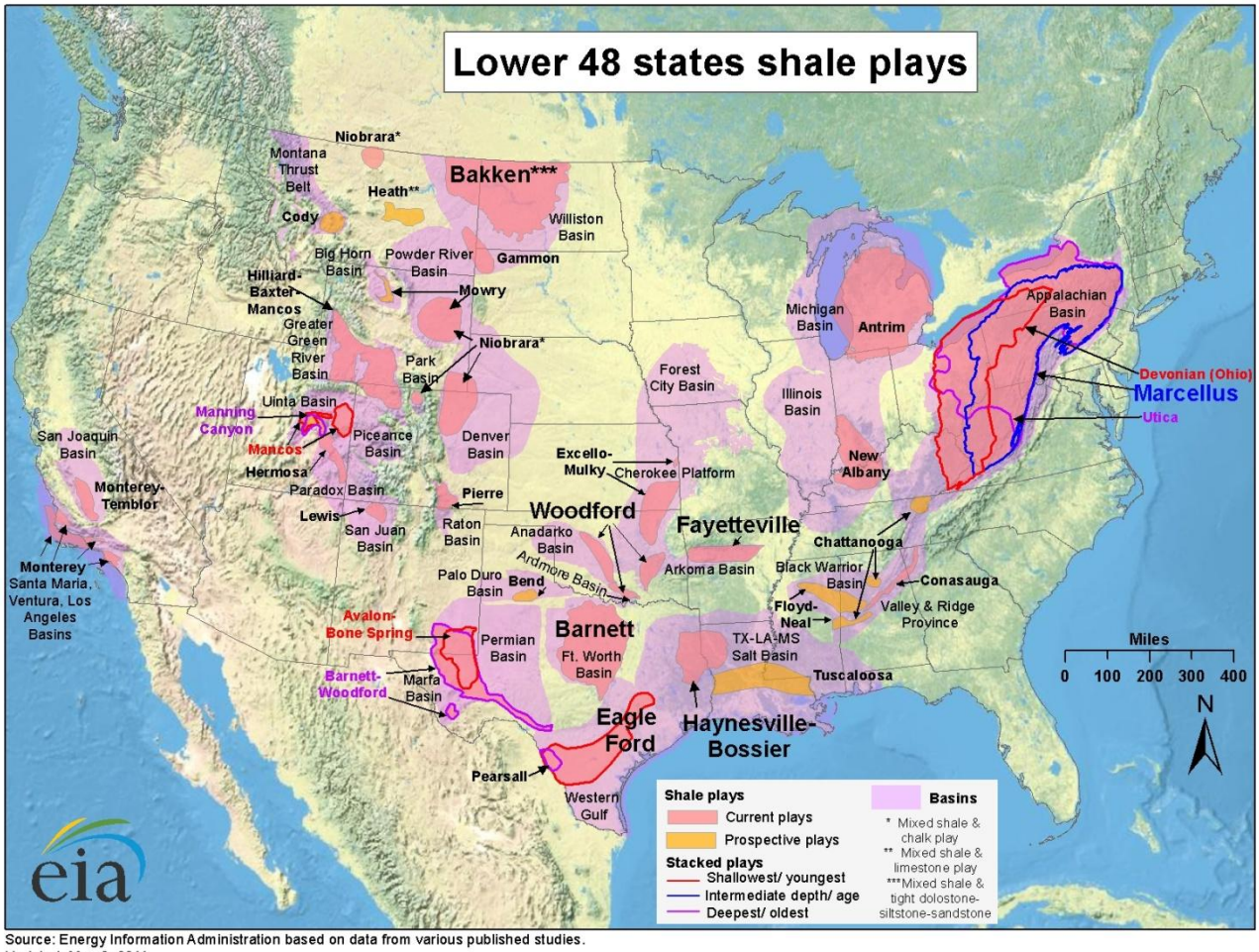
2.2 DOMESTIC SUPPLIES OF NATURAL GAS AND OIL RESOURCES

Prior to 2008, projections for North American natural gas production reflected an expectation that output on the continent would continue to decrease, and this expectation led to the projection of significantly higher wholesale market prices and the expectation that imported liquefied natural gas (LNG) would become an important part of the overall US gas supply going forward. Since 2008, however, the outlook for domestic supplies of natural gas has undergone a dramatic reversal due to advances in drilling and recovery technology that now allows the economic recovery of vast

[15] Value added is the difference between an industry's or a company's total output and the cost of its intermediate inputs.

amounts of natural gas supplies located in many US regions, and in Canada. The technology advances include the combination of horizontal drilling and hydraulic fracturing,[16] which has allowed access to unconventional supplies including coal bed methane, tight formation gas, and especially shale gas, where associated oil finds also have grown rapidly.

Figure 2-1 shows the location of the largest shale gas resources in the US. The reserves are geographically diverse and some resources, such as the Marcellus field that includes significant parts of Pennsylvania, New York, Ohio, and West Virginia, are located near high population and large end-use markets. While development of the Barnett field (near Fort Worth, Texas) began in 2001, most other natural gas plays are largely undeveloped, or have just begun to be developed (e.g., the Eagle Ford in South Texas and Marcellus fields began large scale development only in the last few years). Full development of these resources will create the need for the construction of pipeline and related facilities to connect these new and growing resources to markets.



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

Figure 2-1 Location of Largest Shale Gas Resources in the US

[16] Hydraulic fracturing typically involves pumping a mixture of water, sand and chemicals down a well under high pressure to create fractures in the hydrocarbon-bearing rock to allow the trapped hydrocarbons to be produced.

The rapid development of unconventional gas has drastically improved the outlook for North American supplies of natural gas through 2035 and beyond. According to a 2011 report prepared for the US Energy Information Administration:

> Although the US Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and energy projections began representing shale gas resource development and production in the mid-1990s, only in the past 5 years has shale gas been recognized as a "game changer" for the US natural gas market.[17].

The EIA *Annual Energy Outlook*, *2011* reflects the increase in natural gas resources and assumes that the total remaining resource base of natural gas is 2,552 trillion cubic feet (Tcf). This number is somewhat below the figure estimated in a 2011 INGAA study, *North American Midstream Infrastructure Through 2035 – A Secure Energy Future* (hereafter, the *2035 Midstream Report*) that estimated 3,105 Tcf exists in the US and 3,974 Tcf exists in the US and Canada combined.[18] To put this estimate in perspective, at current US consumption levels, 3,105 Tcf of natural gas would be sufficient to provide current US natural gas needs for approximately the next 140 years, which is why recent finds are accurately described by the EIA as a game changer.[19]

In addition to the dramatic increase in natural gas reserves now recoverable, the *Annual Energy Outlook, 2011* explains that there are an estimated 23.9 billion barrels of shale oil resources located in the onshore lower 48 States. These oil resources are geographically diverse with the largest shale oil formation found in the Monterey field in southern California (15.4 billion barrels), followed by the Bakken (North Dakota) and Eagle Ford fields that are estimated to hold 3.6 billion and 3.4 billion barrels of oil, respectively.[20] As with natural gas supplies, full development of the oil resources will depend on the ability to construct oil pipelines to transport these resources.

Finally, natural gas plays contain various amounts of NGL that can be processed to isolate or produce propane, butane, and ethane. These NGLs have many uses. Ethane, for instance, is a primary feedstock used in the petrochemical industry for the production of resins, polyethylene, vinyl chloride, and adhesives that are used to make a wide array of finished products such as food containers, carpet backing, window frames, and PVC pipe.

2.3 REQUIRED MIDSTREAM INVESTMENTS TO BRING SUPPLIES TO MARKET

In 2011, the INGAA Foundation's *2035 Midstream Report* estimated future midstream investments needed to support the development of announced and projected natural gas, NGL and oil projects in the US through 2035. In the study, midstream investments were defined to include the following:

- Natural gas gathering lines.
- Natural gas processing facilities.
- Main pipeline.
- Lateral pipeline.

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[17] *Review of Emerging Resources: US Shale Gas and Shale Oil Plays*, US Energy Information Administration, July 2011, p. 4.

[18] *North American Midstream Infrastructure Through 2035 – A Secure Energy Future*, ICF International, Prepared for the INGAA Foundation, June 28, 2011, p. 16

[19] Ibid

[20] *Review of Emerging Resources: US Shale Gas and Shale Oil Plays*, US Energy Information Administration, July 2011, p. 4.

- Natural gas compression.
- Natural gas storage.
- LNG import and export facilities.
- Oil pipelines.
- NGL pipelines.

The report divided the lower 48 states into the EIA geographic regions as shown in Figure 2-2 and also included regions for Canada, the offshore Gulf, and the Arctic and projected the projects needed by region. The report projects that by 2035, unconventional production will comprise approximately two-thirds of the domestic natural gas supply, with more than 90 percent of the increase in unconventional natural gas production coming from shale gas production.[21] The *2035 Midstream Report* anticipates that the largest producing shale plays in 2035 will be the Marcellus, Haynesville 1 (Texas-Louisiana), Barnett and Eagle Ford.[22]

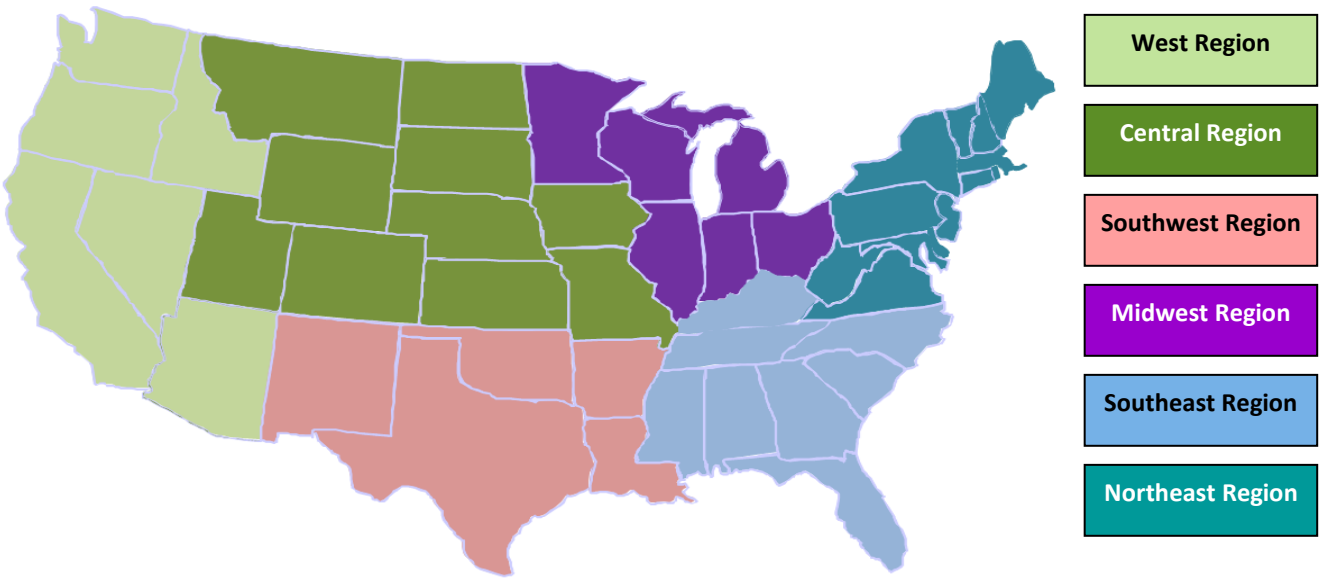

Figure 2-2 EIA Study Regions Adopted for the Study

[21] *North American Midstream Infrastructure Through 2035 – A Secure Energy Future*, ICF International, Prepared for the INGAA Foundation, June 28, 2011, p. 23
[22] Ibid, p. 25

New midstream investments will facilitate the flow of natural gas to end-use markets. Based on announced and projected midstream natural gas, oil and NGL projects, the *2035 Midstream Report* mapped the anticipated interregional gas flows associated with new midstream facilities through 2035. Results indicate that there will be large natural gas flows from the Central and Southwest regions to the Northeast and Southeast regions, but that there also will be flows within the Northeast region that help meet local demand for natural gas. Summarizing the total pipeline requirements, the report projects that:

> Roughly 29 Bcfd of incremental pipeline capacity is built from 2011 to 2020, and, from 2021 to 2035, an additional 14 Bcfd is built. A total of 43 Bcfd of incremental pipeline is needed to accommodate increasing gas supply that is necessary to satisfy market needs over time.[23]

The *2035 Midstream Report* found that more than $205 billion (2010 dollars) in new natural gas infrastructure capital will be needed in North America between 2011 and 2035 based on currently announced and projected projects, or an average of about $8.2 billion per year. In addition, nearly $46 billion in new NGL and oil pipeline investments will be required, bringing the total midstream infrastructure requirements to approximately $251 billion by 2035, or approximately $10 billion per year.[24] Of the total investment amount, the average annual investment by category is projected to include (all in 2010 dollars):

- $3.9 billion per year or nearly 40 percent will go for new or expanded natural gas mainline capacity.
- $1.2 billion per year will be for natural gas laterals.
- $1.7 billion per year will be for natural gas gathering lines.
- $0.9 billion per year will be for natural gas processing plants.
- $1.3 billion per year will be for new oil pipeline.
- $0.6 billion per year will be for new NGL pipelines.
- Pipeline compression and storage fields account for the remainder of expenditures.[25]

These investments will fund development of the following:

- 43 Bcfd of new natural gas transmission capability.
- Approximately 1,400 miles of mainline natural gas transmission per year.
- 550 miles per year of new natural gas laterals connecting power plants, processing facilities and storage fields.
- 16,500 miles of natural gas gathering line per year.
- 1.3 Bcfd per year of new processing capability.
- Nearly 25 Bcf per year of new working gas capacity.
- Approximately 200,000 horsepower per year for new natural gas pipeline compression.

[23] Ibid, p. 33
[24] Ibid, p. 62
[25] Ibid

- More than 5 million barrels per day of new oil transmission pipeline capacity.
- Approximately 800 miles per year of new oil transmission pipeline.
- Approximately 2 million barrels per day of new NGL transmission pipeline capacity.
- Approximately 500 miles per year of new NGL transmission pipeline.[26]

While the *2035 Midstream Report* estimated midstream investments in the 2011 though 2035 period, the current study, completed in early 2012, focused on the impact of investments made in the 2012 through 2035 period and converted the investments to 2011 dollars. In the six US regions (and incorporating the Gulf region but leaving out the Arctic and Canadian regions) the total investment (for natural gas, oil and NGL infrastructure) is projected to be approximately $200 billion through 2035 in 2011 dollars. Expenditures in these six regions are the focus of the impact analysis performed in this study.

2.4 CONSTRUCTING AND OPERATING THE REQUIRED MIDSTREAM INFRASTRUCTURE

To bring new or growing natural gas, oil and liquid hydrocarbon resources to market, new midstream infrastructure will need to be developed, constructed, and placed into commercial operation. A company considering investment in a new natural gas pipeline will seek to determine interest in a new pipeline from potential customers during an "open season" process to obtain commitments from shippers to proceed forward with pipeline development. In addition, multiple permits and approvals at the federal, state and local level must be secured before construction can begin. These approvals, in turn, require detailed studies as to the specific pipeline route, the potential impacts of the pipeline during construction and operation, and appropriate mitigation activities. Regulatory authorities also require an environmental impact study as part of the review and approval process.[27]

When a pipeline project is approved, the pipeline's owner must secure the right-of-way (ROW) for the pipeline. This involves negotiation with landowners along the pipeline route, and agreement on key issues such as payment for the ROW, access to the land, restoration after construction, and future land use along the easement.

Pipeline construction is performed by specialized crews that typically work in sections or "spreads." The pipeline construction process follows a well-developed sequence that is a type of moving assembly line. Primary construction activities include the following:

- Land clearing and preparation, excavation of the ROW using equipment such as chain saws, bull dozers and graders.
- Trenching with heavy equipment and operators.
- Delivery and stringing of the pipe using loading equipment and trucks hauling from a central lay-down area.
- Bending of the pipe using specialized equipment in order to conform the pipe to the specific location where it will be laid without compromising strength.

[26] Ibid, p. 68

[27] Oil and NGL pipelines also have an open season approach to gauging interest in new capacity, but FERC's role is primarily related to tariff setting as state and local agencies are largely tasked with siting and environmental approvals.

- Welding by highly trained craftsmen, with multiple welds to join two pipes.
- Inspection of the welds to ensure the weld has been performed properly.
- Final coating of the pipe near the welds to ensure that the welded area joining two pipes will resist corrosion (the rest of the pipe is typically coated during the manufacturing process).
- Laying of pipe using boom-fitted bull dozers and other equipment.
- Backfilling with backhoes and other specialized equipment.
- Pressure testing with water (hydrostatic testing) to ensure that there are no leaks.
- Restoration and cleanup of the ROW using graders and other equipment, usually followed by seeding activities and the use of erosion prevention materials in steep areas.
- Pipeline tie-in to the existing transmission system or component.
- Commissioning of the facility.

The activities involved with installing a pipeline involve multiple worker disciplines and pieces of equipment. Table 2-1 shows an approximation of the labor categories and an estimate of the percent of total labor accounted for by occupation in a typical pipeline segment installation.

Table 2-1 Typical Pipeline Workforce Occupations and Contributions

LABOR OCCUPATION	PERCENT OF TOTAL LABOR
Pipe fitters and welders	6
Equipment operators	27
Truck drivers	29
Laborers including welder's assistants	18
Supervisory	6
Inspectors, catering, electricians, iron workers, other	13

Source *Natural Gas Pipeline Technology Overview*, S.M. Folga, Argonne National Laboratory, November, 2007, p. 26

The largest transmission pipelines or "mainlines" are usually between 20 inches and 42 inches in diameter. Gathering pipe and lateral pipe also are important midstream components. Lateral pipe refers to medium-diameter (generally, 6 inches to 24 inches) pipe that may branch from a mainline pipe to serve a large industrial customer, processing facility or power plant. Gathering pipe refers to small-diameter (generally, 0.5 inches to 6 inches) pipe located in the production fields that collects the gas from production wells and transports the gas into a central location where it may be processed before being added to a mainline. During processing, NGLs are separated from the gas and can be transported through a dedicated pipeline when sufficient quantities exist.

Natural gas pipelines include compressor stations that help to compact and pressurize the natural gas to keep it flowing. Compressor stations typically are placed every 40 to 100 miles along mainlines, and large compressor equipment typically is housed in what may appear from the outside to be a two-story, metal building, although pipe and other structures are often visible in the yard of the compressor station. Compressors may be powered by natural gas-fired turbines, by electrical-powered motors or by reciprocating engines burning natural gas. Compressor station construction may require approximately 100 workers and installation can take approximately six months, not including site preparation time.[28]

Natural gas can be stored for use in peak periods, when natural gas demand is greater than production, or to balance short-term fluctuation in natural gas demand. This storage usually occurs in large underground areas that can include depleted natural gas fields, aquifers or salt mines. Currently, the US has approximately 400 natural gas storage facilities with a holding capacity of approximately 4.3 trillion cubic feet (Tcf).[29]

Pipelines rise above ground on occasion en route, where shutoff valves may be placed and where pipeline companies are able to insert equipment for inspecting the pipeline. Natural gas transmission companies also utilize sophisticated metering stations to monitor gas operations, help ensure safety and regulate pipeline pressure. Once a natural gas pipeline is in operation, its status is monitored on a continuous basis. Real-time monitoring equipment measures gas flow and pressure along the pipe and helps control-room personnel to detect abnormalities that may be an indication of an outage, malfunction, leak or safety issue. Other operational activities include aircraft fly over inspection of pipeline routes and on-the-ground inspections and pipeline testing. While such activities are not as labor intensive as the construction process, natural gas pipelines do create long-term and well paying O&M jobs in regions containing such infrastructure. According to a 2010 US Department of Labor report, the average annual wage in the pipeline transportation industry was $64,820 or more than $20,000 higher than the US average for all jobs ($44,410).[30]

In the US, there were 220,000 miles of interstate natural gas transmission pipelines and 100,000 miles of intrastate transmission pipelines as of 2009.[31] Figure 2-2 shows the existing transmission pipeline network. These pipelines deliver natural gas to local distribution companies (LDCs) at the "city gates," where the LDCs take possession of the gas and deliver it to individual end users through some 2,000,000 miles of smaller-diameter distribution pipelines. The US also has approximately 170,000 miles of pipeline that moves liquid fuel products such as crude oil, refined petroleum products, and NGL. These pipelines move approximately 70 percent of all crude oil and petroleum products transported in the US annually.[32]

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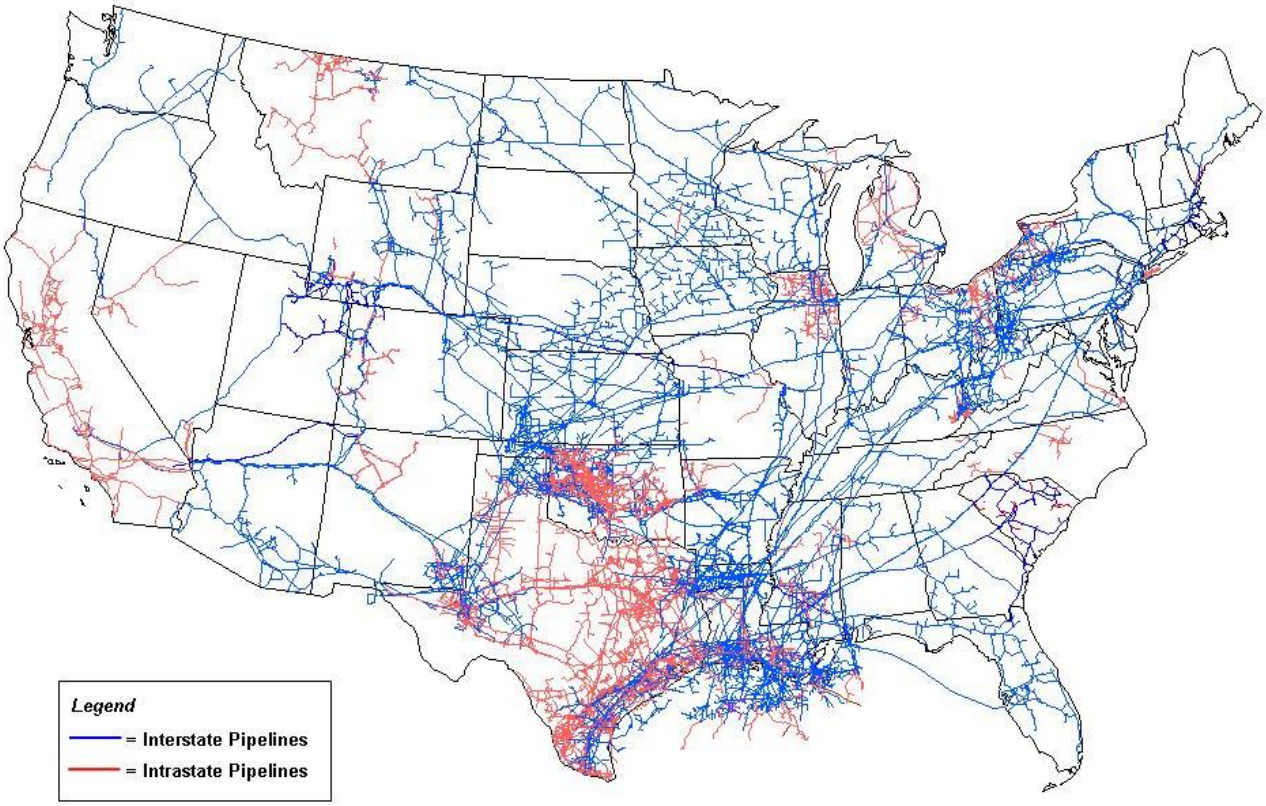
[28] *Natural Gas Pipeline Technology Overview*, S.M. Folga, Argonne National Laboratory, November, 2007, p. 41

[29] http//www.powerincooperation.com/transportation-to-merket.html

[30] *Prudent Development – Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, National Petroleum Council, 2011, Figure 5-2, p. 5-6; originally from the May 2010 National Occupational Employment and Wage Estimates. Annual wages are calculated by BLS as the average hourly wage times 2,080 hours and represent full-time wages. In contrast, the average compensation per job produced from the IMPLAN model runs in this report include wage plus salary benefits, include full-time and part-time workers, and are a weighted mix of earnings in the industries impacted by midstream investment and O&M expenditures.

[31] America's Natural Gas Pipeline Network, Delivering Clean Energy for the Future, Spring 2009 Edition, p. 8, available on-line at WWW.INGAA.ORG

[32] From the Association of Oil Pipe Lines website, http://www.aopl.org/, accessed February 8, 2012



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

Figure 2-3 Map of Major Natural Gas Interstate and Intrastate Pipelines in the US, 2009

3.0 Economic Impacts of New Expenditures

3.1 EXPLAINING THE ECONOMIC MULTIPLIER EFFECT

The estimated $200 billion in direct midstream infrastructure investment through 2035 in the US regions will have a large and direct impact on the US economy. In addition to the direct investment impacts, there are also indirect and induced benefits. To capture the total economic impact of the $200 billion in US midstream infrastructure investment, it would be necessary to follow the expenditure of the investment dollars as they worked their way through the economy over a period of a few years after an investment is complete. For example, firms that develop midstream infrastructure purchase materials and services from their suppliers during the pre-construction and construction phase. Such purchases include those from a diverse number of companies offering products or services such as surveying, pipe, valves, heavy equipment, legal services, financing and catering. As these supplier firms provide output to the pipeline developer, the suppliers will spend their revenue to pay employees and to purchase their own inputs that will be turned into products for sale. Once again, this process continues through many rounds of spending in the economy and will create a total economic impact that is a multiple of the original purchase of material and service inputs by the pipeline company. This type of effect is called the "indirect effect."

Similarly, a significant portion of the direct expenditure on natural gas pipeline will be paid to workers who install the pipeline in the moving assembly process described above. Through what is called the "induced effect," these workers take their disposable earned income and spend it on goods and services such as clothing, rent, car payments, food, vacations, and savings. Establishments that receive the worker income in exchange for goods and services will, in turn, spend the revenue received to pay their own workers, to purchase supplies needed to provide additional goods and services, etc. This process will continue through multiple rounds of spending in the economy and will create a total economic impact that is a multiple of the original wages received by the pipeline workers. Generally, through each round of spending, the impact will lessen because not all of the income is spent in the areas of study due to the purchase of imports, worker savings, etc. Thus, like waves made by a stone thrown into a pond, there will be an economic "ripple effect" that will lessen with time, as the successive rounds of spending work through the economy.

While envisioning the successive rounds of spending in an economy is intuitive, in practice, it would be enormously difficult and expensive to trace the actual spending patterns of even a single construction project. Fortunately, there are mathematical methods for tracking the economic impact of an investment on the economy using complex economic models (commonly referred to as input-output models), first developed in the 1930s by Dr. Wassily Leontief. In recent decades, input-output models have been transformed into computerized commercial software that can generate impact estimates for employment, income, value added, output and taxes that arise due to a new investment or other change in economic activity. These models are built upon detailed databases, including survey data that tracks the historical economic interrelationship and expenditure patterns among industries and households. Two widely used input-output models are the RIMS II Input-Output model developed by the US Bureau of Economic Analysis, and the IMPLAN (Impact analysis for Planning) model, which is probably the most widely used model for large investment studies. IMPLAN was used in this analysis due to its widespread use and its multi-regional modeling capabilities.

The IMPLAN model has its roots in the 1970s and was developed initially by the US Forest Service, which wanted to determine the impacts of certain forestry policy and management decisions. In the mid-1980s, the US Forest Service contracted with the University of Minnesota to support and further develop the model data sets. In 1993, Minnesota IMPLAN Group, Inc. (MIG) was founded as an independent organization through a technology transfer agreement with the University of Minnesota, and MIG was given rights to all future IMPLAN development. In 1995, MIG began to develop the first Microsoft windows version and the following year IMPLAN Version 1 was released. This was followed by Version 2 in 1999 and Version 3 in 2009.[33] Version 3 has the ability to perform multi-regional impact analysis, which was used in the current study. The six EIA regions modeled were selected based on the regions used in the *2035 Midstream Report*.

[33] IMPLAN Version 3.0 Training DVD, available from IMPLAN at IMPLAN.com

4.0 Developing Impact Analysis Models for Midstream Investments and O&M Expenditures

The object of this study is to estimate the total economic impacts associated with the estimated $200 billion of new infrastructure investment in the US regions from 2012 through 2035. A near-term assessment of the impacts from investments in the 2012 through 2013 and 2012 through 2016 periods also are part of the study, and O&M impacts are estimated for all three time frames. Multiple steps were involved in developing the construction and O&M models. Each of these model types is discussed below.

4.1 DEVELOPMENT OF THE MIDSTREAM INVESTMENT MODELS

To construct the investment models, the projects from the *2035 Midstream Report* database for the lower 48 states plus Gulf region were divided by region, investment category, and projected construction period. The result of this process was the listing of projects by investment category and by region during the three evaluation periods. Table 4-1 shows the total investment by region and by investment category for the three time periods evaluated. Values in 2010 dollars are taken from the *2035 Midstream Report* data, and these costs are escalated to 2011 dollars in the table, based on IMPLAN model deflators generated when running the investment impact models. Total investment in the 2012 through 2013 period is $26.8 billion in 2011 dollars, or approximately 13 percent of the 2012 through 2035 total. The investment in the 2012 through 2016 period is $56.8 billion in 2011 dollars, or approximately 28 percent of the 2035 total of $200.2 billion.

In each of the three time periods evaluated, mainline natural gas pipe dominates the investment categories and accounts for approximately 45 percent of all midstream investments projected for the study area through 2035. In terms of regional concentration of investment, the Central and Southwest regions have the largest direct investment in each time period. Through 2035, the West region has the smallest projected midstream investment level, but this investment level, nevertheless, equates to more than $10.5 billion in 2011 dollars.

Following the initial division of expenditures by region and investment type, the next step was to develop expenditure patterns for each of the investment categories. While it is possible to use the general IMPLAN construction category (sector 36) to model midstream investments, this sector is widely defined and would also include, for instance, power plant and airport construction. Thus, the method chosen for this analysis was to follow a "bill of goods" method, also called an "analysis by parts" approach in IMPLAN. This approach involves identifying the sectors or industries in which the midstream investment expenditures will be made.

Expenditure patterns were developed using multiple sources including FERC form 2 filing data, pipeline investment categories in the *2035 Midstream Report* data, the experience of Black & Veatch natural gas experts and consultation with members of the INGAA Foundation, whose companies specialize in the construction and operation of midstream infrastructure. In this step, care was taken to ensure consistency between the cost breakdown available in the *2035 Midstream Report* and the more detailed expenditure sectors selected in this analysis. Also, as part of this step and consistent with the *2035 Midstream Report* breakdown by expenditure category, compression expenditures were combined with the corresponding pipeline investments, leaving seven investment types to be modeled.

Table 4-1 Expenditures by Region and Investment Type

(2010 Dollars)			
Region	**2012-2013**	**2012-2016**	**2012-2035**
Central	$ 8,331,562,304	$ 16,938,050,940	$ 45,044,287,151
Midwest	$ 1,362,713,461	$ 3,579,176,411	$ 20,599,180,637
Northeast	$ 5,603,030,456	$ 8,771,999,082	$ 30,915,768,045
Southeast	$ 2,080,411,117	$ 7,627,381,137	$ 37,338,430,443
Southwest	$ 7,916,886,983	$ 16,824,155,316	$ 52,198,483,212
West	$ 1,013,784,348	$ 1,964,077,536	$ 10,352,671,187
Total	$ 26,308,388,670	$ 55,704,840,422	$ 196,448,820,675
Investment	**2012-2013**	**2012-2016**	**2012-2035**
Mainline pipe	$ 8,761,023,707	$ 21,912,324,474	$ 88,341,926,212
Lateral pipe	$ 2,016,526,944	$ 4,648,071,320	$ 25,675,288,609
Gathering pipe	$ 1,527,774,523	$ 4,986,310,899	$ 28,945,563,258
Storage	$ 1,734,605,973	$ 2,322,531,664	$ 3,360,096,416
Processing	$ 2,276,233,019	$ 5,252,295,811	$ 16,223,158,941
Oil pipe	$ 6,964,562,000	$ 8,895,008,384	$ 20,088,085,926
NGL pipe	$ 3,027,662,504	$ 7,688,297,870	$ 13,814,701,314
Total	$ 26,308,388,670	$ 55,704,840,422	$ 196,448,820,675
(2011 Dollars)			
Region	**2012-2013**	**2012-2016**	**2012-2035**
Central	$ 8,489,861,988	$ 17,259,873,908	$ 45,900,128,606
Midwest	$ 1,388,605,017	$ 3,647,180,762	$ 20,990,565,069
Northeast	$ 5,709,488,035	$ 8,938,667,065	$ 31,503,167,638
Southeast	$ 2,119,938,928	$ 7,772,301,379	$ 38,047,860,621
Southwest	$ 8,067,307,836	$ 17,143,814,267	$ 53,190,254,393
West	$ 1,033,046,251	$ 2,001,395,009	$ 10,549,371,939
Total	$ 26,808,248,055	$ 56,763,232,390	$ 200,181,348,268
Investment	**2012-2013**	**2012-2016**	**2012-2035**
Mainline pipe	$ 8,927,483,158	$ 22,328,658,639	$ 90,020,422,810
Lateral pipe	$ 2,054,840,956	$ 4,736,384,675	$ 26,163,119,092
Gathering pipe	$ 1,556,802,239	$ 5,081,050,806	$ 29,495,528,960
Storage	$ 1,767,563,487	$ 2,366,659,765	$ 3,423,938,248
Processing	$ 2,319,481,446	$ 5,352,089,432	$ 16,531,398,961
Oil pipe	$ 7,096,888,678	$ 9,064,013,544	$ 20,469,759,558
NGL pipe	$ 3,085,188,092	$ 7,834,375,530	$ 14,077,180,639
Total	$ 26,808,248,055	$ 56,763,232,390	$ 200,181,348,268

(Based on the *2035 Midstream Report* data, but does not include Arctic or Canadian Projects. Pipeline costs include compression.)

Table 4-2 shows the derivation of the assumed sector expenditures for this study and also lists the corresponding IMPLAN industry code used in the analysis. The percents indicated refer to the assumed percentage of total project costs that will be spent in a given sector. The breakdown mirrors typical classification of pipeline and other project costs in the natural gas industry based on multiple cost reports reviewed. For pipe, the *2035 Midstream Report* contained the high-level expenditure categories of ROW, materials, labor, and miscellaneous. These were divided into additional expenditure sectors and similar expenditure sectors were developed for storage and processing facilities.

Following the breakdown of expenditures by sector for each investment, additional assumptions were made to account for funds not directly expended for goods and services produced in the region where the project is constructed (the home region). The clearest example is that certain economic leakages will occur if some of the investment in materials involves the purchase of foreign-produced products. In this analysis, based on INGAA Foundation, INGAA Foundation member companies, and Black & Veatch discussion of recent project expenditure patterns, it was assumed that 90 percent of expenditures made for all types of pipe and for valves, fittings and casings used in pipelines would be made domestically, as would 95 percent of expenditures on compression equipment used in pipeline projects. For gas processing, it was assumed that 90 percent of total investments in the areas of compression and equipment, valves and fittings, plus instruments and electrical equipment would be made domestically. The balance would be foreign imports that, combined, accounted for more than $1 billion of the 2012 through 2013 direct project expenditures of $26.8 billion (2011 dollars) and had a proportionally similar impact on the other time periods evaluated.

Next, since the analysis by parts method was followed, assumptions were made concerning the amount of expenditures by investment type and expenditure sector that would be assumed to be made within the home region. This step is important because most regions rely on specialized workers to install and manage the laying of interstate pipeline, and a significant percentage of these workers may come from outside the home region. Thus, if it were assumed that each home region could provide all the project labor needs, the home region impact would be overstated in most instances. Likewise, in the area of financing, while it may appear reasonable to assume that financing activities will occur in the home region for home region projects, given the concentration of natural gas and oil companies in the Southwest region (especially Texas, but also Louisiana and Oklahoma) and the existence of large finance centers in Houston and other regional cities, it is more realistic to assume that a disproportionately high level of financing activity will occur in the Southwest region and also in the Northeast region, where many financial institutions are headquartered, and where large project financings commonly occur.

In practice, it was necessary to make specific assumptions about each of the expenditure sectors identified in Table 4-2. The following expenditure allocation assumptions were made based on discussions among the INGAA Foundation, INGAA Foundation companies, and Black & Veatch project team members:

- ***Financing costs including interest during construction*.** It was assumed that, regardless of the home region, 50 percent of all financing related expenditures would occur in the Southwest region, that 40 percent of all expenditures would occur in the Northeast region, and that 10 percent of expenditures would occur in the home region. This means, for example, that when the multi-region IMPLAN model was run for the Central region, a relatively small share (10 percent) of financing-related expenditures were modeled as occurring in the Central region, while the Southwest and Northeast directly benefited from finance-related expenditures for Central region projects (these impacts will show up as indirect effects in the IMPLAN multi-region planning simulations when these are not the home regions being directly modeled).

Table 4-2 Development of Expenditure Sectors for Midstream Investments

Pipeline Expenditure Breakdown by Sector					Storage Expenditure Breakdown by Sector				Processing Expenditure Breakdown by Sector			
2035 Mid-Stream Report Categories	**2035 Mid-Stream Report Breakdown by Category**	**Further Breakdown by Expenditure Sector**	**Corresponding IMPLAN Industry**	**Project Cost Assumed Spent in Detailed Expenditure Sector**	**High Level Category Breakdown**	**Assumed Breakdown by Category**	**Further Breakdown by Expenditure Sector**	**Project Cost Assumed Spent in Detailed Expenditure**	**High Level Category Breakdown**	**Assumed Breakdown by Category**	**Further Breakdown by Expenditure Sector**	**Project Cost Assumed Spent in Detailed Expenditure**
Misc. / Owner's Costs	28.0%	Financing/Interest During Construction	355 Nondepository credit intermediation and related activities	7.0%	Misc. / Owner's Costs	10.0%	Finance	2.0%	Misc. / Owner's Costs	20.0%	Financing / Interest During Construction	5.0%
		Engineering/ Design/ Construction Monitoring	369 Architectural, engineering and related services	8.0%			Engineering/ Design/ Construction Monitoring	1.0%			Engineering/ Design/ Construction Monitoring	8.0%
		Regulatory Approvals/Fees	355 Nondepository credit intermediation and related activities	2.0%			Legal	1.0%			Regulatory Approvals/Fees	2.0%
		Insurance	359 Insurance Carriers	2.0%			G&A/Office	3.0%			Insurance	2.0%
		Legal	367 Legal Services	2.0%			Insurance	1.0%			Legal	1.0%
		Survey	369 Architectural, engineering and related	2.0%			Regulatory Approvals/FERC	2.0%			G&A/Office	2.0%
		G&A/Office	29 Support activities for oil and gas operations	5.0%	Land and Storage Preparation	40.0%	Storage Preparation	20.0%	Land	1.0%	Payments for Land	1.0%
ROW	7.0%	Payments for Land	10006 Household 50-75k	4.5%			Land	20.0%	Materials	46.0%	Compression & Equip	35.0%
		ROW Restoration	29 Support activities for oil and gas operations	2.5%	Materials	30.0%	Structures	3.0%			Valves/fittings	5.0%
Materials	31.0%	Coated Pipe	170 Iron and steel mills and ferroalloy manufacturing	22.0%			Piping/valves/ fittings	10.0%			Instruments/ elec. Controls	3.0%
		Valves/fittings/ casings	198 Valve and fittings other than plumbing manufacturing	2.0%			Compression	15.0%			Transportation	3.0%
		Transportation	335 Truck	2.0%			Transportation	2.0%				
		Compression	227 Air and gas	5.0%	Labor & Installation	20.0%	Labor & Installation	15.0%	Labor & Installation	33.0%	Labor & Installation	31.0%
Labor/ Installation	34.0%	Labor & Installation	36 Construction of other new nonresidential	32.0%								
		Inspect/Testing	380 All other miscellaneous scientific and technical	2.0%			Inspect/Testing	5.0%			Startup/Testing	2.0%
Total	**100.0%**			**100.0%**	**Total**	**100.0%**		**100.0%**	**Total**	**100.0%**		**100.0%**

- ***Pipeline installation and construction of storage and processing facilities***. It was assumed that 50 percent of the expenditures would be made in the home region and 50 percent would come from outside the home region. The exceptions to this treatment were in the Southwest region, where it was assumed that the home region would be the recipient of all installation expenditures due to the large regional workforce in the sector, and in the Northeast region, which was assumed to receive 60 percent of installation expenditures. In the IMPLAN multi-regional modeling, the installation expenditures not allocated to the home region were assigned to other regions by the model.
- ***Expenditures covering regulatory approvals and fees, legal fees, survey costs, and right of way restoration***. It was assumed that these expenditures would occur in the home region.
- ***Expenditures for insurance, plus engineering, design, and construction monitoring.*** For these items, the IMPLAN model was allowed to allocate these expenditures among regions based on the interregional relationships determined in IMPLAN's internal social accounting matrix (SAM) calculations.
- ***Expenditures in the pipeline manufacturing sector, in the valves, fitting, and casings sector, in the compression equipment sector, and pipeline operations sector*.** For these sectors, more detailed information from INGAA Foundation members regarding the probable pattern of expenditures led to the development of what was termed the "default method" of expenditure allocation among regions. In this method, the NAICS (which stands for the North American Industry Classification System) industry best corresponding to the expenditure sector was determined, and the allocation of direct midstream expenditures was allocated among the six regions based on each region's share of total US employment in that NAICS industry, as determined through data from the Bureau of Economic Analysis (BEA). For example, the manufacture of pipe generally falls under NAICS industry 33121: iron, steel pipe and tube from purchased steel. Based on BEA employment data, total US employment in NAICS 33121 was determined and the expenditure for pipe was allocated based on each region's share of total US NAICS 33121 employment, regardless of the region in which the pipeline was to be installed. Default method allocation percentages for the other NAICS industries used in the analysis are shown in Table 4-3. As seen in the table, one of the results of using the default method allocation approach is that expenditures are more likely to be allocated to regions where the materials and supplies used in midstream investments are produced, and this can significantly influence the economic impact of midstream investments on a region. For example, using the default method of expenditure allocation, the Midwest region receives nearly 38 percent of the domestic expenditures for all types of pipe and also provides significant shares of the compressor and instrumentation needed for midstream projects. This will generate large economic impacts on the Midwest region even though the region receives one of the lowest amounts of direct investment in midstream facilities.

Table 4-3 NAICS Industries and Employment Allocations Used for the Default Method Allocation of Direct Expenditures

Region	NAICS 23712 Oil & Gas Construction	NAICS 486 Gas Pipeline Operating Companies	NAICS 33121 Pipe Manufacturing	NAICS 332911 Valves & Fittings	NAICS 333912 Compressor Manufacturing	NAICS 334513 Instruments
West	10.1%	7.6%	7.6%	8.2%	0.0%	21.5%
Central	12.1%	11.0%	4.4%	10.1%	4.6%	4.5%
Southwest	51.2%	50.1%	15.0%	33.8%	24.8%	16.0%
Midwest	7.5%	10.4%	37.6%	16.9%	20.8%	23.2%
Northeast	10.7%	11.9%	18.3%	15.6%	33.9%	29.1%
Southeast	8.4%	8.9%	17.0%	15.4%	15.8%	5.8%
Totals	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Employment percentages based on BLS data at http://data.bls.gov/cgi-bin/dsrv?en, accessed the week of Dec. 11-17, 2011

NAICS definitions from the U.S. Census Bureau:

NAICS 23712 This industry comprises establishments primarily engaged in the construction of oil and gas lines, mains, refineries, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to oil and gas pipeline and related structures construction. All structures (including buildings) that are integral parts of oil and gas networks (e.g., storage tanks, pumping stations, and refineries) are included in this industry.

NAICS 486 Industries in the Pipeline Transportation subsector use transmission pipelines to transport products, such as crude oil, natural gas, refined petroleum products, and slurry. Industries are identified based on the products transported (i.e., pipeline transportation of crude oil, natural gas, refined petroleum products, and other products).

The Pipeline Transportation of Natural Gas industry includes the storage of natural gas because the storage is usually done by the pipeline establishment and because a pipeline is inherently a network in which all the nodes are interdependent.

NAICS 33121 This industry comprises establishments primarily engaged in manufacturing welded, riveted, or seamless pipe and tube from purchased iron or steel.

NAICS 333912 This U.S. industry comprises establishments primarily engaged in manufacturing general purpose air and gas compressors, such as reciprocating compressors, centrifugal compressors, vacuum pumps (except laboratory), and nonagricultural spraying and dusting compressors and spray gun units.

NAICS 334513 This U.S. industry comprises establishments primarily engaged in manufacturing instruments and related devices for measuring, displaying, indicating, recording, transmitting, and controlling industrial process variables. These instruments measure, display or control (monitor, analyze, and so forth) industrial process variables, such as temperature, humidity, pressure, vacuum, combustion, flow, level, viscosity, density, acidity, concentration, and rotation.

- ***Right of Way (ROW) expenditures***. This sector is somewhat unique compared with other expenditure sectors. Other impact analysis studies evaluating natural gas investments primarily have focused on the impact of developing new natural gas wells. In such studies, a significant portion of the expenditures are allocated to land rental payments during exploration and royalty payments during the well production period. These payments are significant and royalty payments, especially, can involve very large amounts of money paid to land owners. In such cases, there is considerable uncertainty and discussion regarding how to treat such payments due to the lack of good empirical data associated with such events. As a result, some studies have treated these payments as an increase in income and have assumed that up to 95 percent of the royalties received by land owners would be spent in the region each year. Other studies have treated the payments more as an increase in wealth and have assumed that only 5 percent would be spent in the region each year.

  The present analysis acknowledges that payments for pipeline ROW have a different character than royalties and land rentals associated with natural gas wells. Pipeline ROW payments are usually a one-time expenditure and reflect the market value of the land used, rather than a percentage of gas value produced from a well. Thus, most land owners will not see a significant increase in their wealth, and it is likely that the right of way payment would be spent in a pattern more similar to a land owner's regular income. This suggests that a high percentage of ROW legitimately could be treated as an increase in consumer income. Nevertheless, to be somewhat conservative, this study assumed that half of the right of way payments would be seen as in increase in consumer income and would be spent in the home region, while the other half would go into savings or would otherwise be leaked from the economy. Similarly, for storage facilities, it is assumed that half of the land and land preparation payment would not be spent in the regional economy. For processing facilities, the land payment was treated as a land transfer that would not create new economic impacts in the home region.

Following the allocation of expenditures by sector, multi-regional IMPLAN models were constructed. A separate model was constructed for each of the seven investment categories and for the investment types within the six regions. Three time horizons were covered during the construction phase and models were developed in IMPLAN to track the impact of midstream investments. In each model, the multi-region function in IMPLAN was used and each home region also was modeled with the five other US regions so that indirect and induced effects in these regions could be captured. These results provided the direct, indirect and induced impacts of investments in the categories of employment, income, value added and output. In addition, data was produced by IMPLAN to track federal plus state and local taxes in the economy. The results of these simulations have been greatly condensed and are presented in Section 5.0.

4.2 DEVELOPING IMPACT ANALYSIS MODELS OF MIDSTREAM O&M EXPENDITURES

Another impact to be estimated in this study consists of the operating and maintenance, or O&M expenditures of new midstream investments expected to occur during the three study periods. The impact of O&M expenditures are more straightforward to model as IMPLAN contains an "Oil and Gas Support Operations" sector (Sector 29) that is well-suited to track midstream O&M expenditures.

It is common in the natural gas transmission industry to combine O&M expenditures for a company's pipe, storage and processing operations and to report O&M expenditures on a total O&M cost basis, or to report O&M for all types of investment on the basis of a cost per mile of transmission pipe owned. To model midstream O&M expenditures, historical O&M data from the FERC Form 2 reports and from the *Oil and Gas Journal* were studied along with input from INGAA Foundation members that operate midstream facilities. The approach followed was to calculate an all-in O&M cost per mile of transmission pipeline installed, with the "all-in" meaning that O&M costs for all natural gas midstream facilities were included in the O&M figure. The costs were then escalated to 2010 dollars and the resulting cost of $43,649 per mile was applied to the transmission pipeline miles assumed to be installed during the three time frames evaluated to arrive at an impact estimate. Results were then converted to 2011 dollars in IMPLAN. (Note: the IMPLAN model uses a 2010 database, and so 2011 input values are deflated to 2010 dollars and applied to the 2010 multipliers within the model. Results can be viewed in 2010, 2011, or another year dollars in IMPLAN, or results can be escalated to a given year outside the model.) The annual O&M costs for new oil and NGL pipelines were assumed to be $15,000 per pipeline mile installed.[34]

Since there will be significant changes in the miles of transmission pipeline installed during any of the three evaluation time periods, with the full amount of installation not occurring until the final year, it was necessary to avoid overestimating the O&M impacts that would occur if the analysis simply took the annual O&M cost multiplied by the total miles installed at the end of the evaluation period for the duration of the evaluation period. Table 4-4 illustrates the growth of installed miles assumed per year in the O&M models and the resulting 2010 O&M costs, based on the assumed cost per mile of installed transmission pipe estimates for natural gas, oil and NGL. Note that no O&M costs are assumed in the first year of each period shown in the table, as O&M costs are assumed not to commence until a project is operational after an assumed year of construction. Given that O&M personnel will be training during the final months of construction, this is a conservative approach.

Table 4-4 shows the cumulative impact of O&M expenditures as new investments are brought into commercial operation. This cumulative impact is seen most dramatically in the 2012 through 2035 model, where annual average O&M expenditures are linked to an annual average of 1,968 miles of natural gas transmission pipeline and 995 miles of oil and NGL pipeline installed. As the miles of in-service pipeline increases, so do the annual O&M expenditures such that, by 2022, the total annual O&M is projected to exceed $1 billion. By the end of the 2035 study period, total annual O&M expenditures exceed $2.3 billion per year. The combined annual expenditures in the 2012 through 2035 model exceed $27.8 billion. While a substantial sum, this figure does not include the on-going O&M expenditures after 2035 that arise from the 2012 through 2035 midstream investments, which will have useful operating lives well beyond the 2035 time frame.

O&M expenditures for the three models were carried forward to IMPLAN and results are presented below. To reduce the number of simulations, the IMPLAN model was set up to run the impact of pipeline installed, on average, during each year of the three time periods. The results were then multiplied as appropriate to capture the total O&M expenditures during the periods being evaluated.

[34] This pipeline-only figure is consistent with the O&M assumptions used in other studies. See, for example, *An Economic Impact Analysis of the Haynesville Shale Natural Gas Exploration, Drilling and Production*, by Manfred Dix, Ph.D. Staff Economist, Louisiana Department of Natural Resources, and Greg Albrecht, Chief Economist, Legislative Fiscal Office, August 28, 2008.

Table 4-4 In-Service Transmission Pipe Miles Assumed for Purposes of Calculating All-in Midstream O&M Costs

Table 4-4 In-Service Transmission Pipe Miles Assumed for Purposes of Calculating All-in Midstream Investment Costs

2012-2013 O&M Model

Natural Gas Transmission Pipeline
- Miles Installed 3,784
- Avg. Per Year 1,892
- $/mile O&M cost $ 43,649 (2010 dollars)

Oil and NGL Pipeline (combined)
- Avg. Miles Installed/Yr. 995
- $/mile O&M cost $15,000 (2010 dollars)

Year	Annual O&M Natural Gas	Annual O&M Oil and NGL	Total O&M, N. Gas Oil and NGL
2012			
2013	$ 82,588,303	$ 14,925,000	$ 97,513,303
Total	$ 82,588,303	$ 14,925,000	$ 97,513,303

Annual Ongoing O&M After 2013 Not Modeled $ 195,026,605

2012-2016 O&M Model

Natural Gas Transmission Pipeline
- Miles Installed 9,307
- Avg. Per Year 1,861
- $/mile O&M cost $ 43,649 (2010 dollars)

Oil and NGL Pipeline (combined)
- Avg. Miles Installed/Yr 995
- $/mile O&M cost $15,000 (2010 dollars)

Year	Annual O&M Natural Gas	Annual O&M Oil and NGL	Total O&M, N. Gas Oil and NGL
2012			
2013	$ 81,251,585	$ 14,925,000	$ 96,176,585
2014	$ 162,503,169	$ 29,850,000	$ 192,353,169
2015	$ 243,754,754	$ 44,775,000	$ 288,529,754
2016	$ 325,006,338	$ 59,700,000	$ 384,706,338
Total	$ 812,515,846	$ 149,250,000	$ 961,765,846

Annual Ongoing O&M After 2016 Not Modeled $ 480,882,923

2012-2035 O&M Model

Natural Gas Transmission Pipeline
- Miles Installed 47,240
- Avg. Per Year 1,968
- $/mile O&M cost $ 43,649 (2010 dollars)

Oil and NGL Pipeline (combined)
- Avg. Miles Installed/Yr. 995
- $/mile O&M cost $15,000 (2010 dollars)

Year	Annual O&M Natural Gas	Annual O&M Oil and NGL	Total O&M, N. Gas Oil and NGL
2012			
2013	$ 85,916,415	14,925,000	100,841,415
2014	$ 171,832,829	29,850,000	201,682,829
2015	$ 257,749,244	44,775,000	302,524,244
2016	$ 343,665,658	59,700,000	403,365,658
2017	$ 429,582,073	74,625,000	504,207,073
2018	$ 515,498,488	89,550,000	605,048,488
2019	$ 601,414,902	104,475,000	705,889,902
2020	$ 687,331,317	119,400,000	806,731,317
2021	$ 773,247,731	134,325,000	907,572,731
2022	$ 859,164,146	149,250,000	1,008,414,146
2023	$ 945,080,561	164,175,000	1,109,255,561
2024	$ 1,030,996,975	179,100,000	1,210,096,975
2025	$ 1,116,913,390	194,025,000	1,310,938,390
2026	$ 1,202,829,804	208,950,000	1,411,779,804
2027	$ 1,288,746,219	223,875,000	1,512,621,219
2028	$ 1,374,662,634	238,800,000	1,613,462,634
2029	$ 1,460,579,048	253,725,000	1,714,304,048
2030	$ 1,546,495,463	268,650,000	1,815,145,463
2031	$ 1,632,411,877	283,575,000	1,915,986,877
2032	$ 1,718,328,292	298,500,000	2,016,828,292
2033	$ 1,804,244,706	313,425,000	2,117,669,706
2034	$ 1,890,161,121	328,350,000	2,218,511,121
2035	$ 1,976,077,536	343,275,000	2,319,352,536
Total	$ 23,712,930,428	$ 4,119,300,000	$ 27,832,230,428

Annual Ongoing O&M After 2035 Not Modeled $ 2,420,193,950

5.0 Results of the Midstream Infrastructure Models for the US and by Region

The results of the midstream infrastructure models are presented in this section. Results are presented in 2011 dollars and are organized by time frame.

5.1 RESULTS OF THE 2012-2013 MIDSTREAM MODELS FOR THE US AND BY REGION

The 2012 through 2013 analysis results are discussed below for midstream investments and then for midstream O&M expenditures.

5.1.1 2012-2013 Midstream Construction Impacts

Table 5-1 summarizes the total impacts anticipated in the six regions and the cumulative US total due to 2012 through 2013 midstream investments. The US totals for all six regions and all sectors are shown at the bottom of Table 5-1. Results are indicated in 2011 dollars:

- The $26.8 billion in total 2012 through 2013 midstream investments in the US will help support an annual average of 158,730 throughout the economy. (Note: while many of the jobs supported will be new jobs, it also is possible that existing workers will be utilized more fully and, therefore, it is most appropriate to describe the employment impact as the number of jobs supported rather than created. The annual average jobs figure is calculated as the total job-years of employment reported in IMPLAN and appearing in the table, divided by the years in the study period as, especially for longer study periods, an annual average jobs figure is more intuitive. Jobs are sometimes expressed as job-years, which is the equivalent of one job lasting one year. The IMPLAN glossary defines a job as "the annual average of monthly jobs in that industry" but also points out that this can be "1 job lasting 12 months" or "2 jobs lasting 6 months each" or "3 jobs lasting 4 months each" and also explains that "a job can be either full-time or part-time.")
- The 2012 through 2013 midstream investments in the US are estimated to create $18.3 billion in labor income, or an average salary of $57,741/job. (Note: labor income includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. Job estimates and compensation in IMPLAN include full-time and part-time workers. The corresponding 2011 US wage plus benefits average was approximately $53,100).[35]
- The 2012 through 2013 midstream investments in the US are estimated to contribute $28.2 billion in value added. Value added for a firm is their sales revenue less the costs of goods and services purchased. The sum of value added in all industries is the gross domestic product (GDP), or the total market value of all final goods and services produced in the nation. (Note: the IMPLAN glossary defines "value added" as "the difference between an industry's or an establishment's total output and the cost of its intermediate inputs. It equals gross output [sales or receipts and other operating income, plus inventory change] minus intermediate inputs [consumption of goods and services purchased from other industries or imported].")

[35] Based on an average hourly compensation cost for salary and benefits of $30.05 for the first three quarters of 2011 and an assumed average hourly work week per job of 34 hours per job based on seasonally adjusted BLS data for the final three months of 2011. Thus, $30.05/hour * 2080 working hours/year times (34/40) = $53,134. Data available at http://data.bls.gov/pdq/querytool.jsp?survey=cm, and http://www.bls.gov/news.release/empsit.t18.htm

Table 5-1 Regional and US Totals for All Midstream Investments 2012-2013 (In 2011 Dollars, Lower 48 States Plus the Gulf)

Central	**Expenditure for Region Projects**	$ 8,489,861,988	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 3,496,173,745						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	21,699	$ 1,335,617,291	$ 1,651,652,361	$ 3,496,173,745					
	Indirect Effect	14,421	$ 804,750,521	$ 1,312,169,004	$ 2,573,791,368					
	Induced Effect	20,373	$ 807,618,701	$ 1,482,452,650	$ 2,622,095,809					
	Total Effect	56,492	$ 2,947,986,515	$ 4,446,274,012	$ 8,692,060,923	$ 321,468,033	$ 576,765,489	$ 6,703,666,195	1.92	
Midwest	**Expenditure for Region Projects**	$ 1,388,605,017	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 2,748,297,924						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	8,176	$ 626,117,162	$ 864,126,178	$ 2,748,297,924					
	Indirect Effect	16,131	$ 1,045,189,870	$ 1,693,646,084	$ 3,475,607,810					
	Induced Effect	19,463	$ 856,411,763	$ 1,517,686,297	$ 2,668,489,833					
	Total Effect	43,771	$ 2,527,718,796	$ 4,075,458,557	$ 8,892,395,569	$ 319,381,313	$ 537,045,332	$ 5,978,835,714	2.18	
Northeast	**Expenditure for Region Projects**	$ 5,709,488,035	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 4,325,009,028						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	19,654	$ 1,565,966,428	$ 1,985,633,661	$ 4,325,009,028					
	Indirect Effect	17,773	$ 1,320,356,244	$ 2,084,615,806	$ 3,716,593,373					
	Induced Effect	29,000	$ 1,586,595,496	$ 2,777,708,842	$ 4,443,898,660					
	Total Effect	66,427	$ 4,472,918,161	$ 6,847,958,311	$ 12,485,501,066	$ 569,276,034	$ 957,861,169	$ 9,957,430,148	2.30	
Southeast	**Expenditure for Region Projects**	$ 2,119,938,928	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 1,589,278,250						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	8,293	$ 496,854,819	$ 642,556,159	$ 1,589,278,250					
	Indirect Effect	8,165	$ 441,273,904	$ 711,941,566	$ 1,420,120,510					
	Induced Effect	11,030	$ 454,167,361	$ 823,535,420	$ 1,415,606,136					
	Total Effect	27,489	$ 1,392,296,082	$ 2,178,033,144	$ 4,425,004,897	$ 213,224,390	$ 357,892,112	$ 3,416,888,734	2.15	
Southwest	**Expenditure for Region Projects**	$ 8,067,307,836	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 7,066,371,460						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	40,344	$ 2,658,435,302	$ 3,229,631,569	$ 7,066,371,460					
	Indirect Effect	26,973	$ 1,632,768,929	$ 2,643,464,549	$ 5,089,126,664					
	Induced Effect	39,472	$ 1,709,283,868	$ 3,143,176,821	$ 5,306,878,192					
	Total Effect	106,789	$ 6,000,488,106	$ 9,016,272,945	$ 17,462,376,319	$ 573,663,009	$ 1,195,807,322	$ 15,363,799,220	2.17	
West	**Expenditure for Region Projects**	$ 1,033,046,251	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 824,637,356						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	4,103	$ 304,519,183	$ 378,180,611	$ 824,637,356					
	Indirect Effect	5,015	$ 322,321,231	$ 545,192,646	$ 1,003,009,697					
	Induced Effect	7,372	$ 362,261,480	$ 667,584,008	$ 1,115,890,881					
	Total Effect	16,491	$ 989,101,893	$ 1,590,957,262	$ 2,943,537,933	$ 128,593,192	$ 215,534,935	$ 1,867,219,817	2.26	
All Regions All Sectors	**Expenditure for Region Projects**	$ 26,808,248,055	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 20,049,767,762						
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**	
	Direct Effect	102,269	$ 6,987,510,185	$ 8,751,780,538	$ 20,049,767,762					
	Indirect Effect	88,479	$ 5,566,660,700	$ 8,991,029,655	$ 17,278,249,421					
	Induced Effect	126,711	$ 5,776,338,670	$ 10,412,144,038	$ 17,572,859,510					
	Total Effect	317,460	$ 18,330,509,553	$ 28,154,954,232	$ 54,900,876,707	$ 2,125,605,971	$ 3,840,906,360	$ 43,287,839,829	2.16	
	Expenditure for Region Projects		$ 26,808,248,055	Amount Directly Expended in Region Plus Default Method Impacts					$	20,049,767,762
	Total Effect Output		$ 54,900,876,707	Sum of Regional Output Associated with Direct Regional Expenditures					$	43,287,839,829
	Total Output Multiplier		2.05	Multiplier: Dir. Reg Output to Direct Expenditures						2.16

- The 2012 through 2013 midstream investments in the US are estimated to account for $54.9 billion in total economic output, which is the total value of production from all industries impacted by the midstream investment expenditures. (Note: IMPLAN glossary defines "output" as the value of industry production in producer prices. For manufacturers this would be sales plus or minus change in inventory. For service sectors production would equal sales.) As explained in Section 3, through the ripple effect of direct expenditures in the economy, virtually all industries will be impacted by midstream investments. Some industries, such as those identified in Section 4.1, will directly supply equipment and materials for midstream construction. Other industries such as fast food providers, shopping malls, and tourism providers will be impacted as workers spend their income on goods and services. (Note that this study is measuring the output arising from the construction of midstream investments and the operating and maintenance expenditures. It does not capture the value of output associated with the natural gas, oil, and NGL commodities that flow through the pipeline during operation).
- Total state and local taxes generated due to this activity will be $2.1 billion and total federal tax revenues generated will be more than $3.8 billion.
- For every million dollars in direct project expenditure, nearly 12 jobs (an annual average of 6 jobs) are supported.
- For every direct job created, a total of 3.1 jobs is created at the national level.
- For every million dollars in project expenditures, $1.05 million in value added is created.
- For every million dollars in project expenditures, $2.05 million in US output is created, hence a total output to total expenditure multiplier of 2.05 is seen at the US level. (Note: a second multiplier, and the one more meaningful at the regional level (see discussion below), is calculated as the sum of the regional output associated with the direct regional expenditures ($43.3 billion) divided by the amount entered into IMPLAN as expended directly in all of the US regions for home project expenditures by the home region plus direct method allocations ($20.0 billion). This direct expenditure regional output multiplier is 2.16 at the national level for the period. A third multiplier that is commonly reported in other studies is the ratio of total output to the direct output. This ratio is 2.75 for the 2012 through 2013 period.)

Table 5-1 also contains the summary results for each of the six regions modeled. Referencing the Central region because it is listed at the top of the table and easiest to see, this region is projected to experience $8.5 billion of new midstream project investments within the region in 2012 and 2013. Looking at similar entries for other regions, the Midwest is expected to have $1.4 billion in new investments and so on, with the bottom of the table indicating that the US total is $26.8 billion in new midstream investments for the period. These figures match the 2011 dollar totals in Table 4-1.

Table 5-1 also shows that in the Central region, $3.5 billion in direct expenditures is projected to occur in 2012 and 2013. Due to the modeling approach taken, this amount includes the direct expenditures for home region projects made in the home region and expenditures made in the Central region to support other region midstream investments in those sectors for which the default method was used to allocate expenditures. This includes expenditures for installation, pipe, general and administrative expenditures, compressors, transportation, and expenditures for values, fittings and casings.

The table also presents the IMPLAN results for the Central region in the areas of employment, labor income, value added, output and taxes. These results include the direct, indirect and induced effects for expenditures in all investment categories (pipeline, storage, processing). It should be noted that the indirect and induced effect totals include those impacts in the Central region that arise through the multi-regional modeling approach and include, for example, the indirect and

induced effects in service industries arising in the Central region due to investments in other regions. Thus, the indirect and induced effects comprise a relatively high percentage of the total effects relative to their influence if the Central region had been modeled in isolation.

In the Central region, midstream investments in the 2012 and 2013 timeframe are projected to support an annual average of 28,246 jobs (56,492 job-years/2 years in the study period) and account for more than $2.9 billion in cumulative income. These results amount to more than $52,000 per job supported. The value added is shown to be $4.4 billion and the total output is shown to be approximately $8.7 billion. Again, this output impact reflects the impact of direct expenditures in the Central region but also reflects ripple effect expenditures in the Central region arising from projects located in all other regions. Significantly, the Central region generates more than $321 million in state and local taxes, and more than $576 million in federal tax revenue due to the 2012 and 2013 investments.

A direct expenditure regional output multiplier of 1.92 is calculated for the Central region. To calculate this multiplier, the IMPLAN direct, indirect and induced effect results for direct investments in the Central region are separated from the Central region indirect and induced impacts arising from projects built in the other US regions (except default method allocations are included). As seen in the table, the resulting total output effect for the Central region direct expenditures is the $6.7 billion that arises from the $3.5 billion in Central region expenditures for Central region projects, plus direct purchases from other regions in the sectors using the default method allocation approach. Another way to explain the two output figures for the Central region ($6.7 billion and $8.7 billion) is to state that of the total $8.7 billion in output arising in the Central region from all US investments in 2012 through 2013, $6.7 billion arises due to expenditures from the Central region for home region projects, and from direct supplies provided by the Central region to other regional projects in the categories of labor, pipe, general & administrative, compressors, transportation, and values, fittings and casings (where the default method allocation process was used). The remaining $2 billion in total output effect in the Central region arises from the indirect and induced effects associated with the construction of midstream projects in the other regions. Finally, a total output to direct output multiplier of 2.49 ($8.7 billion divided by $3.5 billion) can be calculated from Table 5-1 for the Central region.

Table 5-1 also contains information for the other US regions. Note that in the Midwest region, where the expenditures for projects installed within the region is $1.4 billion, the amount directly expended in the region for all US projects is $2.7 billion. This result is attributable to the allocation of significant expenditures for pipe, compressors and other default method expenditures to this region, which employs some 37 percent of the nation's pipe making workers and has large shares of other critical supply industries as previously discussed and seen in Table 4-3. In the Midwest region, of the $8.9 billion in total output arising from investments in all US projects, $6.0 billion is associated with expenditures in the Midwest region for Midwest projects or due to purchases in the default method sectors of labor and installation, pipe, etc. The remaining $2.9 billion in total output effect comes from the indirect and induced effects arising from the construction of midstream projects in the other regions.

The direct expenditure regional output multiplier for the Midwest region is 2.18, calculated as the $6.0 billion in total output from direct regional expenditures divided by the direct expenditures in the region for home projects and default method expenditures ($2.75 billion). This approach of calculating a multiplier is more meaningful in a multi-regional context than the more traditional approach of simply dividing the total effect output for all US projects in the Midwest region ($8.9 billion) by the Midwest regional investment ($1.4 billion), which would produce an output multiplier of more than six and could incorrectly be interpreted to imply that the total effect output

was the primarily the result of Midwest project investments to the exclusion of the strong economic linkage between the Midwest and other US regions.

Across all regions, the direct expenditure regional output multiplier ranges from a low of 1.92 for the Central region to a high of 2.3 for the Northeast. The commonly reported total output to direct output multiplier is higher for each region and, as mentioned above, is 2.75 for the US as a whole. The total output to direct output multiplier is comparable to the multipliers found in some other studies, which have typically ranged from 1.5 to more than 4.0, with the lower multipliers being calculated for state or sub-state areas.[36] This result is logical because studies looking at impacts on a state level or sub-state level would have more economic leakages than would studies including a multistate region or all lower 48 states. Indeed, the next section will show that the multi-regional modeling approach may account for an additional multiplier value on the order of 0.8 or higher.

5.1.2 The 2012-2013 O&M Impacts

Table 5-2 presents the results of the O&M expenditure projections for midstream investments made in the 2012 through 2013 period for the six regions and cumulatively for all six US regions. The table is organized in a manner similar to Table 5-1 and reflects 2011 dollar values. Overall, the O&M impacts are smaller than the construction impacts, but nevertheless generate total income impacts of more than $111 million, support an annual average of 923 jobs (1846 total job-years divided by the two years in the study period), and have total output impacts of nearly $327 million.

On a regional level, the Central region is shown at the top of the table as having $21.5 million in O&M expenditures. Reading across the table, the output from direct regional expenditures is nearly $43 million and the direct expenditure regional output multiplier is 1.99. The direct, indirect and induced effects also are listed along with the total effect for the region. Totals indicate that an average of 146 jobs are supported and $17 million in total earnings, $23.4 million in total value added and more than $48 million in total output are produced in the Central region during the period. Notice that the table lists $48.3 million in total effect output and $42.9 million in output corresponding to direct regional O&M expenditures. The difference between the two output numbers arises from the multi-regional impacts of O&M expenditures in other regions that benefit the Central region through ripple effects in the economy.

In other regions, the direct expenditure regional output multiplier for O&M expenditures are above a 2.0 multiplier, with the highest being 2.37 in the Northeast region. For the US as a whole, the direct expenditure multiplier is 2.21 and the multiplier impact including all interregional impacts is 3.22. Thus, while the largest impact of O&M in a region is felt through expenditures in the home region, there also is a multi-regional effect that increases the overall US multiplier by approximately one.

[36] See, for example, the discussion by Timothy J. Considine, Ph.D, in *The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia*, July 14, 2010; and *Prudent Development – Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, National Petroleum Council, 2011, Table 5-1, p. 5-7.

Table 5-2 2012-2013 Region and US O&M Impacts (In 2011 Dollars, Lower 48 States Plus the Gulf)

Table 5-2. 2012-2013 Region and U.S. Total O&M Impacts (Impacts in $2011, All Regions Except Canada and Arctic)

Central	Regional O&M Expenditure	$ 21,582,375	Output From Direct Regional O&M Expend.		$ 42,860,795	Regional Direct Exp. Multiplier		1.99
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	103	$ 8,461,108	$ 8,874,836	$ 21,590,927			
	Indirect Effect	77	$ 4,250,886	$ 6,693,150	$ 13,240,808			
	Induced Effect	111	$ 4,263,546	$ 7,850,570	$ 13,557,162			
	Total Effect	292	$ 16,975,543	$ 23,418,555	$ 48,388,897	$ 1,848,489	$ 3,381,390	
Midwest	Regional O&M Expenditure	$ 11,885,211	Output From Direct Regional O&M Expend.		$ 28,061,284	Regional Direct Exp. Multiplier		2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	64	$ 3,964,292	$ 4,153,362	$ 11,889,921			
	Indirect Effect	162	$ 10,498,774	$ 16,536,189	$ 36,636,196			
	Induced Effect	193	$ 8,532,014	$ 15,008,747	$ 27,072,787			
	Total Effect	419	$ 22,995,078	$ 35,698,299	$ 75,598,904	$ 2,840,987	$ 4,948,751	
Northeast	Regional O&M Expenditure	$ 22,697,957	Output From Direct Regional O&M Expend.		$ 53,683,031	Regional Direct Exp. Multiplier		2.37
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	107	$ 8,301,843	$ 8,699,916	$ 21,824,958			
	Indirect Effect	120	$ 9,340,211	$ 14,187,718	$ 25,393,356			
	Induced Effect	179	$ 9,651,854	$ 16,847,505	$ 27,005,887			
	Total Effect	406	$ 27,293,908	$ 39,735,141	$ 74,224,205	$ 3,507,186	$ 5,842,620	
Southeast	Regional O&M Expenditure	$ 12,925,782	Output From Direct Regional O&M Expend.		$ 28,824,449	Regional Direct Exp. Multiplier		2.23
		Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	69	$ 4,431,198	$ 4,641,529	$ 12,930,904			
	Indirect Effect	61	$ 3,250,760	$ 5,179,935	$ 10,306,873			
	Induced Effect	83	$ 3,327,598	$ 6,043,628	$ 10,298,511			
	Total Effect	213	$ 11,009,558	$ 15,865,091	$ 33,536,289	$ 1,113,488	$ 2,227,196	
Southwest	Regional O&M Expenditure	$ 25,103,523	Output From Direct Regional O&M Expend.		$ 53,789,053	Regional Direct Exp. Multiplier		2.14
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	107	$ 10,248,118	$ 10,750,496	$ 24,138,003			
	Indirect Effect	123	$ 8,137,526	$ 13,199,267	$ 27,835,508			
	Induced Effect	174	$ 7,567,838	$ 13,898,804	$ 23,779,319			
	Total Effect	405	$ 25,953,484	$ 37,848,569	$ 75,752,830	$ 2,736,520	$ 5,126,527	
West	Regional O&M Expenditure	$ 7,218,986	Output From Direct Regional O&M Expend.		$ 17,035,339	Regional Direct Exp. Multiplier		2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes	
	Direct Effect	34	$ 2,896,983	$ 3,037,652	$ 7,221,846			
	Indirect Effect	31	$ 1,909,226	$ 3,097,175	$ 5,683,476			
	Induced Effect	46	$ 2,159,193	$ 3,955,631	$ 6,552,522			
	Total Effect	111	$ 6,965,403	$ 10,090,458	$ 19,457,844	$ 851,653	$ 1,458,228	
All Regions, All Sectors	O&M Expenditures, All Regions	$ 101,413,835	Output From Direct Regional O&M Expend.		$ 224,253,950	U.S. Direct Expenditure Multiplier		2.21
	Impact Type	Employment	Labor Income	Value Added	Output	U.S.		
	Direct Effect	485	$ 38,303,542	$ 40,157,791	$ 99,596,560	Multi-region		
	Indirect Effect	575	$ 37,387,383	$ 58,893,434	$ 119,096,217	Multiplier		3.22
	Induced Effect	786	$ 35,502,044	$ 63,604,886	$ 108,266,187	State/Local Taxes	Federal Taxes	
	Total Effect	1,846	$ 111,192,974	$ 162,656,112	$ 326,958,968	$ 12,898,323	$ 22,984,711	

5.1.3 2012-2016 Midstream Construction Impacts

Table 5-3 summarizes the total impacts anticipated in the six regions arising from 2012 through 2016 midstream investments. The format of the table is organized in the same manner as the previous summary tables and the discussion will go into less detail explaining results.

The US totals are shown at the bottom of the table. Results indicate that, in 2011 dollars:

- The $56.8 billion in total 2012 through 2016 midstream investments in the US will support an annual average of 132,190 jobs.
- The 2012 through 2016 midstream investments in the US are estimated to create a five-year total of $37.3 billion in labor income (an average of $56,418/job).
- The 2012 through 2016 midstream investments in the US are estimated to contribute $57.2 billion in value added.
- The 2012 through 2016 midstream investments in the US are estimated to account for $111.1 billion in total output.
- Total state and local taxes generated due to this activity will be $4.5 billion and total federal tax revenues generated will be more than $8.4 billion.
- For every million dollars in direct project expenditure, approximately 11.6 jobs are supported.
- For every million dollars in project expenditures, $1.01 million in value added is created.
- For every million dollars in project expenditures, $1.96 million in US output is created, hence a total output to total expenditure multiplier of 1.96 is seen at the US level (calculated as $111.08 billion divided by $56.76 billion in total project expenditures. The commonly used total output to direct output multiplier is 2.74 and is calculated as $111.08 billion divided by $40.52 billion).

In terms of regional impacts, the Central region and the Southwest region are projected to account for the highest levels of midstream investments with the respective expenditure levels of $17.3 billion and $17.1 billion, respectively. These regions are followed by the Northeast, which is projected to receive more than $8.9 billion in midstream investments. Across all regions, the direct expenditure regional output multiplier ranges from a low of 1.96 for the Central region to a high of 2.3 for the Northeast.

Table 5-3 Regional and US Totals for All Midstream Investments 2012-2016 (In 2011 Dollars, Lower 48 States Plus the Gulf)

Central	**Expenditure for Region Projects**	$ 17,259,873,908	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 7,034,085,399				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	45,874	$ 2,774,431,342	$ 3,401,324,632	$ 7,034,085,399				
	Indirect Effect	26,668	$ 1,428,697,592	$ 2,297,742,045	$ 4,412,046,914				
	Induced Effect+K	41,250	$ 1,588,114,283	$ 2,921,623,722	$ 5,085,798,379				
	Total Effect	113,792	$ 5,791,243,217	$ 8,620,690,400	$ 16,531,930,698	$ 675,800,991	$ 1,274,211,911	$ 13,817,045,409	1.96
Midwest	**Expenditure for Region Projects**	$ 3,647,180,762	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 3,967,512,112				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	12,911	$ 962,114,804	$ 1,308,735,971	$ 3,967,512,112				
	Indirect Effect	23,040	$ 1,454,936,142	$ 2,354,277,512	$ 4,794,482,866				
	Induced Effect	28,561	$ 1,231,091,263	$ 2,182,062,187	$ 3,823,544,435				
	Total Effect	64,511	$ 3,648,142,209	$ 5,845,075,670	$ 12,585,539,412	$ 477,051,542	$ 806,979,804	$ 8,673,650,925	2.19
Northeast	**Expenditure for Region Projects**	$ 8,938,667,065	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 8,940,146,835				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	40,034	$ 3,186,506,089	$ 4,029,142,112	$ 8,940,146,835				
	Indirect Effect	39,014	$ 2,859,953,010	$ 4,523,853,934	$ 8,082,547,053				
	Induced Effect	62,603	$ 3,374,277,024	$ 5,897,790,030	$ 9,444,431,284				
	Total Effect	141,650	$ 9,420,736,119	$ 14,450,786,080	$ 26,467,125,168	$ 1,248,966,791	$ 2,086,289,619	$ 20,563,579,133	2.30
Southeast	**Expenditure for Region Projects**	$ 7,772,301,379	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 5,496,624,044				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	27,115	$ 1,641,607,945	$ 2,133,425,154	$ 5,496,624,044				
	Indirect Effect	29,720	$ 1,582,526,204	$ 2,560,681,391	$ 5,137,784,177				
	Induced Effect	39,046	$ 1,580,894,205	$ 2,864,711,787	$ 4,940,073,986				
	Total Effect	95,882	$ 4,805,028,350	$ 7,558,818,334	$ 15,574,482,207	$ 530,919,509	$ 1,055,931,405	$ 11,735,438,810	2.14
Southwest	**Expenditure for Region Projects**	$ 17,143,814,267	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 13,344,685,789				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	78,139	$ 5,037,459,236	$ 6,114,475,078	$ 13,344,685,789				
	Indirect Effect	52,613	$ 3,120,009,592	$ 5,049,462,009	$ 9,736,179,777				
	Induced Effect	76,627	$ 3,252,815,102	$ 5,979,592,862	$ 10,103,863,578				
	Total Effect	207,379	$ 11,410,283,930	$ 17,143,529,946	$ 33,184,729,142	$ 1,227,886,521	$ 2,570,903,855	$ 29,230,764,455	2.19
West	**Expenditure for Region Projects**	$ 2,001,395,009	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 1,735,357,767				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	8,272	$ 606,919,670	$ 758,003,997	$ 1,735,357,767				
	Indirect Effect	12,196	$ 771,406,920	$ 1,313,775,469	$ 2,418,212,974				
	Induced Effect	17,268	$ 835,998,706	$ 1,546,654,173	$ 2,586,553,565				
	Total Effect	37,736	$ 2,214,325,295	$ 3,618,433,639	$ 6,740,124,305	$ 368,941,197	$ 613,523,341	$ 3,894,041,749	2.24
All Regions	**Expenditure for Region Projects**	$ 56,763,232,390	**Amount Directly Expended in Region Plus Default Method Impacts**	$ 40,518,411,945				
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	212,345	$ 14,209,039,086	$ 17,745,106,944	$ 40,518,411,945				
	Indirect Effect	183,250	$ 11,217,529,460	$ 18,099,792,360	$ 34,581,253,762				
	Induced Effect	265,354	$ 11,863,190,583	$ 21,392,434,762	$ 35,984,265,228				
	Total Effect	660,950	$ 37,289,759,119	$ 57,237,334,069	$ 111,083,930,932	$ 4,529,566,552	$ 8,407,839,935	$ 87,914,520,481	2.17
	Expenditure for Region Projects		$ 56,763,232,390	Amount Directly Expended in Region Plus Default Method Impacts					$ 40,518,411,945
	Total Effect Output		$ 111,083,930,932	Sum of Regional Output Associated with Direct Regional Expenditures					$ 87,914,520,481
	Total Output Multiplier		1.96	Multiplier: Dir. Reg Output to Direct Expenditures					2.17

5.1.4 The 2012-2016 O&M Impacts

Table 5-4 presents the O&M impacts during the 2012 through 2016 timeframe that arise from the midstream facilities installed during the same period.

The table shows that total O&M impacts are modest compared with construction impacts, but nevertheless generate total income impacts of more than $1.0 billion during the five year period, support an annual average of 3,443 jobs and have total output impacts of more than $3.0 billion during the five-year period. In the area of taxes, the state and local taxes generated are estimated to be more than $115 million during the five-year period and an estimated $209 million in federal taxes is generated from 2012 through 2016 O&M activities in all regions.

At the regional level, the Central region has the highest total O&M expenditure of $278 million, followed by the Southwest. The direct output multiplier from home region O&M expenditures varies among the regions from a low of 1.99 in the Central region to 2.37 in the Northeast region. At the national level, the output multiplier from direct regional investments is 2.18 but is 3.0 once the impact of multi-regional spending is considered.

5.1.5 2012-2035 Midstream Construction Impacts

Table 5-5 summarizes the total impacts anticipated in the six regions and in the US due to 2012 through 2035 midstream investments. These results capture twenty additional years worth of impacts compared with the 2012 through 2016 analysis and the economic impact potential of the midstream investments is revealed in these long-term results.

For all regions and all investments for the US regions, results in Table 5-5 indicate that, in 2011 dollars:

- The $200.2 billion investment in 2012 through 2035 midstream projects will help support an annual average of 104,579 jobs.
- The 2012 through 2035 midstream investments in the US are estimated to create a cumulative $141 billion in labor income (an average of $56,300 job).
- The 2012 through 2035 midstream investments in the US are estimated to contribute nearly $218 billion in value added.
- The 2012 through 2035 midstream investments in the US are estimated to account for nearly $425 billion in total output.
- Total state and local taxes generated due to this activity will be $16.8 billion and total federal tax revenues generated will be more than $30.9 billion.
- For every million dollars in direct project expenditure, more than 12.5 jobs are supported.
- For every million dollars in project expenditures, $1.09 million in value added is created.
- For every million dollars in project expenditures, $2.12 million in US output is created, hence a project expenditure to total output multiplier of 2.12 is seen at the US level.

Table 5-4 2012-2016 Region and US Total O&M Impacts (2011 Dollars, Lower 48 States Plus the Gulf)

Table 5-4. 2012-2016 Region and U.S. Total O&M Impacts
(Impacts in $2011, All Regions Except Canada and Arctic)

Central	Regional O&M Expenditure	$ 278,226,002	Output From Direct Regional O&M Expend.		$552,533,615	Regional Direct Exp. Multiplier	1.99
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	1,335	109,075,133	114,408,633	278,336,239		
	Indirect Effect	984	54,037,957	85,035,079	167,741,785		
	Induced Effect	1,420	54,376,240	100,144,418	172,647,120		
	Total Effect	3,739	217,489,304	299,588,105	618,725,131	23,629,098	43,288,280
Midwest	Regional O&M Expenditure	$ 105,716,701	Output From Direct Regional O&M Expend.		$ 249,599,798	Regional Direct Exp. Multiplier	2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	573	35,261,625	36,943,374	105,758,595		
	Indirect Effect	1,173	75,274,021	118,367,627	258,543,070		
	Induced Effect	1,420	62,342,679	109,866,930	196,656,336		
	Total Effect	3,162	172,878,306	265,177,931	560,958,001	21,116,314	36,885,452
Northeast	Regional O&M Expenditure	$ 137,623,528	Output From Direct Regional O&M Expend.		$ 325,493,976	Regional Direct Exp. Multiplier	2.37
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	651	50,336,199	52,749,817	132,330,314		
	Indirect Effect	758	59,217,531	89,981,856	161,301,190		
	Induced Effect	1,122	60,728,885	105,926,536	169,917,856		
	Total Effect	2,530	170,282,631	248,658,217	463,549,360	21,938,913	36,519,790
Southeast	Regional O&M Expenditure	$ 186,770,046	Output From Direct Regional O&M Expend.		$ 416,496,538	Regional Direct Exp. Multiplier	2.23
		Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	994	64,028,237	67,067,397	186,844,049		
	Indirect Effect	886	46,969,028	74,848,696	148,909,897		
	Induced Effect	1,199	48,069,053	87,306,267	148,759,820		
	Total Effect	3,077	159,066,301	229,222,360	484,513,775	16,087,543	32,178,643
Southwest	Regional O&M Expenditure	$ 246,705,161	Output From Direct Regional O&M Expend.		$ 528,612,537	Regional Direct Exp. Multiplier	2.14
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	1,055	100,713,499	105,650,614	237,216,495		
	Indirect Effect	1,226	81,037,768	131,480,117	277,597,558		
	Induced Effect	1,727	74,993,885	137,717,926	235,725,425		
	Total Effect	4,005	256,745,152	374,848,686	750,539,492	27,131,693	50,746,449
West	Regional O&M Expenditure	$ 45,195,042	Output From Direct Regional O&M Expend.		$ 106,651,105	Regional Direct Exp. Multiplier	2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	212	18,136,792	19,017,461	45,212,949		
	Indirect Effect	197	12,178,813	19,799,751	36,330,923		
	Induced Effect	291	13,728,916	25,166,961	41,697,170		
	Total Effect	701	44,044,523	63,984,177	123,241,044	5,232,276	9,233,824
All Regions, All Sectors	O&M Expenditure, All Regions	$ 1,000,236,480	Output From Direct Regional O&M Expend.		$ 2,179,387,569	U.S. Direct Expenditure Multiplier	2.18
	Impact Type	Employment	Labor Income	Value Added	Output	U.S.	
	Direct Effect	4,821	$ 377,551,484	$ 395,837,297	$ 985,698,640	Multi-region	
	Indirect Effect	5,224	$ 328,715,117	$ 519,513,126	$ 1,050,424,423	Multiplier	3.00
	Induced Effect	7,179	$ 314,239,658	$ 566,129,038	$ 965,403,727	State/Local Taxes	Federal Taxes
	Total Effect	17,215	$ 1,020,506,217	$ 1,481,479,477	$ 3,001,526,802	$ 115,135,838	$ 208,852,438

Table 5-5 Regional and US Totals for All Midstream Investments 2012-2035 (In 2011 Dollars, Lower 48 States Plus the Gulf)

Central	**Expenditure for Region Projects**	$ 45,900,128,606	**Amount Directly Expended in Region for All U.S. Projects**			$ 19,516,371,817			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	127,669	$ 7,662,096,397	$ 9,396,291,047	$ 19,516,371,817				
	Indirect Effect	76,318	$ 4,120,042,339	$ 6,655,036,024	$ 12,849,381,299				
	Induced Effect	116,630	$ 4,502,869,519	$ 8,277,843,785	$ 14,474,680,721				
	Total Effect	320,618	$ 16,285,008,258	$ 24,329,170,859	$ 46,840,433,838	$ 1,796,906,839	$ 3,383,643,016	$ 38,284,327,944	1.96
Midwest	**Expenditure for Region Projects**	$ 20,990,565,069	**Amount Directly Expended in Region for All U.S. Projects**			$ 26,591,294,567			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	98,092	$ 6,974,070,580	$ 9,299,571,531	$ 26,591,294,567				
	Indirect Effect	143,262	$ 8,954,471,770	$ 14,453,080,026	$ 29,122,313,924				
	Induced Effect	185,487	$ 7,954,592,657	$ 14,121,171,487	$ 24,612,278,159				
	Total Effect	426,841	$ 23,883,135,011	$ 37,873,823,037	$ 80,325,886,652	$ 3,092,279,309	$ 5,290,845,881	$ 58,518,026,956	2.20
Northeast	**Expenditure for Region Projects**	$ 31,503,167,638	**Amount Directly Expended in Region for All U.S. Projects**			$ 31,561,126,196			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	140,262	$ 11,216,376,276	$ 14,171,868,069	$ 31,561,126,196				
	Indirect Effect	136,432	$ 9,988,319,851	$ 15,836,258,914	$ 28,269,224,515				
	Induced Effect	218,912	$ 11,785,066,193	$ 20,620,705,345	$ 33,017,907,536				
	Total Effect	495,606	$ 32,989,762,321	$ 50,628,832,331	$ 92,848,258,251	$ 4,422,773,698	$ 7,370,571,599	$ 72,580,299,142	2.30
Southeast	**Expenditure for Region Projects**	$ 38,047,860,621	**Amount Directly Expended in Region for All U.S. Projects**			$ 23,330,174,805			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	126,583	$ 7,423,965,207	$ 9,494,671,797	$ 23,330,174,805				
	Indirect Effect	119,054	$ 6,295,782,948	$ 10,141,524,677	$ 20,077,333,387				
	Induced Effect	163,797	$ 6,610,987,037	$ 11,990,940,064	$ 20,563,815,110				
	Total Effect	409,434	$ 20,330,735,186	$ 31,627,136,540	$ 63,971,323,297	$ 2,079,049,861	$ 4,224,529,467	$ 50,432,769,479	2.16
Southwest	**Expenditure for Region Projects**	$ 53,190,254,393	**Amount Directly Expended in Region for All U.S. Projects**			$ 44,435,734,426			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	261,162	$ 16,801,058,536	$ 20,382,416,335	$ 44,435,734,426				
	Indirect Effect	175,276	$ 10,447,092,711	$ 16,930,080,334	$ 32,646,287,985				
	Induced Effect	256,423	$ 10,908,981,736	$ 20,056,455,690	$ 33,909,246,029				
	Total Effect	692,862	$ 38,157,132,983	$ 57,368,952,356	$ 110,991,268,446	$ 4,083,890,677	$ 8,507,512,891	$ 96,902,013,183	2.18
West	**Expenditure for Region Projects**	$ 10,549,371,939	**Amount Directly Expended in Region for All U.S. Projects**			$ 7,811,497,236			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	36,662	$ 2,681,913,030	$ 3,354,743,914	$ 7,811,497,236				
	Indirect Effect	52,787	$ 3,344,453,115	$ 5,694,643,272	$ 10,509,908,405				
	Induced Effect	75,089	$ 3,636,189,945	$ 6,719,318,757	$ 11,246,702,037				
	Total Effect	164,539	$ 9,662,556,088	$ 15,768,705,944	$ 29,568,107,676	$ 1,305,993,869	$ 2,148,788,278	$ 15,076,300,382	1.93
All Regions All Sectors	**Expenditure for Region Projects**	$ 200,181,348,268	**Amount Directly Expended in Region for All U.S. Projects**			$ 153,246,199,047			
	Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**	**Total State and Local Taxes**	**Total Federal Taxes**	**Total Output Effect, Direct Regional Expenditures**	**Output Multiplier from Direct Region Expenditures**
	Direct Effect	790,430	$ 52,759,480,025	$ 66,099,562,694	$ 153,246,199,047				
	Indirect Effect	703,129	$ 43,150,162,735	$ 69,710,623,246	$ 133,474,449,514				
	Induced Effect	1,016,339	$ 45,398,687,087	$ 81,786,435,128	$ 137,824,629,592				
	Total Effect	2,509,899	$ 141,308,329,847	$ 217,596,621,069	$ 424,545,278,160	$ 16,780,894,253	$ 30,925,891,132	$ 331,793,737,086	2.17
	Expenditure for Region Projects		$ 200,181,348,268	Amount Directly Expended in Region for All U.S. Projects					$ 153,246,199,047
	Total Effect Output		$ 424,545,278,160	Sum of Regional Output Associated with Direct Regional Expenditures					$ 331,793,737,086
	Total Output Multiplier		2.12	Multiplier: Dir. Reg Output to Direct Expenditures					2.17

In terms of regional impacts, the Southwest and Central regions are projected to receive the highest level of new investment with total project values of $53.2 billion and $45.9 billion, respectively, through 2035. Combined, the value of these projects approaches 50 percent of the total US investments of $200.2 billion through 2035. However, of the $45.9 billion cost of projects installed in the Central region, only $19.5 billion in expenditures are made for direct Central region purchases or are realized in the region due to default method allocation impacts. By way of contrast, the Southwest region has $53.2 billion in home region investments and $44.4 billion of direct expenditures in the region.

The lowest direct expenditure regional output multiplier occurs in the West region and is 1.93. The Central region also has a direct expenditure regional output multiplier of slightly less than 2.0 but other regions are projected to experience a multiplier of up to 2.3.

5.1.6 The 2012-2035 O&M Impacts

Table 5-6 presents the impact analysis results for O&M expenditures associated with midstream investments through 2035. Dollar figures are in 2011 dollars. As with the previous O&M models, the annual average O&M impacts are smaller than the construction impacts, but nevertheless generate significant economic impacts on the US economy. For example, the cumulative, direct O&M expenditures through 2035 are projected to approach $29 billion for all midstream investments (this is the total from Table 4-4 escalated to 2011 dollars). The total effect output of these expenditures is projected to be nearly $87 billion. Total labor income from all O&M expenditures is estimated to approach $30 billion and an annual average of 20,760 jobs will be supported at an average salary plus benefit level of nearly $60,000 per job. Total value added in the economy is projected to surpass $43 billion. At the national level, the total output multiplier is estimated to be 2.97 (2.23 when considering the sum of the direct expenditure effects before the multi-regional impact is considered). Finally, nearly $6.0 billion in federal taxes and nearly $3.3 billion in state and local taxes could be generated by the O&M expenditures through 2035. These impacts do not include the ongoing impact of O&M on the economy after 2035, even though the facilities constructed will have many years of remaining life and will continue to provide O&M benefits.

Regional impacts also are substantial, with large impacts occurring in the Northeast, Southeast, Midwest, and Southwest regions, all of which are projected to have total output impacts of more than $15 billion. Direct expenditure regional output multipliers based on in-region expenditures only are estimated to range from a low of 1.99 to a high of 2.37.

Table 5-6 2012-2035 Region and US Total O&M Impacts (In 2011 Dollars, Lower 48 States Plus the Gulf)

Table 5-6. 2012-2035 Region and U.S. Total O&M Impacts (Impacts in $2011, All Regions Except Canada and Arctic)

Central	Regional O&M Expenditures	$ 6,101,059,375	Output From Direct Regional O&M Expend.		$12,116,194,264	Regional Direct Exp. Multiplier	1.99
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	29,257	2,391,846,343	2,508,801,462	6,103,476,670		
	Indirect Effect	22,465	1,241,680,929	1,957,288,633	3,896,450,898		
	Induced Effect	32,173	1,235,105,577	2,272,950,924	3,941,406,492		
	Total Effect	83,894	4,868,632,186	6,739,041,682	13,941,333,398	624,628,291	1,144,313,036
Midwest	Regional O&M Expenditures	$ 3,086,621,293	Output From Direct Regional O&M Expend.		$ 7,287,590,804	Regional Direct Exp. Multiplier	2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	16,694	1,029,537,037	1,078,639,512	3,087,844,221		
	Indirect Effect	32,720	2,098,003,069	3,296,150,917	7,200,331,873		
	Induced Effect	39,808	1,748,397,187	3,082,775,459	5,519,235,496		
	Total Effect	89,325	4,875,936,265	7,457,565,888	15,807,411,590	586,496,533	1,024,477,521
Northeast	Regional O&M Expenditures	$ 5,723,965,018	Output From Direct Regional O&M Expend.		$ 13,537,773,348	Regional Direct Exp. Multiplier	2.37
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	27,067	2,093,556,514	2,193,942,483	5,503,812,468		
	Indirect Effect	28,489	2,213,561,346	3,368,676,676	6,013,816,211		
	Induced Effect	42,901	2,307,679,203	4,035,547,416	6,461,217,438		
	Total Effect	98,457	6,614,797,343	9,598,166,854	17,978,846,674	722,136,113	1,202,076,833
Southeast	Regional O&M Expenditures	$ 5,902,670,062	Output From Direct Regional O&M Expend.		$ 13,162,933,264	Regional Direct Exp. Multiplier	2.23
		Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	31,403	2,023,544,784	2,119,594,322	5,905,008,900		
	Indirect Effect	27,788	1,470,367,227	2,341,885,182	4,649,424,448		
	Induced Effect	37,581	1,507,210,533	2,737,351,937	4,660,225,516		
	Total Effect	96,771	5,001,122,544	7,198,830,362	15,214,659,133	480,815,584	961,737,464
Southwest	Regional O&M Expenditures	$ 6,692,318,439	Output From Direct Regional O&M Expend.		$ 14,339,559,798	Regional Direct Exp. Multiplier	2.14
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	28,640	2,732,033,798	2,865,961,947	6,434,921,680		
	Indirect Effect	32,614	2,147,396,675	3,480,697,671	7,337,239,303		
	Induced Effect	46,135	2,000,540,629	3,674,534,769	6,286,311,976		
	Total Effect	107,352	6,879,971,102	10,021,194,015	20,058,472,960	706,841,647	1,322,059,153
West	Regional O&M Expenditures	$ 1,438,885,458	Output From Direct Regional O&M Expend.		$ 3,395,476,992	Regional Direct Exp. Multiplier	2.36
	Impact Type	Employment	Labor Income	Value Added	Output	State/Local Taxes	Federal Taxes
	Direct Effect	6,763	577,425,466	605,463,484	1,439,455,587		
	Indirect Effect	6,338	391,062,130	636,621,239	1,170,002,983		
	Induced Effect	9,342	441,266,962	808,532,977	1,340,760,504		
	Total Effect	22,443	1,409,754,559	2,050,617,773	3,950,219,146	178,372,404	314,788,329
All Regions, All Sectors	Regional O&M Expenditures	$ 28,945,519,645	Output From Direct Regional O&M Expend.		$ 63,839,528,470	U.S. Direct Expenditure Multiplier	2.21
	Impact Type	Employment	Labor Income	Value Added	Output	U.S.	
	Direct Effect	139,824	$ 10,847,943,942	$ 11,372,403,210	$ 28,474,519,526	Multi-region	
	Indirect Effect	150,414	$ 9,562,071,375	$ 15,081,320,320	$ 30,267,265,717	Multiplier	3.00
	Induced Effect	207,940	$ 9,240,200,091	$ 16,611,693,482	$ 28,209,157,422	State/Local Taxes	Federal Taxes
	Total Effect	498,242	$ 29,650,213,997	$ 43,065,416,575	$ 86,950,942,901	$ 3,299,290,572	$ 5,969,452,336

6.0 Additional Benefits and Impacts

It is clear that the direct investment in US midstream natural gas, oil and NGL infrastructure will have a significant impact on the US economy in terms of job, income, taxes, output and value added. And yet, these economic impact estimates capture only the midstream impacts arising from natural gas, oil and NGL investments. Neither the benefits from natural gas and oil field and well development nor the impact on the market price of natural gas, oil and NGL are captured directly in this study.

While such upstream and downstream impacts are not the focus of the current study, it is nevertheless useful to briefly summarize the findings of other recent studies that have tried to quantify such impacts. Through such a broad summary, an appreciation is gained for just how massive the economic impact of developing domestic natural gas, oil and NGL resources will be over the coming decades. Specifically, by summarizing these upstream and price impacts projected in other recent studies, it will be evident that, while the midstream impacts estimated in this study are significant, the upstream and downstream impacts associated with gas field development are widely projected to be just as significant, if not larger.

Moreover, the most significant economic impact of natural gas supply development in the US will be the direct price impact that new supplies of natural gas, oil and NGL will have on the domestic energy market. In other words, the impacts on employment, income, taxes and output will arise because, fundamentally, natural gas will be an economical energy choice in most applications for the American economy through 2035 and beyond. It is this price benefit that will allow all the upstream, midstream and downstream impacts on employment, income, taxes and output to materialize. These price impacts will allow US manufacturers to gain a competitive advantage over many international manufacturers who will increasingly rely upon more costly LNG imports that surpassed $17/MMBtu in some international markets in 2011.

Multiple studies have been performed to evaluate the economic impact associated with shale gas field development; and a few studies have evaluated the economic impact of the entire natural gas industry. Nearly all of these studies have utilized an approach similar to that taken in the current study, and many have utilized IMPLAN as the impact analysis tool. A sampling of the findings of these studies follows:

- A 2011 study by IHS Global Insight titled *The Economic and Employment Contributions of Shale Gas in the United States* evaluated the economic impacts of projected shale gas exploration and production investments in the US through 2035. The study concluded that nearly $1.9 trillion ($2010) in shale gas capital investments are expected between 2010 and 2035, or more than nine times the total investment evaluated in the current assessment. The study also found that in 2010 the shale gas industry supported 600,000 jobs and the number will increase to 870,000 in 2015 and 1.6 million by 2035. It also concluded that the shale gas contribution to GDP will increase from $76 billion in 2010 to $118 billion by 2015 and $231 billion in 2035. The study concluded that shale gas production contributed $18.6 billion in tax and royalty revenues at the state, local and federal level in 2010 and that, over the next 25 years, total federal, state and local government tax revenues and federal royalty payments could exceed $933 billion.[37]

[37] *The Economic and Employment Contributions of Shale Gas in the United States,* IHS Global Insight, December 2011, p. v and p. 1.

Importantly, the same 2011 IHS study found that "the full-cycle cost of shale gas produced from wells drilled in 2011 is 40-50 percent less than the cost of gas from conventional wells drilled in 2011."[38] Competitive pressures will translate this lower cost into lower end use prices and IHS projects that in 2010 dollars, the price of natural gas will average $4.79/MMBtu from 2011 through 2035.[39] The study estimated that shale gas will result in an average reduction of 10 percent in electricity costs and that lower energy prices will help boost industrial production by 2.9 percent by 2017 and by 4.7 percent by 2035. The lower gas prices also will mean an annual average increase of $926 in disposable household income between 2012 and 2015 versus a scenario without shale gas development.[40] The study concluded that "without shale gas production, reliance on high levels of liquefied natural gas (LNG) imports would influence US natural gas prices, causing them to increase by at least 100 percent."[41]

- At the county impact level, a 2009 study entitled *Potential Economic and Fiscal Impacts from Natural Gas Production in Broome County, New York* estimated the impacts of the development of the Marcellus shale play, which extends into New York, plus the impact of ongoing well operations. The study concluded that between 2,000 and 4,000 wells could be developed in Broome County, New York and that

> …over a 10 year period the economic impact of drilling alone could exceed $15 billion, supporting more than 16,000 person-years of employment and generating salaries and wages of $792 million. State and local tax coffers would receive $85 million of new revenues. Ongoing production from completed wells will also contribute significantly…Our model predicts as much as $4.1 billion in new economic activity per year over a 10-year period supporting over 4,000 jobs and $314 million in salaries and wages. State and local tax receipts could be boosted by $52 million per year, with slightly less than half accruing to Broome County taxing jurisdictions. Local revenues will also be enhanced by bonus payments and royalties from wells located on county-owned property as well as new ad valorem taxes on wells located on private property.[42]

The study discussed the 2000 to 2005 impact of drilling in the Barnett Shale of North Texas as an example of local tax revenue impacts, explaining that during this period,

> oil and gas property value (mainly gas) escalated dramatically in the 10 core counties of the Barnett Shale…the taxable value of [oil and gas properties] jumped from about $341 million to $5.9 billion as drilling and production ramped up during this period. Local school districts in the Barnett Shale have been the primary beneficiaries of rising [oil and gas] valuations."[43]

[38] Ibid, p. v.
[39] Ibid, p. 4
[40] Ibid, p. 4
[41] Ibid, p. v
[42] *Potential Economic and Fiscal Impacts from Natural Gas Production in Broome County, New York,*, Bernard L. Weinstein, Ph.D., and Terry L. Clower, Ph. D., September, 2009, p. 15
[43] Ibid, p. 13

- A 2011 study by the Public Policy Institute of New Your State, Inc. called *Drilling for Jobs: What the Marcellus Shale could mean for New York* estimated the potential impact of the Marcellus play on the state, which placed a moratorium on fracture drilling. The study found that if 500 wells were drilled each year, "the Empire State could gain 62,620 jobs, $2.7 billion in value added and $1 billion in local, state, and federal taxes."[44] The study concluded:

  > There are very few opportunities available to New York State with the same job-creating potential as exploring and developing the Marcellus Shale formation…We need only to look south into Pennsylvania, where 48,000 private sector jobs in Marcellus Shale-related sectors were created in 2010, to see how development of this resource has positively affected their citizens and businesses. If New York fails to allow the development of this resource, the state stands to lose over $11 billion in economic output and thousands of private sector jobs between 2011 and 2020. By conservative estimates the development of the Marcellus has the potential to create 37,572 new jobs each year in New York, jobs that may pay over $79,184 annually—over double the average private sector wage upstate.[45]

- A 2008 report by two economists at the Louisiana Department of Natural Resources titled *An Economic Impact Analysis of the Haynesville Shale Natural Gas Exploration, Drilling and Production* concluded that:

  > the prospective Haynesville Shale Play exploration, drilling and natural gas production can potentially bring big benefits to the economy of the State of Louisiana. In the first five years, it may add a total of over forty thousand jobs, and even after that period, new jobs would be in the order of 25,000 more compared to the case the Play is not developed at all. Disposable income…could increase by $2 to $3 billion dollars a year in the state as a whole. And state tax revenue would increase by at least $150 million per year, with a higher increase [over $200 million] in some of the first five years of the analysis [*note*: this tax revenue does *not* include the state revenue from severance tax and state royalty income].[46]"

- A 2010 report by Timothy Considine, Ph.D. of Natural Resource Economics, Inc. called *The Economic Impact of the Pennsylvania Marcellus Shale Natural Gas Play: An Update* focusing on upstream activities concluded that during 2009:

  > Marcellus gas producers spent a total of $4.5 billion to develop Marcellus shale gas resources. Using the IMPLAN modeling system, we estimate that this spending generated $3.9 billion in value added, $389 million in state and local tax revenues, and more than 44,000 jobs…Based on our survey, Marcellus producers plan to spend significantly more this year and next, generating more than $8 billion in value added in 2010 and another $10 billion during 2011. This higher economic activity generates almost $1.8 billion in additional state and local tax revenues during 2010 and 2011. Employment in the state expands by more than 88,000 jobs during 2010 and over 111,000 jobs during 2011. This dramatic increase in Marcellus drilling activity has occurred during a period of

[44] *Drilling for Jobs: What the Marcellus Shale could mean for New York,* the Public Policy Institute of New York State, Inc., July 2011, p. 16
[45] Ibid, p. 3
[46] *An Economic Impact Analysis of the Haynesville Shale Natural Gas Exploration, Drilling and Production,* Manfred Dix, Ph.D., Louisiana Department of Natural Resources, August 28, 2008, p.2

> general economic recession and relatively low natural gas prices…This study estimates a dramatic expansion of Marcellus gas production from slightly over 327 million cubic feet per day during 2009 to over 13 *billion* cubic feet per day by 2020. If this occurs, employment would expand by 200,000 jobs and annual gains in state and local taxes revenues would exceed $1 billion.[47]

- Another 2010 report performed for the American Petroleum Institute by Dr. Considine titled *The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia* found that "under the medium development scenario…Marcellus gas production reaches 9.5 billion cubic feet per day in 2020, which generates more than $16 billion in economic output, almost $4 billion in additional tax revenue, and more than 180,000 jobs." The report also noted, that "there is currently no Marcellus activity in New York due to a de facto moratorium on hydro fracturing. This study finds that these restrictive policies could cost New Yorkers between $11 and $15 billion in lost economic output and between $1.4 and $2.0 billion in lost state tax revenues just between 2011 and 2020."[48]
- A June 2010 report that assessed the impact of a high-profile oil pipeline, the $5.2 billion Keystone XL project, was prepared by The Perryman Group and titled *The Impact of Developing the Keystone XL Pipeline Project on Business Activity in the US: An Analysis Including State-by-State Construction Effects and an Assessment of the Potential Benefits of a More Stable Source of Domestic Supply*. The report concluded that the total impact of the construction and development of the proposed Keystone XL pipeline on the US economy included "$20.931 billion in total spending, $9.605 billion in output, and 118,935 person-years of employment." Regarding price impacts of the Keystone pipeline complex, which would be able to deliver 1.1 million barrels of oil with the XL addition, the report stated that under the "normal" oil price scenario, "the gains in US business activity stemming from a permanent increase in stable oil supplies to include $100.144 billion in total spending, $29.048 billion in output, and 250,348 permanent jobs."[49]
- A 2011 report prepared by the Center for Community and Business Research called the *Economic Impact of the Eagle Ford Shale* concluded that since 2008 the Eagle Ford play:

> Is already accounting for roughly six percent of the Gross Regional Product for the 24 county area. It creates close to $1.3 billion of gross state product impact, supports 12,601 full-time jobs, and adds $2.9 billion in total economic output…This in turn generates close to $60.9 million in State's revenues and $47.6 million in local government revenues…Under moderate assumptions, by 2020 (in 2010 dollars), the Eagle Ford Shale is expected to account for close to $11.6 billion in gross state product, $21.6 billion in total economic output (or revenues) impact, and support close to 67,971 full-time jobs in the area. This will add close to $1.2 billion in State's revenues and more than $450.6 million in local government revenues.[50]

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[47] *The Economic Impact of the Pennsylvania Marcellus Shale Natural Gas Play: An Update,* Timothy J. Considine, Ph.D., Robert Watson, Ph.D., P.E., Seth Blumsack, Ph.D., The Pennsylvania State University College of Earth and Mineral Sciences, Department of Energy and Mineral engineering, May 24, 2010, pp. iv, v

[48] *The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia*, Timothy J. Considine, Ph.D., Natural Resource Economics, Inc., July 14, 2010, pp. iii, iv

[49] *The Impact of Developing the Keystone XL Pipeline Project on Business Activity in the US: An Analysis Including State-by-State Construction Effects and an Assessment of the Potential Benefits of a More Stable Source of Domestic Supply*, The Perryman Group, June, 2010, pp. 4, 6.

[50] *Economic Impact of the Eagle Ford Shale,* The Center for Community and Business Research, the University of Texas at San Antonio, Institute for Economic Development, February 2011, p. 4

- A 2008 report prepared by the University of Arkansas Sam M. Walton College of Business titled *Projecting the Economic Impact of the Fayetteville Shale Play for 2008-2012* projected, based on surveys of investing natural gas companies, that the five-year impact of development will include total economic activity of $17.9 billion, annual direct employment of about 4,600 workers and 11,000 workers overall, an estimated $1.76 billion in Arkansas state taxes, and nearly $151 million in local taxes.[51]
- A 2009 study prepared for the Louisiana Department of Natural Resources titled *The Economic Impact of the Haynesville Shale on the Louisiana Economy in 2008* concluded, based on a survey of just seven of the seventeen companies involved with area extraction activity, that expenditures in 2008 "generated approximately $2.4 billion in new business sales within the state of Louisiana" and "nearly $3.9 billion in household earnings was created in 2008. This estimate includes both direct and indirect earnings and includes almost $3.2 billion in lease and royalty payments to private landowners." Further, "there was an increase of 32,742 new jobs within the state in 2008" and "collectively, state and local tax revenues increased by at least $153.3 million in 2008 due to the extraction activities in the Haynesville Shale. In one parish sales tax collections alone are up over 300 percent in the first quarter of 2009." Due to the limited surveying and conservative assumptions, the study also concluded that "the multiplier impacts reported here may be viewed as lower bound estimates. The actual impacts are likely to be substantially larger."[52]
- Finally, a 2011 study called *Shale Gas and New Petrochemicals Investment: Benefits for the Economy, Jobs, and US Manufacturing* by the American Chemistry Council (ACC) quantifies the downstream impact of recent shale gas finds and, in particular, increased NGL supplies, especially ethane. The study concludes that "after years of high, volatile natural gas prices, the new economics of shale gas are a "game changer," creating a competitive advantage for U.S. petrochemical manufacturers, leading to greater U.S. investment and industry growth."[53] Projecting that recent shale gas discoveries will lead to a 25 percent increase in ethane supplies, the ACC predicts that impacts on the petrochemical industry will include:
  - 17,000 new knowledge-intensive, high-paying jobs in the U.S. chemical industry
  - 395,000 jobs outside the chemical industry
  - $4.4 billion more in federal, state, and local tax revenue annually
  - A $32.8 billion increase in U.S. chemical production
  - $132.4 billion in U.S. economic output[54]

[51] *Projecting the Economic Impact of the Fayetteville Shale Play for 2008-2012*, Center for Business and Economic Research, Sam M. Walton College of Business, University of Arkansas, March, 2008, pp. iii, iv.
[52] *The Economic Impact of the Haynesville Shale on the Louisiana Economy in 2008*, Loren C. Scott & Associates, April 2009, pp. ii, iii.
[53] *Shale Gas and New Petrochemicals Investment: Benefits for the Economy, Jobs, and US Manufacturing*, American Chemistry Council, March 2011, p. 1
[54] Ibid

The study also explains that the recent shale finds and associated NGL supplies will help increase US competitiveness relative to other countries such as Japan, Western Europe and China. The study reported that "in 2010, the US Gulf Coast cost position improved so much that the region now is second only to the Middle East in terms of competitiveness. As a result, for example, US plastic exports are up nearly 10 percent due to this improved position."[55] Also, due to the difficulty in transporting ethane, the study anticipates that new petrochemical investments will occur in previously recession-prone areas, such as in the Northeastern US, as the Marcellus shale continues to be developed.

The study's estimate of the large downstream impacts of shale gas development are especially revealing given that investments in NGL facilities constitute only $14.1 billion out of the total $200.2 billion in total midstream investments projected in the 2012 through 2035 time frame. The implication is that, were downstream studies performed to trace the impacts of developing the US natural gas plays in all industries or even a selected number of important industries, the total impact on the US economy would be a multiple of the already significant impacts associated with the midstream investments studied in this report.

6.1 SUMMARY AND OTHER CONSIDERATIONS

This and other economic impact studies consistently have found enormous benefits associated with natural gas development. Some , however, have criticized such reports as failing to directly address issues of concern such as the socioeconomic impact and disruption to local communities when projects are constructed. Specific worries include a "boom to bust" impact and harm done to local roadways, especially during the well drilling phase. Such criticism are not necessarily a repudiation of input-output studies—for these studies are not designed to address such issues—as they are a call for local decision makers to recognize that natural gas development will have local impacts that can incur costs or require mitigation efforts. While this and other impact studies do not address such issues directly, it is clear from the impact analysis that there will be substantial tax revenues generated at the federal, state and local levels as upstream and midstream investments occur. With proper coordination and timing, it is possible that local impacts can be minimized through the allocation of development-induced tax revenue to impacted areas.

Another criticism of input-output studies is they fail to predict the timing of the economic impacts and rounds of spending associated with investment. This is true, as models such as IMPLAN provide a mathematical solution that captures the cumulative rounds of spending all at once when a multiplier is estimated. While the timing of impacts is not projected by input-output models, economic theory and practical experience tell us that the impact of a construction project is not permanent and a year-long project likely will generate the vast majority of economic impacts in a three- to four-year period. What is interesting about natural gas project development (upstream and midstream), however, is that the number and magnitude of projects projected to be built through 2035 are so large (and projects are generally contiguous) that, as a whole, the construction of upstream and downstream projects will tend to have a steady impact on the national economy. While regional impacts will be more variable, many regions will experience sizable expenditures for new projects for decades to come, and will benefit from long-term development opportunities not historically seen in other construction sectors.

[55] Ibid, p. 17

On a related point, the development of several large US natural gas resources promises to be of such a long-term nature that governments in state and local areas without a strong historical employment base in the natural gas field could find it beneficial to team with private industry and local institutions to ensure that an increased share of local workers have training opportunities for the well-paying jobs that will be directly associated with future natural gas development. Employment of local workers is one way to attain a significant increase in the local ripple effects of midstream and upstream investments and to help local populations benefit directly from regional development.

Last, the IMPLAN model is based on a historical snapshot of the economy. If regions with the large natural gas plays can attract new natural gas and oil related industry and supplier investment, the ripple effects shown for any region in this analysis would increase, making the current projections conservative. Likewise, since investments in Canada and the Arctic were not directly included in this study and given that project investments in these regions will impact the selected study regions, the results herein can be considered to be somewhat conservative, as were many of the input assumptions made.

7.0 Conclusions

The US Energy Information Administration has characterized the emergence of new US natural gas supplies as a game changer. In terms of the economic multiplier impacts, gas price impacts and increased domestic energy security, there is no doubt that the natural gas industry will, indeed, be a game changer for decades to come. The results of this study show that economic benefits will accrue to every region in the nation and that these benefits will be in the form of increased employment, including high-wage jobs, high value added and output impacts, plus significant new tax revenue at the federal, state and local levels. These economic benefits will come primarily through construction of midstream facilities, but also from long-term O&M expenditures.

Every region of the US stands to realize substantial economic benefits as the midstream investments unfold. Benefits and impacts will be greatest for those regions containing large natural gas plays that will be economical to develop, but this analysis also has shown that there will be significant economic benefits for those regions with an industrial base that supplies the natural gas and oil industries with materials such as pipe, compressors or valves. Given the competitive advantage of being in close proximity to natural gas investment locations, midstream infrastructure development presents a significant opportunity for suppliers of materials used in such investments to reverse or at least slow the decades-long decline seen in most manufacturing in the US.

In addition to the economic impacts quantified in this study, other studies have concluded that there will be other national benefits in the form of lower energy prices, increased energy security and lower emissions associated with a switch from coal to natural gas in electric generation and increased natural gas usage in industrial processes. Combined, these benefits make a compelling case for the continued prudent development of the nation's natural gas and liquid hydrocarbon plays.