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Benefits and Opportunities of Natural Gas Use, Transportation, and Production







Key Observations and Findings

Benefits and Opportunities of Natural Gas Use, Transportation, & Production

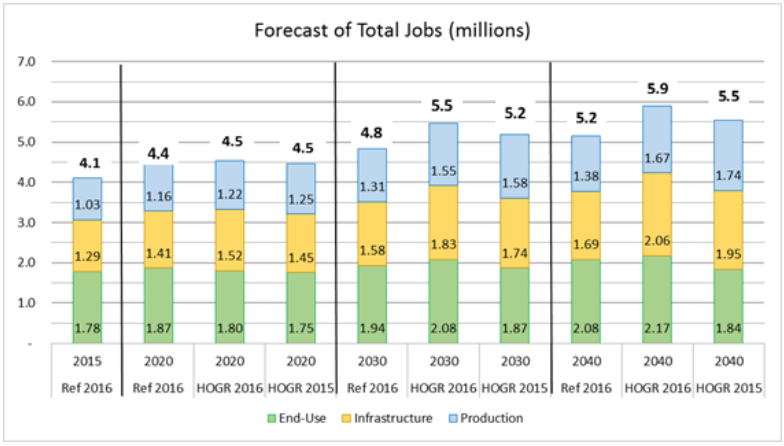
Introduction: This report describes how natural gas and its associated liquids (lease condensate and natural gas plant liquids) contribute to the U.S. economy both at a national level and in terms of the economies of individual states. The economic contribution is estimated for the historical year of 2015 and is projected to 2040 under three scenarios drawn from EIA's AEO.

Scope: Economic impacts are measured in terms of the number of jobs that are supported, the wages paid for those jobs, and the total value added (that is, the contribution to the national GDP and to its constituent state products). **A unique feature of this report is that it defines the natural gas value chain as going "all the way through consumption" to include the economic activity of converting the natural gas to other products and useful energy services.**

Base Year Results: Shown to the right are the job counts, wages and value added by three segments of the natural gas value chain: "end use," "infrastructure," and "production." The end use segment is made up of the industries that convert natural gas and its associated liquids to electricity, petrochemical and other products and the industries that manufacture, sell, install and maintain gas-fired appliances and equipment used in the residential, commercial, vehicle and industrial sectors. The end use segment is the largest of the three with 43.6% of the total jobs. The infrastructure segment— which is made up of gatherers, gas processing, petroleum refining, natural gas distribution, and propane distribution— contributes 31.2% of the 2015 total jobs. The production segment— consisting of oil and gas production companies and their suppliers of goods and services— contributes the remaining 25.2% of 2015 total natural gas value chain jobs.

Direct, Indirect and Induced Economic Impacts: 2015			
Segment	Employment (# of Workers)	Labor Income ($ million)	Value Added ($ million)
End-Use	1,788,207	106,941	271,663
Infrastructure	1,282,306	84,341	167,624
Production	1,033,510	78,204	111,390
All Segments	**4,104,023**	**269,486**	**550,677**

Forecast Results: Estimates for total jobs (direct, indirect and induced) through 2040 are shown to the right for the three AEO cases. The growth rate in employment for the Reference Case is 0.91% per year from 2015 to 2040 when total jobs reach 5.15 million. Due to the increased amount of oil and gas produced and consumed in 2016 High Oil and Gas Resource Case, the rate of growth in employment is higher in that case at 1.46% per year. By 2040 there are 0.75 million more jobs compared to the Reference case. The 2015 High Oil and Gas Resource Case falls in between the other two cases with an average growth rate in total employment of 1.21% per year. The results for wages show similar tends among the three cases. The forecasted direct, indirect and induced value added for all three segments combined grows from $551 billion in 2015 to $934 billion in the Reference Case, an annual growth rate of 2.14%. The 2016 High Oil and Gas Resource Case has a higher growth rate of 2.45% per year and reaches $1,008 billion by 2040. The 2015 High Oil and Gas Resource Case also grows faster (2.28% per year) than the Reference Case and reaches $967 billion by 2040.



Exports: The natural gas value chain contributes substantially to U.S. exports of commodities. In 2015 gas-related exports totaled over $37.6 billion. This includes primary hydrocarbons, refined petroleum products, petrochemicals, fertilizers, plastics and resins. The fastest growth in natural gas value chain exports are expected to be in LNG exports and petrochemicals with substantial growth also expected in pipeline natural gas and NGLs. Such exports are expected grow at annual rates of 3.4% to 3.8% per year, which is 60% to 70% faster than the overall natural gas value chain.

Conclusion: The natural gas value chain touches all states and a large number of industrial sectors supporting 2.9% of all non-farm jobs and contributing 3.1% of the national economy (GDP). These contributions to the U.S. economy are expected to grow in the future under each of the AEO scenarios examined here.

Table of Contents

Table of Exhibits

Definitions & Acronyms

ACC: American Chemistry Council

AEO: EIA Annual Energy Outlook

AHAM: Association of Home Appliance Manufacturing

AHRI: Air Conditioning, Heating, & Refrigeration Institute

ASM: Annual Survey of Manufacturers

Bcf: Billion cubic feet of gas

BLS: U.S. Bureau of Labor Statistics

BTX: Benzene, Toluene, and Xylene

CAPEX: Capital expenditures

CBECs: EIA Commercial Buildings Energy Consumption Survey

EIA: Energy Information Administration

GDP: Gross Domestic Product

IMPLAN: Input-output model used for economic analysis in this study

ISTUM: Industrial Technology Use Model

LDC: Local Distribution Company

LCOE: Levelized Cost of Electricity

LPG: Liquefied Petroleum Gas

MECS: EIA Manufacturing Energy Consumption Survey

MMbbls: Million Barrels

MWh: Megawatt hour of electricity

MTBE: Methyl Tertiary Butyl Ether

NAICS: North American Industry Classification System

NEEDS: EIA's National Electric Energy Data System

NEMS: National Energy Modeling System

NGLs: Natural gas liquids (ethane, propane, butanes, pentanes plus)

NGVC: Natural Gas Value Chain

PDH: Propane Dehydrogenation Plant

RECs: EIA Residential Energy Consumption Survey

Executive Summary

ES-1. This Report Is Unique in That It Covers Economic Impacts through End-use

The purpose of this report is to describe how natural gas and its associated liquids (lease condensate and natural gas plant liquids) contribute to the U.S. economy both at a national level and in terms of the economies of individual states. This economic contribution is estimated for the historical year of 2015 and is projected to 2040 under three scenarios drawn from the Energy Information Administration's (EIA) Annual Energy Outlook (AEO). Economic impacts are measured in terms of the number jobs that are supported, the wages paid for those jobs, and the total value added (that is, the contribution to the national GDP and to its constituent state products).

A unique feature of this report is that it defines the natural gas value chain as going "all the way through consumption" to include the economic activity of converting the natural gas to other products and useful energy services. For example, in the power generation sector, natural gas is converted to electricity and so the jobs and value added impacts of building and operating gas-fired power plants is counted here as part of the natural gas value chain. Similarly, the value chain as described here includes not only the uses of natural gas and its associated liquids as feedstocks in the petrochemical industry to make primary bulk chemicals (most importantly ammonia, methanol and olefins), but also the further processing of those primary bulk chemicals into derivative chemical products. Therefore, the jobs and value added associated with building and operating such petrochemical facilities through the derivative chemical levels – what is called here the "n^{th} petrochemical" – is counted as part of the natural gas value chain. However, the use of those "n^{th} petrochemicals" (e.g., plastics, resins, fertilizers and fibers) to manufacture consumer or intermediate products is not counted here.

The majority of natural gas and associated liquids used in the U.S. is in end-use applications where the fuels are used in appliances and equipment to provide steam, industrial process energy, hot water, space heat, or cooking and other services. For these uses, the value chain is defined as including the manufacturing, installation and maintenance of those appliances and equipment.

ES-2. Only Domestic Natural Gas and Related Liquids Are Counted in the Value Chain

For most of the findings to be reported here, only domestically produced natural gas and its associate liquids are being considered. As is illustrated in Exhibit ES-1, this means that uses of imported natural gas are not included in calculations of economic impact measures. Similarly, imported primary bulk chemicals (such as methanol) that are converted to derivative products are also not counted as part of the domestic natural gas value chain.

Exhibit ES-1: Concept of U.S. Natural Gas Value Chain as Used in This Report

Source	Petroleum Resource	Part of U.S. Natural Gas Value Chain?
U.S. Oil Wells	Crude Oil	No
U.S. Oil Wells	Dry Natural Gas	Yes
U.S. Oil Wells	NGLs & Other Gas Plant Products	Yes
U.S. Gas Wells	Condensate	Yes
U.S. Gas Wells	Dry Natural Gas	Yes
U.S. Gas Wells	NGLs & Other Gas Plant Products	Yes
Imported Natural Gas	Natural Gas	No
Imported Crude & Condensate	Crude & Condensate	No
Imported Petrochemicals	Petrochemicals	No

As will be discussed later in the report, in order to be able to compute the portion of jobs, wages and value added that is attributable to domestic natural gas, it was first necessary to compute those same economic measures for each relevant industry, regardless of whether natural gas (as opposed to crude oil or petroleum products) — or specifically domestic natural gas— was used for all energy and feedstock inputs. This "100% Basis" concept is used for several tables and chart in this report to measure U.S. activity related to converting oil, gas and NGL into chemical products regardless of the origin of the primary feedstock or intermediate petrochemical. These "100% Basis" results are comparable to many industry and government statistical reports (wherein the origin of the fuel/feedstocks is seldom relevant). However most charts and tables in this report will show results for the "U.S. Natural Gas Value Chain Basis" or "NGVC Basis" concept which will present only U.S. activity that can be traced back to domestic natural gas feedstocks and fuels (dry gas, lease condensate and NGLs).

ES-3. Jobs, Wages and Value Added are Computed First in the 2015 Base Year

The first step for this study was to estimate all economic activity in the U.S. natural gas value chain for a historical year for which all critical statistics could be compiled and analyzed. The year 2015 was selected for analysis because it was the latest year for which complete data was available at the time of writing. The steps taken to estimate the base year include:

1) Compile state-level statistics on the production of the relevant hydrocarbons (dry natural gas, natural gas plant liquids and lease condensate) and their wellhead values.
2) Trace the pathways taken by each hydrocarbon as it is gathered, processed, transported and distributed to domestic customers and for export. Determine how much value is added in each step.
3) Determine how much of the natural gas and associated liquids are used by customers within major end use applications (e.g. producing domestic hot water).

4) For industrial feedstock and power generation end uses wherein the natural gas and liquids are converted to other products, trace these conversion pathways and estimate the value added at each conversion step.

5) For residential, commercial, vehicle and industrial applications where the natural gas or liquids are used in appliances and equipment, determine value added in the manufacture, sales, installation and maintenance of those appliances and equipment.

6) Compile Bureau of Labor Statistics (BLS) job and wage statistics for the relevant industries and using input/output analysis determine how many of those jobs and what portion of wages can be attributed to domestic natural gas and its associated liquids. This analysis includes both the industry sectors that are links in the natural gas value chain and those industries that supply intermediate goods and services to the links. Economist sometimes refer to this combination as "direct and indirect" jobs, wages and value added.

7) Using the IMPLAN model estimate the "induced" jobs, wages and value added that is produced when the income earners in the direct and indirect sectors spend their income. The sum of "direct and indirect" plus "induced" jobs, wages and value added are referred to as "total" jobs, wages, and value added.

The results of this base year analysis are shown in Exhibit ES-2. The exhibit shows that the direct and indirect jobs that can be attributed to domestic natural gas value chain total 1.95 million. Adding another 2.15 million jobs that can be attributed to induced economic activity produces a total job count of 4.10 million or 2.9% of all non-farm jobs reported by the BLS for 2015. The total value added by these direct, indirect and induced activities sums to $551 billion in 2015, which is 2.9% of the entire U.S. GDP for that year.

Exhibit ES-2 breaks out the job counts, wages and value added by three segments referred to as "end use," "infrastructure," and "production." The end use segment is made up of the industries that convert natural gas and its associated liquids to electricity, petrochemical and other products and the industries that manufacture, sell, install and maintain gas-fired appliances and equipment used in the residential, commercial, vehicle and industrial sectors. The end use segment is the largest of the three with 43.6% of the total jobs. The infrastructure segment— which is made up of gatherers, gas processing, petroleum refining, natural gas distribution, and propane distribution— contributes 31.2% of the 2015 total jobs. The production segment— consisting of oil and gas production companies and their suppliers of goods and services— contributes the remaining 25.2% of 2015 total natural gas value chain jobs.

The distribution of 2015 total jobs by state and by segment is shown in Exhibit ES-3. Texas has the largest number of jobs in total, as well as in each segment, due to the fact it is a large natural gas producer and has a large number of gas-using industries and power plants. California has the second highest number of jobs due to its large population and a manufacturing base that contributes indirect jobs to the production and other segments. All states, including those that do not produce any natural gas, have at least some number of jobs related to (1) the distribution of natural gas and propane, (2) production of intermediate goods used in the three segments, and (3) production of consumer goods and services purchased through induced activity.

Exhibit ES-2: U.S. Jobs, Wages and Value Added by Natural Gas Value Chain Segment for 2015

		Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Segment	**Category**	**Direct & Indirect**	**Induced**	**Total**	**Direct & Indirect**	**Induced**	**Total**	**Direct & Indirect**	**Induced**	**Total**
End-Use	Power Generation	147,857	258,596	406,453	11,419	12,891	24,311	42,395	22,735	65,130
	Industrial	297,763	563,432	861,195	23,354	28,228	51,582	83,885	49,717	133,602
	Residential/ Commercial	163,499	211,665	375,165	10,934	10,946	21,880	38,907	19,123	58,029
	Export	81,532	60,548	142,080	5,965	3,075	9,040	9,076	5,396	14,471
	Transportation	1,751	1,564	3,315	82	81	130	284	146	430
Infrastructure	Processing	86,951	102,342	189,293	7,211	5,296	12,508	17,856	9,327	27,183
	Pipelines	268,373	257,754	526,128	21,702	13,409	35,111	43,793	23,637	67,430
	Distribution	287,063	264,488	551,552	21,992	13,693	35,717	47,079	23,962	71,041
	Wholesalers, Marketers, Other	7,920	7,414	15,333	619	385	1,005	1,296	675	1,971
Production	Natural Gas/ NGLs	609,382	424,129	1,033,510	56,667	21,537	78,204	73,596	37,794	111,390
All Segments	**Grand Total**	**1,952,091**	**2,151,932**	**4,104,023**	**159,946**	**109,541**	**269,486**	**358,167**	**192,510**	**550,677**

Exhibit ES-3: U.S. Natural Gas Value Chain Jobs by State for 2015

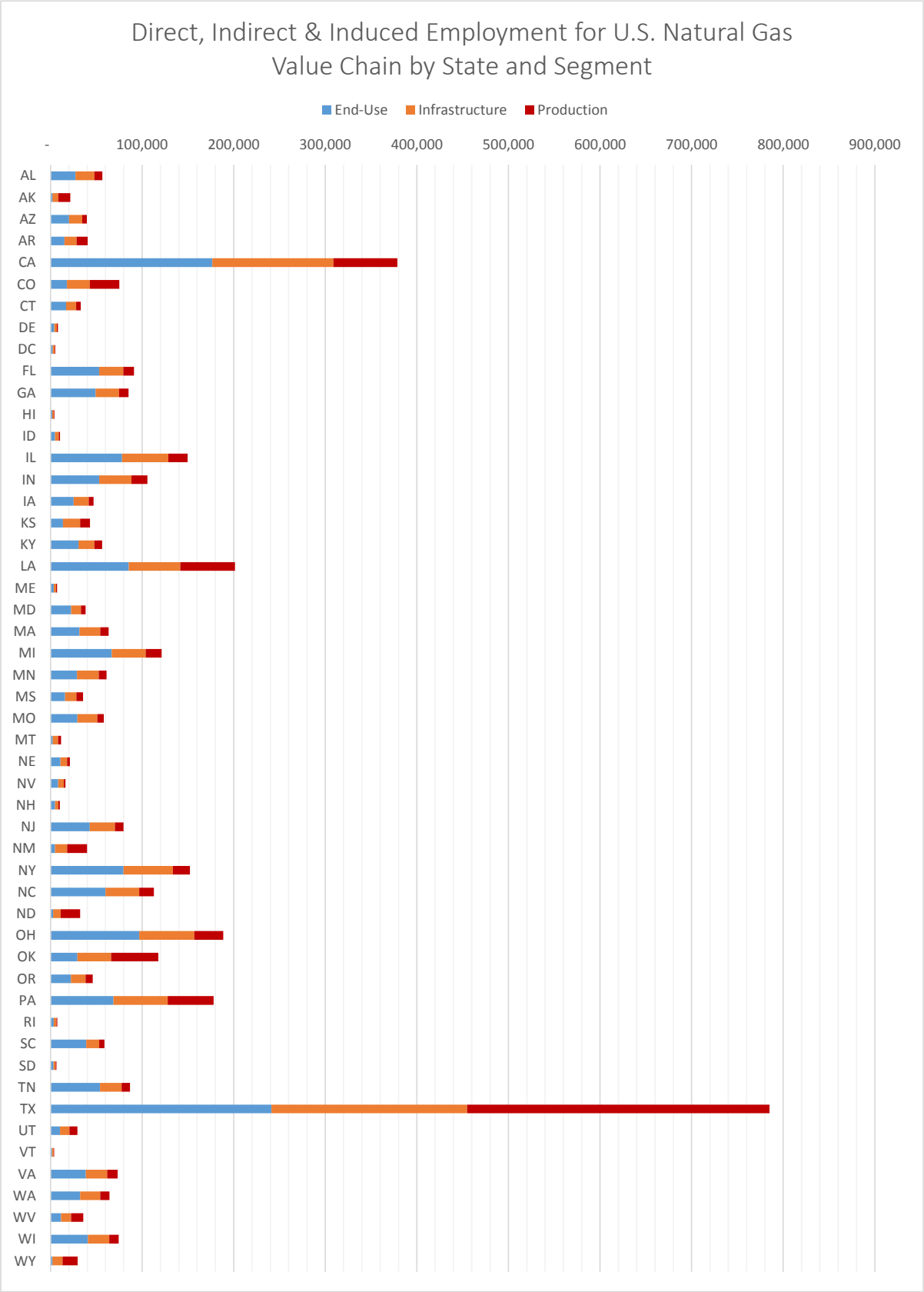


Exhibit ES-4 shows the direct and indirect jobs broken out by 20 North American Industry Classification System (NAICS) codes with the largest job counts. The last column of the table indicates the primary segment of the value chain that each NAICS code represents or supports. In some case the same NAICS code can support two or even all three of the natural gas value chains segments.

Exhibit ES-4: U.S. Natural Gas Value Chain Jobs by NAICS Code for 2015

Rank	NAICS	Industry Sector	Direct and Indirect Jobs	Primary Segment(s)
1	213112	Support Activities for Oil & Gas Operations	134,530	Production
2	325	Chemical Manufacturing	114,505	End-Use
3	237120	Oil & Gas Pipeline Construction	97,220	Infrastructure
4	211111	Crude Petroleum & Natural Gas Extraction	90,579	Production
5	221210	Natural Gas Distribution	84,211	Infrastructure
6	811310	Industrial Equip. & Machinery Repair & Maint.	54,205	All 3
7	236210	Industrial Construction	41,651	All 3
8	213111	Drilling Oil & Gas Wells	33,878	Production
9	4841	Freight Truck	33,515	All 3
10	45431NGL	NGL Retail	27,678	Infrastructure
11	486210	Pipeline Transportation of Natural Gas	23,808	Infrastructure
12	333132	Oil & Gas Field Machinery & Equipment Manufacturing	23,343	Production
13	221112	Gas-fired Electric Power Generation	23,325	End-Use
14	33241	Power Boiler & Heat Exchanger Manufacturing	15,973	End-Use
15	333611	Turbine and Turbine Generator Manufacturing	14,735	End-Use, Infra.
16	331210	Iron & Steel Pipe & Tube Manufacturing	13,759	All 3
17	811412	Household Appliance Repair & Maintenance	13,332	End-Use
18	211112	Natural Gas Liquid Extraction	8,730	Infrastructure
19	333994	Industrial Process Furnace & Oven Manufacturing	7,892	End-Use
20	4821	Freight Rail	7,812	All 3

The largest NAICS codes associated with the end-use segment are Chemical Manufacturing, Gas-fired Electric Power Generation, Power Boiler and Heat Exchanger Manufacturing, Household Appliance Repair and Maintenance, and Industrial Process Furnace and Oven Manufacturing. The end-use segment also includes portions of the jobs related to Industrial Equipment and Machinery Repair and Maintenance, Industrial Construction, Freight Trucks, Turbine and Turbine Generator Set Manufacturing, Iron and Steel Pipe and Tube Manufacturing, and Freight Rail.

The largest NAICS codes primarily associated with natural gas infrastructure are Oil and Gas Pipeline Construction, Natural Gas Distribution, NGL Retailing, and Pipeline Transportation of Natural Gas. The largest NAICS Codes primarily associated with the production segment include Support Activities for Oil and Gas Operations, Crude Petroleum and Natural Gas Extraction, Drilling Oil and Gas Wells, and Oil and Gas Field Machinery Manufacturing.

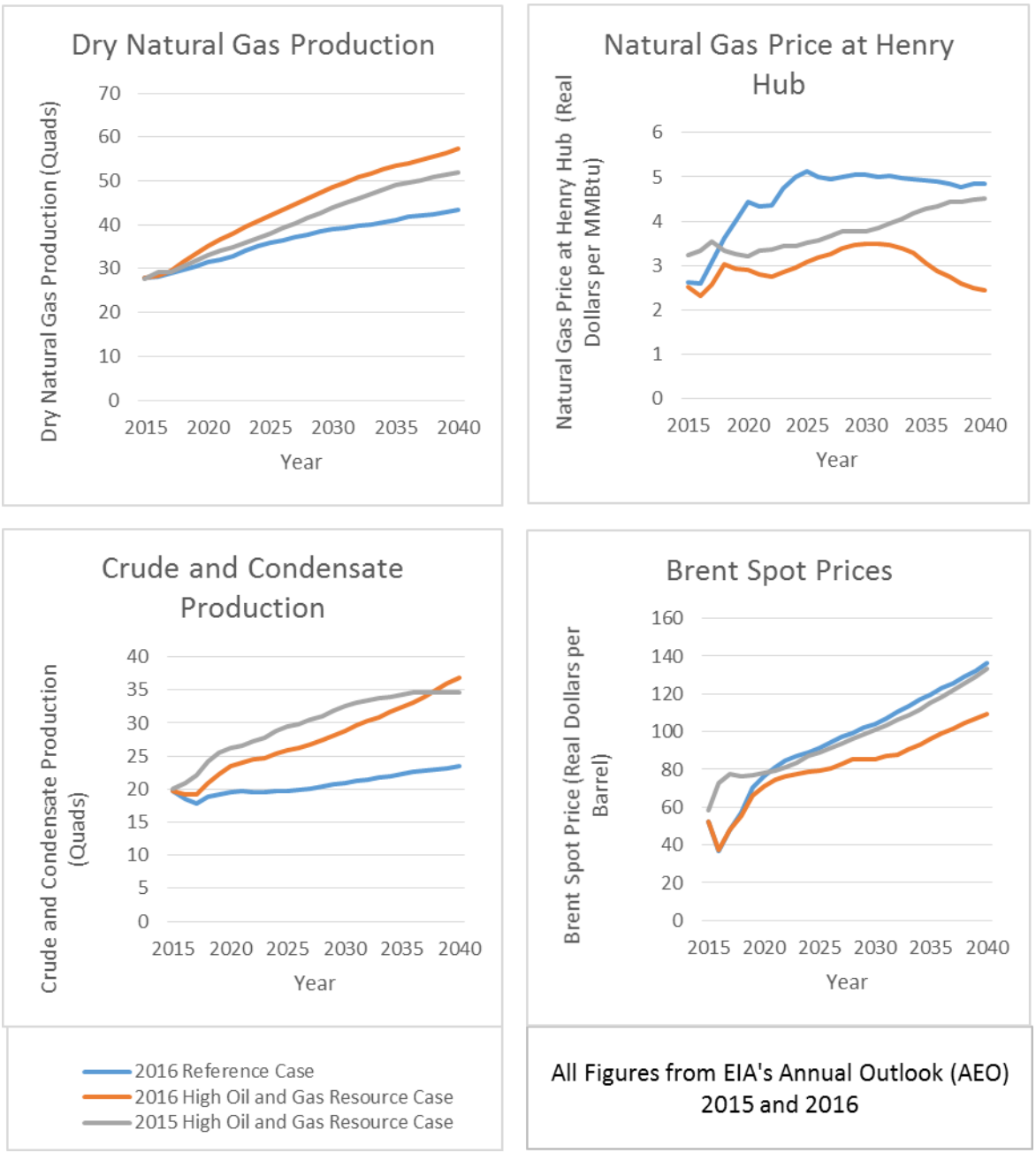
ES-4. Three Economic Scenarios are Used to Project Jobs, Wages and Value Added thru 2040

Future jobs, wages and value added were estimated through the year 2040 based on energy supply, energy demand, and prices for both fuels and electricity contained in three cases produced by the EIA as part of its Annual Energy Outlook[1]. This report uses the 2016 AEO Reference Case, the 2016 High Oil and Gas Resource Case, and the 2015 High Oil and Gas Resource Case. (The 2015 High Oil and Gas Resource Case was included to maintain consistency with prior API reports that used that case and because it has U.S natural gas production that generally falls between the two 2016 cases.) Each of the three cases has projections of future energy consumption (purchased electricity, natural gas, distillate fuel oil, propane, etc.) for residential, commercial, industrial, and power generation customers. The Reference Case assumes resource endowment, demographics, economic growth, and technology improvements that are intended to reflect the central expectations of government and private forecasters. The High Oil and Gas Resource Cases assumes easier access to resources, larger resource endowment and greater upstream technology improvements, all of which contribute to greater production of oil and gas at lower prices in comparison to the Reference Case in the given year.

Exhibit ES-5 shows selected key results of the three cases. The 2016 Reference Case has the lowest U.S. gas production and the highest natural gas prices. The highest U.S. natural gas production and the lowest price are seen in the 2016 High Oil and Gas Resource Cases. The 2015 High Oil and Gas Resource Case falls in between the two 2016 cases in terms of both production and natural gas prices. Because the more optimistic supply-side assumptions in the High Oil and Gas Resource Cases apply to oil and gas exploration and development worldwide, world oil production is greater in those cases and oil prices are lower.

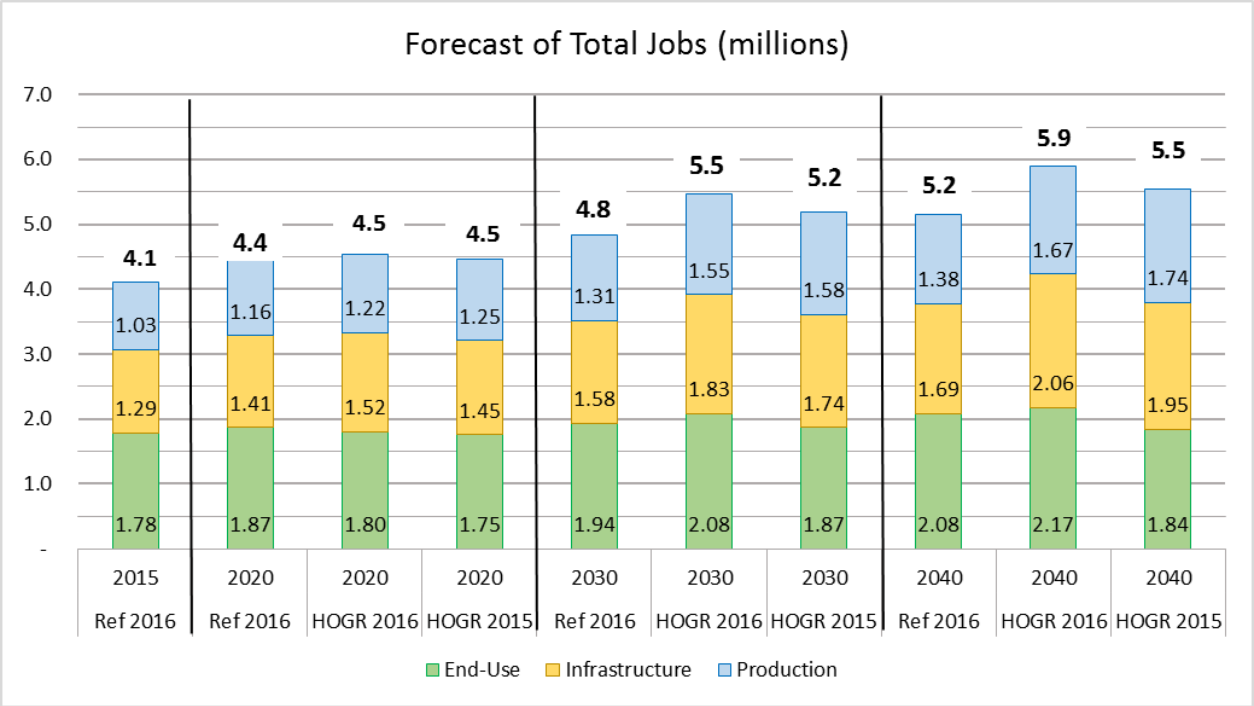
[1] Energy Information Administration (EIA), https://www.eia.gov/outlooks/aeo/

Exhibit ES-5: Key Results from AEO Cases Used in the Study



The ICF estimates for total jobs (direct, indirect and induced) through 2040 are shown in Exhibit ES-6 for the three AEO cases. The growth rate in employment for the Reference Case is 0.91% per year from 2015 to 2040 when total jobs reach 5.15 million. Due to the increased amount of oil and gas produced and consumed in 2016 High Oil and Gas Resource Case, the rate of growth in employment is higher in that case at 1.46% per year. By 2040 there are 0.75 million more jobs compared to the Reference case. The 2015 High Oil and Gas Resource Case falls in between the other two cases with an average growth rate in total employment of 1.21% per year.

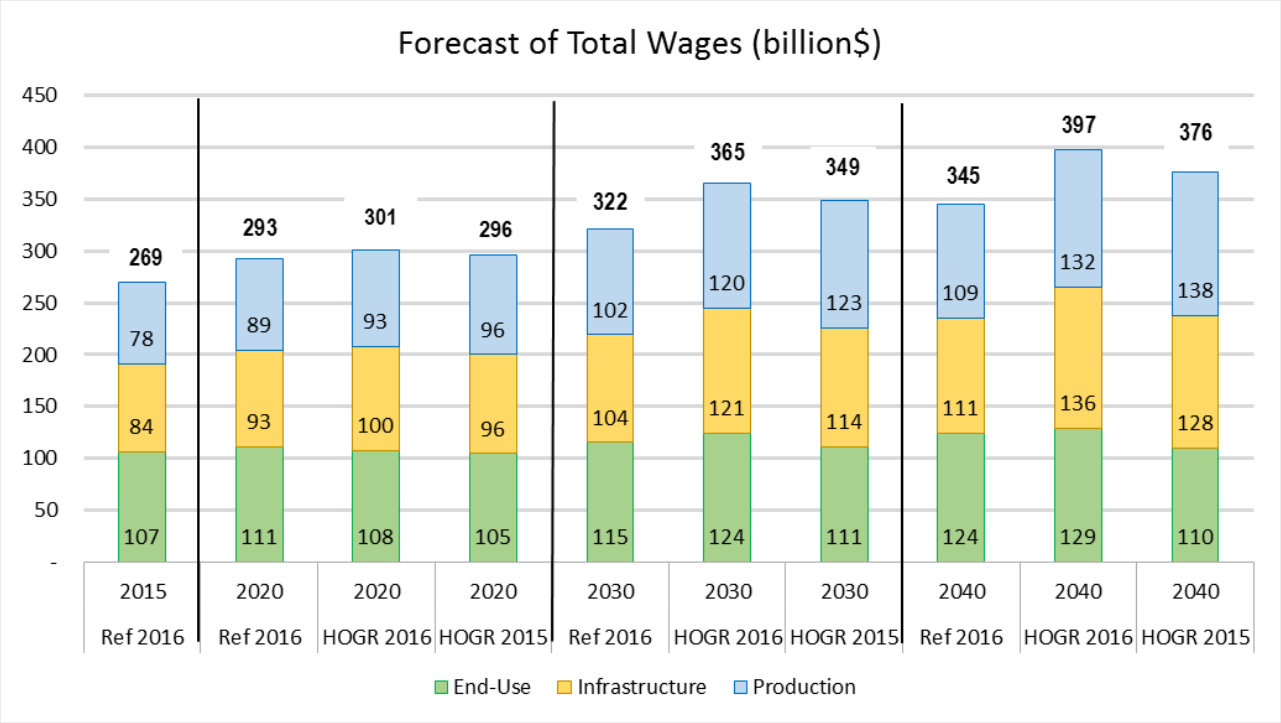
Exhibit ES-6: Forecast of Total Jobs for Three AEO Cases



The rate of growth in jobs related to the end-use segment changes the least among the three cases, with the growth rates being 0.62%, 0.78% and 0.13% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases respectively. There are wider differences among the three cases in the number of jobs and the growth rate in those jobs in the infrastructure and production segments. In the infrastructure segment, the rate of growth in jobs is 1.10%, 1.91% and 1.68% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases respectively. The corresponding growth rates in the production segment are 1.16%, 1.94% and 2.12%.

Exhibit ES-7 shows ICF estimates for direct, indirect and induced wages through 2040 for the same three AEO cases. The patterns for wages are very similar to the patterns shown in the previous chart for employment in that the widest variation among the cases occurs in the production and infrastructure segments and the least variation occurs in the end-use sector. The rate of growth in wages across all segments is 0.99%, 1.57% and 1.34% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases respectively. Wages summed for all segments grow from $269 billion in 2015 to $345 billion in the Reference Case. The 2016 High Oil and Gas Resource Case has 2040 wages of $397 billion and the 2015 High Oil and Gas Resource Case has wages of $376 billion in that year.

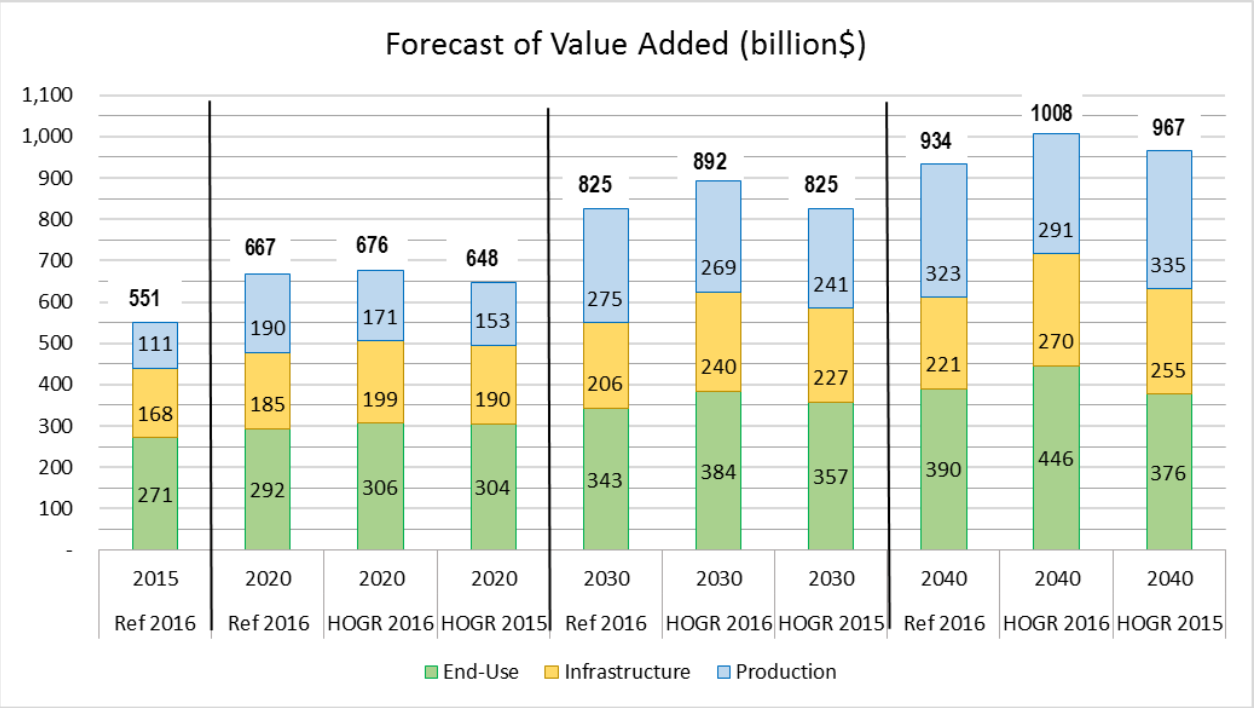
Exhibit ES-7: Forecast of Total Wages for Three AEO Cases



The forecasted direct, indirect and induced value added amounts for the three AEO cases are shown in Exhibit ES-8. Value added for all three segments combined grows from $551 billion in 2015 to $934 billion in the Reference Case, an annual growth rate of 2.14%. The 2016 High Oil and Gas Resource Case has a higher growth rate of 2.45% per year and reaches $1,008 billion by 2040. The 2015 High Oil and Gas Resource Case also grows faster (2.28% per year) than the Reference Case and reaches $967 billion by 2040.

An interesting feature of the value added trends is that the growth in value added in production segment lags behind the growth in oil and gas production volumes. This occurs because the assumptions of more accessible resources and better upstream technologies cause the oil and gas prices and upstream capital expenditures to fall relative to the Reference Case, reducing the potential for value added. This is why the production value added in 2030 and 2040 is lower in the 2016 High Oil and Gas Resource Cases compared to the 2016 Reference Case.

Exhibit ES-8: Forecast of Total Valued Added for Three AEO Cases



ES-5. The Contribution of Natural Gas to U.S. Exports

The natural gas value chain contributes substantially to U.S. exports of commodities. In 2015 gas-related exports totaled over $37.6 billion. This category includes primary hydrocarbons, refined petroleum products, petrochemicals, fertilizers, plastics and resins. Plastics and resins was the most valuable category followed by natural gas liquids and natural gas.

The AEO forecasts due not provide enough detail on international commodity trade to determine what future exports would be for the products shown in Exhibit ES-9. However by looking at the exports of items explicitly accounted for in the AEO cases (e.g. LNG exports) and making reasonable assumptions about other items, one can come up with forecasts that show that exports will grow faster than total value added in the U.S. natural gas value chain. The fastest growth in natural gas value chain exports would be expected in LNG exports and petrochemicals with substantial growth also expected in pipeline natural gas and NGLs. By 2020 the exports of all natural gas value chain items might be 133% to 158% of 2015 export values. By 2030 the natural gas value chain exports might be expected to 190% to 215% of 2015 levels and by 2040 about 232% to 253%. In other words, exports of natural gas value chain items would grow at annual rates of 3.4% to 3.8% per year, while the overall value chain grows between 2.0% and 2.4% per year.

Exhibit ES-9: 2015 Exports of Natural Gas-Related Fuels and Products

Category	Units	2015 Exports Quantity (1000s)	2015 Exports Value "100% Basis" ($1000s)	% NG Value Chain	NG Value Chain Basis ($ 1,000s)
Natural Gas	MMcf	1,784	$5,350,500	100%	$5,350,500
Crude Oil	barrels	169,741	$8,259,597	0%	$0
Pentanes Plus	barrels	66,642	$3,083,525	100%	$3,083,525
Naphtha	Barrels	61,872	$3,569,015	13%	$457,561
Electricity	MWh	9,100	$450,715	33%	$147,395
Organic Chemical	MTs	4,223	$4,236,509	38%	$1,604,171
Fibers	MTs	1,222	$2,749,636	50%	$1,374,818
Nitrogenous Fertilizer	MTs	5,698	$2,391,002	95%	$2,272,871
Refined and Unfinished Petroleum Products	Barrels	930,649	$61,624,631	5%	$3,192,591
Petrochemical	MTs	3,342	$2,422,879	69%	$1,680,229
NGL	Barrels	259,233	$6,744,786	95%	$6,407,547
Misc. Gases	MTs	0.457	$357,965	98%	$351,899
Plastics/Resins	MTs	7,902	$10,403,275	85%	$8,891,361
Misc. Chemicals	MTs	1,114	$1,138,181	50%	$569,091
Rubber, etc.	MTs	2,472	$2,815,815	79%	$2,213,989
Totals		***not meaningful***	***$115,598,031***	**33%**	**$37,597,548**

1. Introduction

1.1 Scope of Study and U.S. Natural Gas Consumption by Sector

This report describes how natural gas and its associated liquids (lease condensate and natural gas plant liquids) contribute both to the U.S. economy and to the economies of all states. The report first presents the economic impacts for the historical year of 2015 and then presents what the future impacts through the year 2040 might be under three scenarios drawn from the Energy Information Administration's Annual Energy Outlook (AEO). The economic impacts presented here include direct, indirect and induced job counts, wages and value added (that is, the contribution to the national GDP).

The overall breakout of natural gas consumption in 2015 is represented in Exhibit 1-1. Across all sectors of the U.S. economy, over 73.5 million customers consumed 27.3 Tcf of natural gas.

Exhibit 1-1: 2015 Natural Gas Consumption by Sector

End Use Sector	Volume of Natural Gas (Tcf) in 2015	Number of Natural Gas Customers (Thousands)
Residential	4.6	67,874
Commercial	3.2	5,449
Industrial	7.5	189
Vehicle Fuel	0.04	2
Electric Power	9.7	2
Lease Fuel	1.2	--
Plant Fuel	0.4	--
Pipeline and Distribution Use	0.7	--
Total Consumption	**27.3**	**73,516**

Source: Natural Gas Annual 2015, EIA.

1.2 Definition of the U.S. Natural Gas Value Chain

This report defines the natural gas value chain as beginning with the production of natural gas and associated liquids from domestic gas and oil wells. The value chain continues through gas gathering and gas processing, as well as gas transmission and distribution systems. For liquids produced in association with natural gas, the value chain includes transportation, refining and distribution to end users.

In addition to defining the traditional value chain as including the delivery of natural gas and associated liquids to end users, this report extends the value chain "all the way through consumption" to include the economic activity of converting the natural gas or liquids to other products and useful energy services. In the power generation sector where natural gas is converted to electricity this means that the jobs and value added impacts of building and operating gas-fired power plants are counted as part of the natural gas value chain.

Likewise, the uses of natural gas and its associated liquids as feedstocks in the petrochemical industry to make primary bulk chemicals (most importantly ammonia, methanol and olefins) and the further processing of those primary bulk chemicals into derivative chemical products are similarly defined to be part of the natural gas value chain. Therefore, the jobs and value added associated with building and operating such petrochemical facilities is counted as part of the natural gas value chain through what is called here the "n^{th} petrochemical". However, the use of an "n^{th} petrochemical" (e.g., plastics, resins, fertilizers and fibers) to manufacture final consumer or intermediate products is not counted here as being part of the natural gas value chain.

Much of the natural gas consumed in the U.S. is directed toward end-use applications where natural gas or associated liquids are used in appliances and equipment to provide steam, industrial process energy, hot water, space heat, cooking and other services. For these "combustion uses," the value chain is defined as the manufacturing, installation and maintenance of those appliances and equipment.

Natural Gas for Combustion Uses

Natural gas is used extensively for many residential, commercial, and industrial processes and applications. Natural gas combustion occurs in a wide variety of appliances and equipment including boilers, furnaces, stoves, ovens, gas turbines and engines.

In the residential sector, the largest portion of natural gas use is for space heating, followed by water heating, cooking, clothes drying, fireplaces, gas lighting and space cooling with absorption chillers. Space heating use varies by state as natural gas is used more prevalently in colder climates. Commercial sector applications of natural gas are distributed among multiple uses including space heating, water heating, cooking, cogeneration and space cooling. The largest use of natural gas by the commercial sector is attributable to space heating of offices, health care facilities, education institutions, hotels/motels, and warehouses[2]. In the industrial sector the most substantial use of natural gas is for process heating and boilers. Process heating includes direct (non-steam) heating to transform the state or chemical properties of some item or material. Industrial direct heating can include melting, heat treating, cooking, baking, fluid heating, and direct drying. Another important use of natural gas is steam production in boilers

[2] http://www.c2es.org/technology/factsheet/natural-gas

and combined heat and power systems. Natural gas is also used for space heating of industrial buildings.

Natural Gas for Feedstock Uses

Natural gas is an important feedstock across several industries including chemicals, industrial gases, refining, primary metals and food. Natural gas is primarily converted into hydrogen and then subsequently utilized in downstream reactions to make ammonia, methanol and other chemicals and products.

Natural Gas for Electricity Generation

Natural gas is converted into electricity in the power sector using several technologies; these include combined cycle units (a gas turbine plus waste heat recovery boiler plus a steam turbine), simple cycle gas turbines, and (in old power plants only) boilers with steam turbines. In addition to the power sector, natural gas is also used to make electricity in the industrial and commercial sectors, predominantly in cogeneration applications where hot water or steam is most often produced concurrently with the electricity.

Uses of Associated Liquids

The liquids produced with natural gas include lease condensate (a hydrocarbon liquid sometimes called natural gasoline that is separated from “wet” natural gas near the wellhead) and natural gas plant liquids (consisting of ethane, propane, butanes and pentanes plus that are separated at gas processing plants to produce “dry” natural gas that can be transported in pipelines). The lease condensate is usually refined at petroleum refineries (along with crude oil and other feeds) and makes its way into various finished petroleum products and petrochemical feedstocks. The gas plant liquids have a variety of uses, including as petrochemical feedstocks and fuel. Natural gas liquids used as feedstock are primarily made into olefins (ethylene, propylene and butylene) and their derivative chemicals. The mostly widely used NGL for fuel is propane, which is consumed in the residential, commercial and industrial sectors for space heating, water heating, cooking, crop dying, vehicle fuel and other uses.

1.3 U.S. Natural Gas Value Chain Includes Only Domestic Gas Sources

The U.S. natural gas value chain is defined in this report to include only the use of domestically produced natural gas and its associated liquids. As is illustrated in Exhibit 1-2, this means that jobs and value added figures attributable to the consumption of imported natural gas are not counted. Similarly, imported primary bulk chemicals (such as methanol) that are converted to derivative products by the U.S. chemical industry are also not counted as part of the domestic natural gas value chain.

Exhibit 1-2: Concept of U.S. Natural Gas Value Chain as Used in This Report

Source	Petroleum Resource	Part of U.S. Natural Gas Value Chain?
U.S. Oil Wells	Crude Oil	No
U.S. Oil Wells	Dry Natural Gas	Yes
U.S. Oil Wells	NGLs & Other Gas Plant Products	Yes
U.S. Gas Wells	Condensate	Yes
U.S. Gas Wells	Dry Natural Gas	Yes
U.S. Gas Wells	NGLs & Other Gas Plant Products	Yes
Imported Natural Gas	Natural Gas	No
Imported Crude & Condensate	Crude & Condensate	No
Imported Petrochemicals	Petrochemicals	No

In order to be able to compute the portion of jobs, wages and value added that is attributable to domestic natural gas, it is first necessary to compute those same economic measures for the entire relevant industry regardless of whether natural gas (as opposed to crude oil or petroleum products) – or specifically regardless of whether domestic natural gas— was used for all energy and feedstock inputs. When this is done in this report the label “100% Basis” will appear on the relevant tables and chart to indicate all U.S. activity related to converting oil, gas and NGL into chemical products, electricity, LNG or other energy services, regardless of the origin of the primary feedstock or intermediate petrochemical. These “100% Basis” results will be directly comparable with many industry and government statistical reports (wherein the origin of the fuel/feedstocks is seldom relevant).

In summary, most charts and tables in this report will show results for the “U.S. Natural Gas Value Chain Basis” or “NGVC Basis” and will present only the economic impact measures of U.S. activity that can be traced back to domestic natural gas feedstocks and fuels (dry gas, lease condensate and NGLs). In some instances, charts and tables will also be presented on a “100% Basis” to show the same sort of economic measures for all activity, regardless of the origin of the fuel/feedstock.

2. General Discussion of Methodology

2.1 Base Year Economic Impacts

The first part for this study estimates the economic activity in the U.S. natural gas value chain for 2015, the latest year for which a complete set of necessary statistics could be compiled and analyzed. The seven steps taken to estimate the base year figures were as follows:

Step 1: ICF compiled statistics from the Energy Information Administration and other sources on the production of the relevant hydrocarbons (dry natural gas, natural gas plant liquids and lease condensate) in each state. Then, using EIA and private sources of energy price data such as Bloomberg,[3] ICF estimated the wellhead prices and total dollar values of those hydrocarbons.

Step 2: Using a variety of data sources, ICF traced the use pathway for each hydrocarbon as it is gathered, processed, transported and distributed to domestic customers and for export. For natural gas this involved using EIA Form 176[4], filed by companies (primarily local distribution companies and gas pipelines) delivering gas to consumers, and FERC Form 2, filed by gas pipeline companies. For liquids this involved using FERC Form 6, filed by crude oil and refined petroleum product pipelines; the Surface Transportation Board Waybill data for railroads; and transportation data and modeling information from the Bureau of Transportation Statistics and the Federal Highway Administration.[5] ICF determined how much value is added in each step.

Step 3: Next ICF determined how much of the natural gas and associated liquids are used by customers within major end use applications (e.g. producing domestic hot water). The major source of information on energy consumption by end use came from the various surveys conducted by the Department of Energy, which records energy usage in the residential, commercial, industrial and power sectors.

Step 4: For industrial feedstock and power generation end uses wherein the natural gas and liquids are converted to other products, ICF traced these conversion pathways and estimated the value added at each conversion step. For petrochemicals, this step required the use of stoichiometric calculations to balance the inputs and outputs of various chemical processing steps using chemical production data from industry sources including the American Chemistry Council and international trade data from the federal government.

Step 5: For residential, commercial, vehicle and industrial applications where the natural gas or liquids are used in appliances and equipment, ICF determined value added through the manufacture, sales, installation and maintenance of those appliances and equipment. Data for this step primarily came from trade association sales data for appliances and federal government data on industry shipments and international trade.

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[3] For information on the Bloomberg Terminal see https://www.bloomberg.com/professional/
[4] The query system for EIA 176 can be found at https://www.eia.gov/cfapps/ngqs/ngqs.cfm?f_report=RP1
[5] The Freight Analysis Framework (FAF), produced through a partnership between Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA), integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. See: http://faf.ornl.gov/faf4/Extraction1.aspx

Step 6: ICF compiled Bureau of Labor Statistics (BLS) job and wage statistics for the relevant industries and using input/output analysis determined how many of those jobs and what portion of wages could be attributed to domestic natural gas and its associated liquids. This analysis includes both the industry sectors that are links in the natural gas value chain and those industries that supply intermediate goods and services to the links. Economists sometimes refer to this combination as "direct and indirect" jobs, wages and value added.

Step 7: Using the IMPLAN model, ICF estimated what economics considers "induced" jobs, wages and value added: that which is produced when the income earners in the direct and indirect sectors spend their income. The sum of "direct and indirect" plus "induced" jobs, wages and value added are referred to as "total" jobs, wages, and value added.

Many of the aspects of these steps are discussed in the coming chapters, when base year data for each link of the value chain is further explored.

2.2 Estimation of Jobs and Wages

Estimates for jobs and wages related to the natural gas value chain were made using data from both the Bureau of Labor Statistics' Quarterly Job and Wage Report[6] and input-output relationships developed with the Impact Analysis for Planning (IMPLAN)[7] model of the U.S. economy. This input-output (I-O) model is based on a social accounting matrix that incorporates all flows within the U.S. economy and is used to assess the aggregate economic impacts associated with a given level of an industry's output. For example, natural gas production requires oil and gas drilling and support services, equipment, and materials. Those direct impacts will lead to indirect impacts as intermediate inputs for those items (e.g., steel production to make casing and iron mining to make steel) also will see higher demand. The IMPLAN model also estimates induced impacts due to consumers' expenditures rising due to higher household incomes that are generated by the direct and indirect effects flowing through to the general economy. The term "induced impacts" is used in industry-level input-output modeling and applies to similar scenarios as does calculation of the Multiplier Effect used in macroeconomics.

These I-O relationships can be extracted into matrices that indicate the number of direct and indirect jobs in sector X per million dollars of output in sector Y. A matrix can also be defined as the number of direct and indirect jobs in sector X per physical unit of output in sector Y. Similar matrices can be constructed showing the value added in sector X per million dollars or per unit of production in sector Y. By multiplying these matrices by a base year or forecast year level of output in sector X (that is to say a given level of capital or O&M expenditures that lead to that sector X output) direct, indirect and induced jobs and wages can be estimated.

[6] For information of the Quarterly Census of Employment and Wages (QCEW) see https://www.bls.gov/cew/home.htm
[7] For more information on IMPLAN see http://www.implan.com/

Direct Impacts represent the immediate impacts (e.g., employment or output changes) in Sector X due to greater demand for and output from Sector X.

Indirect Impacts represent the impacts outside of Sector X in those industries that supply or contribute to the production of intermediate goods and services demanded by Sector X.

Induced or "Multiplier Effect" Impacts represent the cumulative impacts of the spending of income earned in the direct and indirect sectors and subsequent spending of income in each successive round. Examples include a restaurant worker who takes a vacation to Florida, or a store owner who sends children to college, based on higher income that arises from the initial activity in Sector X.

Data provided in this report for 2015 jobs and wages at a state level generally come directly from the BLS. The exception is that in some cases the BLS withholds data to preserve proprietary information, mostly in states where the number of companies in an industry is small. In those cases ICF had to estimate jobs and wages using alternative government or private data sources.

2.3 Calculation of Value Added

The level of output in an industry is often measured in terms of "value of shipments" and "value added." Value of shipments is the total value (price *x* quantity) of what an industry produces in terms of goods or services. Value added can be computed as value of shipment minus the value of imported intermediate goods and services (all along the supply chain) and is a measure of contribution to Gross Domestic Product (GDP). Calculating the value added to the U.S. economy in this way differs from calculating value added of just one specific industry whereby the costs of the intermediate goods and services are deducted whether imported or domestic. On the other hand, the value added for the aggregate GDP includes domestic intermediate goods and services (all along the supply chain) because they also are part of U.S. GDP, and so, only imported intermediate goods are subtracted.

The convention used in this report is to estimate the value added associated with capital stock in the year in which the capital expenditures are made. In this way the value added (GDP contribution) occurs in the same years as are the jobs associated with the construction of the capital stock and the mining and manufacturing of materials and equipment used in the capital stock. To avoid double counting of the GDP contribution from the capital stock, depreciation of the capital stock is subtracted when production occurs. More specifically, the equation used to estimate value added in given year is:

$$\textit{Value Added}_{i,t} = \textit{Value of Shipments}_{i,t} - \textit{Imported Intermediate Goods}_{i,t} - \textit{Depreciation}_{i,t} + \textit{Capital Expenditures}_{i,t} - \textit{Imported Capital Goods}_{i,t}$$

Where:

Value Added$_{i,t}$ = the contribution of industry i to the U.S. GDP in year t.

Value of Shipments$_{i,t}$ = the total revenue received for goods and service produced by industry i in year t.

Imported Intermediate Goods$_{i,t}$ = the value of goods and services imported to U.S. for foreign countries for materials, feedstocks, operations and maintenance in year t.

Depreciation $_{i,t}$ = the cost of prior year's capital investments (which were counted in prior year's GDP) that must be subtracted to avoid double counting.

Capital Expenditures $_{i,t}$ = new capital investment made in year t.

Imported Capital Goods $_{i,t}$ = foreign purchases of goods and services used in new capital investment made in year t.

This method of calculating value added is different from what might be done by the Department of Commerce or other sources for a given industry in that we are adding in the value added by domestic intermediate goods (other than fuels and feedstocks). Our method is also different in that we count capital expenditures in the year in which they are made (so that they will align year-by-year with related construction and capital good jobs) and (to avoid double counting) remove annual depreciation. Conceptually, the method used in the this study should over time yield the same total value added as the Department of Commerce method, but might differ either in terms of which industry for which the value added is counted or in terms of the annual pattern.

3. Natural Gas and Natural Gas Liquids Supply and Delivery Value Chain Links

This chapter presents base year information for each link in the supply chain from the production of natural gas and associated liquids to the delivery of those products to the end users. Producers who own the gas and associated liquids will sell those products somewhere along the value chain either to end users or to marketers, who in turn will sell them to another marketer/distributor or to an end user. Either the producer or the buyer of the gas will pay gathering, processing, transmission, and distribution service fees. As the natural gas and liquids move toward the end users, the market price of the gas goes up to reflect these fees. In other words, there is value added – contributions to the GDP— at each step.

3.1 Production

In the production sector, hydrocarbons are extracted through wells from reservoirs that are typically thousands of feet under the earth's surface. Hydrocarbons are under pressure in the reservoir and this energy is typically sufficient for hydrocarbons to flow to the surface of the well. The hydrocarbons are a mixture of gases, typically referred to as wet natural gas, and liquids consisting of complex-chain hydrocarbons. Liquid hydrocarbons are typically distinguished as being crude oil or condensate depending on the viscosity of the liquid. (More viscous liquids are referred to as crude oil and less viscous liquids are referred to as lease condensate or, simply, condensate.) Wells that primarily produce crude oil along with some natural gas are referred to as crude oil wells, and natural gas from these wells is referred to as "associated" or "associated-dissolved" natural gas. On the other hand, wells that primarily produce natural gas, possibly along with lease condensate, are referred to as natural gas wells.

Wet natural gas from gas and oil wells primarily consists of methane, but can also contain varying amounts of other hydrocarbon gases (such as ethane, propane, butanes, and pentanes plus), nonhydrocarbon gases (such as helium, nitrogen, and carbon dioxide) and water. This natural gas is referred to as "wet" natural gas when it has substantial quantities of non-methane hydrocarbon components. Some of the liquids produced in association with natural gas are separated from the gases near the wellhead in lease separators using gravity and the pressure differential. The natural gas that is separated is then sent to a dehydrator to extract any entrained water that was not separated in liquid form in the separator. The natural gas is finally metered and transported to gas processing plants through the gathering system.

There were 555,364 natural gas wells and 215,867 natural gas producing oil wells operating in 2015. As shown in Exhibit 3-1, these wells collectively produced 32.9 Tcf of raw, wet natural gas in that year. Gathering systems transported about 29.2 Tcf of this produced gas, as some of the produced natural gas either was reinjected for reservoir re-pressurization or was vented or flared. The EIA Natural Gas Annual is the source of this report's disposition of all streams of natural gas used to balance the various supplies and deliveries. Natural gas prices come from a combination of private price survey sources, including Bloomberg, SNL Energy and EIA. For example, the value of produced dry natural gas delivered to transmission pipelines is calculated in this study as the amount of natural gas delivered to pipelines (as reported by EIA) times the

average delivered-to-pipeline price as reported in private price surveys like Bloomberg[8] and SNL Energy.[9]

Exhibit 3-1: Natural Gas Balance from Wellhead to Pipeline Delivery

Natural Gas Stream	Volume (Bcf)	Price ($/Mcf)	Billion Dollars
Wet Gas Production	32,895		
Re-pressuring and Vented & Flared Volumes	3,689		
Wet Gas Production (excludes value of NGLs)	29,205	$1.78	$52.01
Gathering of Wet Gas Production	29,205	$0.30	$8.76
Processing of Wet Gas Production	20,626		
Nonhydrocarbon Gases Removed at Processing Plants	452		
Gases Removed at Processing Plants to Produce NGL (shrinkage)	1,693		
Dry U.S. Production	27,060		
Lease Use	1,153		
Plant Use	434		
U.S. Prod Delivered to Pipeline	**25,473**	**$2.39**	**$60.78**

ICF estimates based on EIA volume data and private survey price data for natural gas.

Total upstream industry revenues in 2015 are shown in Exhibit 3-2 along with production volumes. Total 2015 revenues (including royalties and severance taxes) were $213.24 billion dollars, the largest components of which was crude oil which had gross revenues of $132.86 Billion. The components that make up the natural gas value chain (dry gas, lease condensate and gas plant liquids) had a wellhead value of $80.38 billion, or 37.7% of all wellhead revenues.

[8] https://www.bloomberg.com/professional/
[9] http://www.snl.com/marketing/microsite/EnergyCommodities/index.html

Exhibit 3-2: U.S. Upstream Revenue 2015

Product/ Service	Fraction Counted toward U.S. NG Value Chain	Production Volume	Volume Units	Valuation Concept	Gross Wellhead Revenue ($billions)
Crude Oil	0.0%	3,118	Million barrels	wellhead value	$132.86
Lease Condensate	100.0%	323	Million barrels	wellhead value	$13.76
Dry Natural Gas	100.0%	27,059	Bcf	wellhead value	$52.01
Natural Gas Liquids (other plant products appear only under gas processing)	100.0%	1,202	Million barrels	value of shrinkage for NGLs + processing gains kept by producers	$14.60
Total	**37.7%**	**9,012**	**Million BOE of hydrocarbons**	**wellhead value**	**$213.24**

ICF estimates based on EIA volume data, EIA pricing data for crude oil and private survey price data for natural gas and NGLs.

Upstream Oil and Gas Capital Expenditures

The upstream sector is usually thought to represent not only oil and gas producers, but also the service companies that provide them with drilling, completion, hydraulic fracturing, cementing, geophysical survey, wireline, and other services needed to drill and operate oil and gas wells. Other industries that provide substantial volumes of materials, equipment and services to oil and gas producers include oilfield equipment, pipe & tube manufacturing, and the iron and steel industry, as well as the ship building, industrial sand, sand & aggregates, cement, rail transportation and trucking industries.

Total capital expenditures in the U.S. by oil and gas producers (excluding land acquisition cost and the cost of buying either producing properties or other companies) for the last several years are shown in Exhibit 3-3. The recent peak in expenditures was $186.6 billion in 2014, which was followed by a decline in expenditures in 2015 and 2016 after the drop in oil prices in the Fall of 2014.

Exhibit 3-3: U.S. Upstream Capital Expenditures on Wells and Equipment 2010 to 2016 ($billions)

Type of Expenditure	2010	2011	2012	2013	2014	2015	2016
Onshore Oil and Gas Drilling & Completion	72.4	118.6	140.0	136.4	153.8	113.7	56.9
Offshore Oil and Gas Drilling & Completion	6.3	6.2	8.8	11.3	15.0	9.1	2.9
Onshore Lease Equipment	4.8	6.2	7.1	7.1	7.3	4.4	2.2
Offshore Platforms, etc.	10.2	10.5	10.9	15.0	15.8	12.6	12.3
Total Upstream	93.7	141.5	166.8	169.8	191.9	139.8	74.3

ICF estimates based on company financial reports, API Quarterly Well Completion Report and API Joint Association Survey of Drilling Costs and Department of Census capital expenditure surveys.

In this study's base year of 2015, upstream capital expenditures on drilling and equipping wells were estimated to be $139.8 billion. The largest portion of expenditures is related to onshore oil and gas wells, for which $113.7 billion was spent on drilling and completing and another $4.4 billion was spent on onshore lease equipment (flow lines, separators, meters, dehydrators, tanks, etc.). An approximate breakout of costs for drilling and completing onshore wells is shown in Exhibit 3-4. The largest cost category, representing about 40% of expenditures, is for oil and gas support services; this category includes cementing, well completion, hydraulic fracturing, wireline and other geological and geophysical surveys. The second largest category is drilling services, which is computed here to represent 12% of costs. This category includes rig day rates, tool rentals and rig fuel. Frac sand (7.1%) and oil country tubular goods (6.4%) are the next largest categories. The construction of roads, drilling pads and site remediation are about 4.6% of costs and the trucking of equipment and materials to and from the drill site is about 4.0%.

Exhibit 3-4: Breakout of Drilling and Completion Costs for Onshore Wells 2015

Cost Category	$ billion in 2015	Percent
Support Services (wireline, other geological & geophysical, cementing, hydraulic fracturing, etc.)	46.0	40.4%
Drilling Services (rig day rates, tool rentals, rig fuel)	13.7	12.0%
Frac Sand and Other Proppants	8.1	7.1%
Oil Country Tubular Goods	7.3	6.4%
Road and Pad Construction, Site Remediation	5.3	4.6%
Trucking Services (rig mobilization, materials, water, etc.)	4.5	4.0%
Completion & Frac Chemicals and Gases	2.9	2.5%
Water and Water Treatment, Recycling, Disposal (excluding trucking which is listed separately)	2.5	2.2%
Cement	2.0	1.8%
Other Costs (solid waste disposal, legal assistance, environmental surveys and consultants, permits, insurance, lodging, food, etc.)	6.6	5.8%
Engineering, Supervision, Overhead	14.8	13.0%
Total	**113.7**	**100.0%**

Source: ICF estimates

Capital spending in 2015 for offshore field development included $9.1 billion for drilling and completing wells and $12.6 billion spent on production platforms and various topside and subsea production equipment and flowlines. A breakout of typical costs for deepwater oil field development is shown in Exhibit 3-5. This example is for an oil field that would produce 50,000 barrels of oil equivalent per day of crude oil and natural gas from a floating production platform with seven subsea wells. Total development costs for the field would be about $1.6 billion, or about $32,000/boe/day. Of this amount, steel and other materials and topside equipment amount to $234 million, fabrication costs for the platform and topsides are $320 million, spending on wells and subsea production equipment and flowlines is $833 million, and the remaining $212 million is allocated for supervision, engineering, hook-up, and commissioning.

Exhibit 3-5: Example Cost Components for a Gulf of Mexico Deepwater Field Development

Cost Category	Count	Units of Measure	$/Unit	Cost $million)	Cost in $/boe/day	As % of Costs
Steel for Topside	28,000	metric tons	$700	$20		1.2%
Steel for Platform, etc.	27,000	metric tons	$700	$19		1.2%
Other Materials				$77		4.8%
Topside Equipment	50,000	boe/day	$2,000	$100		6.3%
Packing & Shipping		% of M&E	8.5%	$18		1.1%
Delivered Materials & Equipment				**$234**	**$4,676**	**14.6%**
Fabrication of Topsides	28,000	metric tons	$4,000	$112		7.0%
Fabrication of Platform, etc.	27,000	metric tons	$2,500	$68		4.2%
Fabrication and Integration Management		% of fab.	30.0%	$54		3.4%
Certification & Surveys		% of fab.	3.0%	$5		0.3%
Transport & Installation		% of fab.	45.0%	$81		5.1%
Fabrication, Transport, Installation				**$320**	**$6,390**	**20.0%**
Well Count	7	wells				
Well Measured Depth	16,000	feet/well				
Drilling and Completion Costs		$/foot	$4,000	$448		28.0%
Subsea Templates, Wellheads, BOP, etc.		$million/well	$30	$210		13.1%
Subsea Umbilicals, Risers, and Flowlines		$million/well	$25	$175		10.9%
Total Well D&C and Equipment				**$833**	**$16,660**	**52.1%**
Home Office Engineering and Supervision	1,000,000	labor hours	$110	$110		6.9%
Consulting Engineering	200,000	labor hours	$130	$26		1.6%
Engineering and Supervision				**$136**	**$2,720**	**8.5%**
Hook Up & Commissioning		% of above	5.0%	**$76**	**$1,522**	**4.8%**
Total Costs				**$1,598**	**$31,969**	**100.0%**

Source: ICF estimates based on reported operator costs.

3.2 Gas Gathering

The distance between wells varies significantly from site to site. Two to 16 or more wells can be located on the same well pad. In other cases, adjacent wells can be more than a mile apart. A gathering system consists of a network of pipelines operating with pressure between 25 and several hundred psi per square inch gauge (psig) that collects natural gas from production wells. A gathering system will often collect hydrocarbons from dispersed wells to a central gathering site, where natural gas is separated from liquids and dehydrated. The gathering site also consists of tank batteries to store the condensate or crude oil for transportation to a gas processing plant or refinery, respectively. The natural gas is still considered wet at this stage because it contains trace amounts of water and higher chain hydrocarbons that need to be extracted from the natural gas at a gas processing plant.

Often, well sites are located at a significant distance from the nearest gas processing plant. Hence the gas pressure is not sufficient to carry it all the way from the gathering well site to the processing plant. In such cases the gathering site also will include natural gas compressors to boost the pressure of the gas to a level sufficient to push it all the way to the gas processing plant. Depending on the distance between the plant and the gathering site, boosting of the gas pipeline pressure may be required multiple times along the way.

The net volume of wet natural gas produced multiplied by the service fee charged by gathering companies provides an estimate of service revenue for gathering companies. The Texas Railroad Commission reports an average 24 cents per Mcf gathering fee in Texas. Nationally there are several new gathering systems operational, for which the service fee is expected to be higher. Therefore, ICF assumed the standard gathering fee to be 30 cents per Mcf for this study. The difference between the value of dry natural gas delivered to pipelines and the gathering service fee provides an estimate of value of dry natural gas produced. This dry natural gas value does not include the value of NGLs, crude helium, sulfur, or lease condensate. Total gas gathering fees in 2015 are estimated to have been $8.8 billion (see Exhibit 3-1).

There are no official data reported on the total number of gathering systems and gathering system mileage operating across the U.S. However, ICF estimated that over 396,000 miles of gathering pipelines operated in 2015. Exhibit 3-6 shows the number of miles of natural gas gathering line estimated to exist in each state in 2015. These are ICF estimates made by analyzing the geographic distribution of gas wells and oil wells that coproduce natural gas.

Exhibit 3-6: Gas Gathering Miles by State 2015

State	Miles of gas gathering line		State	Miles of gas gathering line
Alabama	3,475		Montana	6,985
Alaska	292		Nebraska	501
Arizona	16		Nevada	1
Arkansas	4,874		New Hampshire	0
California	3,337		New Jersey	0
Colorado	14,579		New Mexico	20,699
Connecticut	0		New York	5,495
Delaware	0		North Carolina	0
DC	0		North Dakota	7,536
Florida	35		Ohio	24,066
Georgia	0		Oklahoma	48,138
Hawaii	0		Oregon	27
Idaho	0		Pennsylvania	26,536
Illinois	0		Rhode Island	0
Indiana	0		South Carolina	0
Iowa	0		South Dakota	183
Kansas	17,553		Tennessee	861
Kentucky	9,833		Texas	133,136
Louisiana	13,640		Utah	5,442
Maine	0		Vermont	0
Maryland	6		Virginia	2,782
Massachusetts	0		Washington	0
Michigan	2,491		West Virginia	22,825
Minnesota	0		Wisconsin	0
Mississippi	1,628		Wyoming	19,702
Missouri	0		**NATIONAL TOTAL**	**396,674**

Source: ICF estimate for gathering lines based on GIS analysis of wells

Capital Expenditures for Gas Processing

Capital costs for new gathering lines in 2015 were approximately $4.2 billion. The breakout of recent capital costs by category is shown in Exhibit 3-7. The majority of costs are for the gathering line itself followed by compressors.

Exhibit 3-7: Breakout of Typical Gas Gathering System Capital Costs

Typical CAPEX Mix for Natural Gas Gathering	
Gathering Line	75.6%
Field Compressors	14.3%
Measurement & Control Equipment	7.6%
Gas Treatment Equipment	1.5%
ROW, Land & Land Rights	1.0%
Total	**100.0%**

Source: Gas gathering systems reporting under FERC Form 2.

3.3 Gas Processing

The natural gas put into a pipeline and sent to end users has to be of "pipeline quality" so that it can be transported in the pipeline without causing damage or poor performance and can be safely and cleanly used in customers' combustion devices without malfunction. Pipeline quality gas primarily contains methane (typically 95 percent), carbon dioxide (1-2 percent), and small amounts of other hydrocarbons, such as ethane, propane, butane, and pentanes plus (collectively 3 – 4 percent). Natural gas processing plants perform two primary functions – to condition the gas to meet pipeline quality specifications and to separate high-value hydrocarbons (ethane, propane, butane, and pentanes plus) – and helium when it is present – from the primarily methane-composed gas.

There are over 500 natural gas processing plants in the U.S. with a combined annual throughput of over 21 Tcf. These gas processing plants remove water through dehydration and extract natural gas liquids (NGLs) using refrigeration and expansion of natural gas under pressure. The NGLs are separated into individual components using fractionation. Fractionation is also used to separate nitrogen and helium from the methane rich natural gas. Any carbon dioxide in the methane rich natural gas stream is removed using an acid gas removal process such as an amine unit. Finally, any hydrogen sulfide in gas is extracted and, when it is found in high concentrations, converted into elemental sulfur, typically using the Klaus process.

As was shown earlier in Exhibit 3-1, the total volume of gas delivered to gas processing plants is reduced at the gas processing plant due to (1) the volume of NGLs extracted (that were in gaseous/vapor phase), (2) removal of non-hydrocarbon gases (carbon dioxide, nitrogen and helium), and (3) use of some of the gas as fuel within the plant. This remaining quantity of gas, called residue gas, is delivered to the gas pipelines.

The volume of natural gas liquid component (ethane, propane, butane, and pentanes plus) produced at the gas processing plants and their value is shown in Exhibit 3-8. Mont Belvieu is a large NGL trading hub in Texas with close proximity to refiners, NGL fractionating processing plants, storage, and access to the seaport for shipping NGLs. Volumes in Exhibit 3-8 come from the EIA Natural Gas Annual and Petroleum Supply Annual. The value of the NGLs comes from

Bloomberg. The total value of products removed from gas processing plants was $24.7 billion in 2015.

Exhibit 3-8: Gas Processing Volume Balance

Value Stream	Annual Volume	Units	Value per Unit	Billion Dollars
Gas fed to gas processing plants	20,626	Bcf		
Gas consumed as fuel at plants	434	Bcf		
Gas shrinkage (volume converted to NGL)	1,693	Bcf		
Nonhydrocarbon gases removed	452	Bcf		
Residue gas	8,047	Bcf	$2.39	$43.06
Value of Purity Natural Gas Plant Liquids at Market Centers				
Ethane Value (@ Mont Belvieu prices)	407	Million bbl	$7.71	$3.14
Propane Value (@ Mont Belvieu prices)	410	million bbl	$18.98	$7.79
Butane Value (@ Mont Belvieu prices)	228	million bbl	$25.45	$5.79
Pentanes Plus Value (@ Mont Belvieu prices)	158	million bbl	$45.27	$7.14
Total NGL Value (@ Mont Belvieu prices)	1,203	million bbl	$19.84	$23.86
Value of carbon dioxide at plant gates (excludes gas from no/low-methane CO2 fields)	344	Bcf	$1.22	$0.42
Value of crude helium at plant gates	3	Bcf	$115.55	$0.32
Value of sulfur at plant gates	930,000	metric tons	$100.00	$0.09
Total NGL, CO_2, crude helium and sulfur value				$24.68

Sources: EIA 2015 Natural Gas Annual; EIA 2015 Petroleum Supply Annual; Bloomberg; U.S. Geologic Survey, Mineral Commodities Summaries January 2016

The split in revenues coming from gas processing is shown in Exhibit 3-9. Producers receive the $11.2 billion representing the shrinkage of the gas in the processing plants. The minimum fees paid to the processing plants are about $5.2 billion, transport of raw NGLs to the market centers is about $3.4 billion, fractionation fees are about $1.5 billion and the remaining $3.4 billion is split between the producer and processor in some manner determined by the confidential contractual relationship between the two parties.

Exhibit 3-9: Value Added by Gas Processing and NGL Transport, Storage & Fractionation (T&S&F) to/at Market Centers

Value Stream	Annual Volume	Units	Value per Unit	Billion Dollars
Gas Shrinkage and Plant Fuel Value (Btus in NGLs + Btus in gas burned at plant) * value of dry gas	4,859	Quadrillion Btu	$2.30	$11.18
Gas Processing Plant Fee (excl. fuel)	20,626	Bcf	$0.25	$5.16
Transport of raw mix to M.B. or Other Market Center	1,202	million bbl	$2.83	$3.41
Storage & Fractionation Fees at Market Centers	1,202	million bbl	$1.26	$1.52
Remaining Value Added that is Kept by Producer or Shared with Processor	20,626	Bcf	$0.17	$3.43
Sum of Components				**$24.68**

Note: Value added in transporting NGL from market centers to consumers is not included in this table. Also, the value added in refining crude helium to Grade-A helium and delivering to consumers is not shown in this table,

Sources: EIA 2015 Natural Gas Annual; EIA 2015 Petroleum Supply Annual; Bloomberg; U.S. Geologic Survey, Mineral Commodities Summaries January 2016.

The balance of volumes and values for carbon dioxide in the U.S. is shown in Exhibit 3-10 for 2015. The U.S. produced 1,375 Bcf of carbon dioxide in 2015 of which 344 Bcf came from natural gas processing plants (of the sort that produce a methane-rich residue gas for pipeline transport). Another 908 Bcf came from fields in Colorado and New Mexico that produce a nearly pure CO_2 and 124 Bcf came from various sorts of industrial processes. The value of the CO_2 at the natural gas processing plants was approximately $420 million.

Exhibit 3-10: Volume and Value Balance for Carbon Dioxide 2015

CO_2 Streams	Bcf/ year	$/Mcf	Value in Million Dollars
Supply Volumes by Source (value at plant gate)			
Produced from natural gas processing plants (mining industry)	344	$1.22	$420
Produced from CO_2 fields (mining industry)	908	$1.22	$1,110
Produced at refineries, ethanol plants, coal gasification plants and other type of industrial manufacturing plants	124	$1.22	$151
Total U.S. Supply	**1,375**	**$1.22**	**$1,681**
Disposition Volumes by Categories and Delivered Costs			
Used for Enhanced Oil Recovery (mining industry)	1,236	$1.77	$2,192
Industrial Manufacturing Uses	83	$2.76	$228
Exports to Canada (for EOR)	56	$1.25	$70
Total Disposition	**1,375**	**$1.81**	**$2,490**
Value Chain by Component			
Supply Costs at Plant Gate	1,375	$1.22	$1,681
Pipeline Transport	1,320	$0.55	$726
Processing and Deliver to non-EOR Uses	83	$1.00	$83
Total Value Delivered to Consumers	**1,375**	**$1.81**	**$2,490**

Source: ICF estimates based on EPA GHG Inventory 2016, Office of Natural Resources Revenue of BLM and other sources

Exhibit 3-11 shows the volume and value balance for helium in 2015. All helium produced commercially in the U.S. comes from natural gases. Some of the U.S. production was stored in prior years and was withdrawn in 2015 for sale. The value of all (newly produced and withdrawn from storage) raw helium sold in the U.S. was $417 million. Adding another $483 million for refining and transporting to consumer and point of export yields a total market value of $900 million.

Exhibit 3-11: Volume and Value Balance for Helium 2015

Supply and Demand	Units	Volume 2015
Newly Extracted from Natural Gas Wells	million cubic feet	2,740
Withdrawn from Storage	million cubic feet	865
Total Sales	million cubic feet	3,605
Exports	million cubic feet	2,416
Domestic Use	million cubic feet	1,190
Average crude He price at processing plant	$/Mcf	$115.55
Value added in He purification, liquefaction, and transport to consumer	$/Mcf	$134.08
Average purity He price delivered to consumer	$/Mcf	$249.63
Value of new production at processing plant	$million	$317
Value of stored He withdrawn for market	$million	$100
Value added in He purification and transport to consumer	$million	$483
Value of Exports	$million	$603
Value of Domestic Sales	$million	$297
Total Value	**$million**	**$900**

Sources: ICF estimates developed from U.S. Geologic Survey, Mineral Commodities Summaries January 2016.

The volume and value balance for sulfur is shown in Exhibit 3-12. In 2015 natural gas processing plant produced about 10% of the commercial sulfur produced in the U.S. This sulfur recovered from natural gas had a value of approximately $93 million.

Exhibit 3-12: Value Balance for Sulfur 2015

Sulfur Streams	Volume (1,000 metric tons)	Sulfur Price in $/metric ton	Value (Million Dollars)
Elemental sulfur recovered at natural gas processing plants	930	$100	$93
Elemental sulfur recovered at petroleum refineries and coking plants	7,795	$100	$780
Total elemental sulfur recovered	8,720	$100	$872
Production of sulfuric acid (sulfur weight) from metal processing and other manufacturing	575	$100	$58
Total sulfur	**9,295**	**$100**	**$930**
Imports of recovered elemental sulfur	2,200		
Imports of sulfuric acid (sulfur weight)	1,200		
Exports of recovered elemental sulfur	1,600		
Exports of sulfuric acid (sulfur weight)	60		
Apparent U.S. Consumption	11,035		

Sources: ICF estimates developed from U.S. Geologic Survey, Mineral Commodities Summaries January 2016.

Capital Expenditures for Gas Processing Plants

A typical gas processing plant chills the incoming gas to drop out heavy hydrocarbons (pentanes-plus, butanes, propane and ethane), leaving a methane-rich "dry gas" that can be transported in a pipeline. Depending on the composition of the raw gas, a gas processing plant might also remove other gases such as carbon dioxide, hydrogen sulfide, and nitrogen. The capital expenditure for gas processing plants in 2015 was $5.6 billion. A breakout of typical capital costs by category is shown in Exhibit 3-13. The largest component is non-compressor plant equipment, which includes items like turbo-expanders, distillation units, heat exchangers/ cryogenic-boxes, pumps, pipes and valves. If CO_2 or H_2S is being removed, an amine unit or similar process would also be among the plant equipment. The next largest cost category is the gas compressors, which are used in the refrigeration process and to bring up the pressure of the residue gas so it can be put into a gas transmission line. The next largest category of cost is for the structure housing the equipment and the pipeline that connects the processing plant to a gas pipeline.

Exhibit 3-13: Breakout of Typical Gas Processing Construction Costs

Typical CAPEX Mix for Natural Gas Processing Plants	
Plant Equipment	59.7%
Compressors	13.2%
Structures	9.9%
Pipe Line	9.8%
Liquids Storage	4.9%
Measurement & Control Equipment	2.1%
ROW, Land & Land Rights	0.3%
Total	**100.0%**

Source is FERC Form 2 financial report of gas pipelines and press releases and news articles on individual projects.

3.4 Energy Pipelines

There are several kinds of energy pipelines that are part of the natural gas value chain. These include:

- Natural gas pipelines: There are 298,005 miles of these pipelines in the U.S. as shown in Exhibit 3-14. They transport gas to local gas distribution companies and to some large industrial gas consumers and gas-fired power plants. U.S. natural gas transmission pipelines have over 1,400 compressor stations, collect gas from over 5,000 receiving points, and deliver gas to over 11,000 delivery points.
- Crude oil pipelines: The U.S. has 73,260 miles of these pipelines that transport lease condensate and crude oil to refineries and terminals.
- Natural gas liquid pipelines: There are about 67,467 miles of these pipelines in the U.S. either transporting a mixture of raw NGLs from a production region to a market center or transporting fractionated “purity” ethane, propane and butane from a market center to a consuming region. Some of these pipelines also transport chemicals, including ethylene.
- Petroleum product pipelines: The U.S. has 62,543 miles of petroleum product pipelines that move gasoline, diesel fuel, jet fuel and other light products from refineries to terminals in consuming regions.
- Carbon dioxide pipelines: There are 5,205 miles of pipelines that move carbon dioxide from carbon dioxide fields, natural gas processing plants, and industrial plants to oil fields for enhanced oil recovery.

Exhibit 3-14: Gas, Oil, NGL, Product and CO_2 Pipeline Miles by State

STATE	Miles of gas transmission pipelines	Miles of crude oil pipelines	Miles of NGL pipelines	Miles of petroleum product pipelines	Miles of CO_2 pipelines
Alabama	6,712	395	357	1,102	11
Alaska	973	1,133	0	119	0
Arizona	6,694	0	12	575	0
Arkansas	7,211	453	947	406	0
California	12,458	4,391	63	3,338	0
Colorado	7,775	888	1,897	1,034	229
Connecticut	591	0	0	93	0
Delaware	336	0	1	40	0
DC	0	0	0	0	0
Florida	5,091	44	93	346	0
Georgia	4,556	0	362	1,763	0
Hawaii	0	0	0	96	0
Idaho	1,503	11	0	646	0
Illinois	9,293	2,818	1,385	3,793	0
Indiana	5,332	532	931	2,654	0
Iowa	8,340	422	2,200	1,813	0
Kansas	13,762	3,480	4,641	3,556	29
Kentucky	6,757	550	91	274	0
Louisiana	26,750	6,785	7,419	1,618	322
Maine	510	144	0	125	0
Maryland	974	0	0	311	0
Massachusetts	1,133	0	0	93	0
Michigan	8,698	1,554	582	1,390	0
Minnesota	5,466	2,660	573	1,722	0
Mississippi	10,445	1,468	275	1,538	524
Missouri	4,608	1,847	1,372	1,913	0
Montana	3,893	2,661	280	871	9
Nebraska	5,813	756	680	1,489	0
Nevada	2,018	0	0	276	0
New Hampshire	248	71	0	0	0
New Jersey	1,569	0	11	614	0
New Mexico	6,580	1,730	2,021	2,140	1,039
New York	4,557	94	200	859	0
North Carolina	4,185	0	89	1,062	0
North Dakota	2,479	3,058	266	774	167
Ohio	9,796	552	1,254	2,684	0
Oklahoma	11,843	6,376	4,955	2,166	336

STATE	Miles of gas transmission pipelines	Miles of crude oil pipelines	Miles of NGL pipelines	Miles of petroleum product pipelines	Miles of CO_2 pipelines
Oregon	2,535	0	0	415	0
Pennsylvania	9,899	24	1,141	1,956	0
Rhode Island	95	0	0	13	0
South Carolina	2,736	0	227	585	0
South Dakota	1,556	220	0	523	0
Tennessee	4,882	277	14	864	0
Texas	44,034	21,737	30,301	9,775	1,808
Utah	3,127	598	605	719	74
Vermont	74	117	0	0	0
Virginia	3,155	0	0	1,135	0
Washington	1,962	69	5	732	0
West Virginia	3,520	5	411	40	0
Wisconsin	4,536	1,181	238	1,113	0
Wyoming	6,943	4,160	1,568	1,379	658
NATIONAL TOTAL	**298,005**	**73,260**	**67,467**	**62,543**	**5,205**

Source: PHMSA database of pipelines operating in 2015.

The estimated volumes of product moved through each type of pipeline and the associated volumes are shown in the Exhibit 3-15. These figures include both interstate and intrastate flows. The estimated revenues are also shown in the exhibit along with the portion of those revenues attributable to the domestic natural gas value chain.

Exhibit 3-15: Transport Volumes and Revenues for Gas, Oil, NGL, Product and CO2 Pipelines

NAICS	Sector	Product/ Service	Volume Transported 2015	Volume Units	Revenue	Fraction Counted toward U.S. NGVC
486110	Pipeline Transportation of Crude Oil	crude oil and condensate transport	9,289	million barrels	$12,739	9.4%
486210	Pipeline Transportation of Natural Gas	natural gas transport	27,388	Bcf (delivered)	$25,545	90.4%
486910	Pipeline Transportation of Refined Petroleum Products	petroleum products	6,478	million barrels	$4,746	7.8%
486910	Pipeline Transportation of NGLs (Highly Volatile Liquids)	NGLs (Y grade and purity)	1,613	million barrels	$4,470	100.0%
486910	Pipeline Transportation of CO2	CO2	1,320	Bcf	$726	25.0%
486	**Pipelines**	**Total**			**$48,226**	**60.8%**

Source: ICF estimates derived from FERC Form 2 for interstate gas pipelines and FERC Form 6 for interstate oil pipelines adjusted to account for non-reporting intrastate pipelines. Revenues for CO2 pipelines represent imputed transportation-only services and do not reflect the cost of the CO2 itself (which is often sold on a delivered basis as a bundled service).

Capital Expenditures for Energy Pipelines

Total capital investment in energy pipelines is estimated to have been $21.3 billion in 2015. The annual level of capital investment can fluctuate considerably depending on which large projects are under construction at any given time. Per-unit costs have generally been increasing in recent years and stood at approximately $200,000 per inch-mile of pipeline (inclusive of all rights of way, materials, and construction costs, but excluding compressor and pump stations) for large projects of 30 inch diameter and greater. The cost of constructing and equipping compressor and pump stations was estimated to be about $2,000 to $2,500 per horsepower. In total, a typical large (36-inch diameter) natural gas pipeline— including compressor stations— would have cost $7.7 million per mile in 2015.

A breakdown of actual incurred gas pipeline capital costs by category, reported in recent years under FERC Form 2, is shown in Exhibit 3-16 below. The largest costs are the pipeline itself followed by the compressors. Approximately 95% of the horsepower at natural gas compressor stations is generated by natural gas while only 5% is generated by electric drive. After compressors, the next most costly category includes measurement, control and communication equipment (also referred to supervisory control and data acquisition or SCADA systems). The third most costly category represents rights of way and structures, each of which is about 2.7% of costs on average, but rights of way for green field projects (that is, where existing pipeline rights of way are not used) can often exceed 10% of the gas pipeline capital costs.[10]

Exhibit 3-16: Breakout of Typical Gas Pipeline Construction Costs

Typical CAPEX Mix for Natural Gas Transmission	
Pipe Line	63.5%
Compressors	23.7%
Measurement, Control & Communications Equipment	7.3%
Structures	2.7%
ROW, Land & Land Rights	2.7%
Total	**100.0%**

Source is FERC Form 2 financial report by gas pipelines

Crude oil, petroleum product, NGL, and carbon dioxide pipelines are constructed from the same sort of carbon steel line pipe used for natural gas pipelines and use similar construction techniques. The primary difference is that the operating pressures for some fluids, such as

[10] The purchase of land and rights of way are capitalized cost that are amortized over time for tax purposes and form part of the rate base of cost-of-service regulated pipelines and local distribution companies. However, for purposes of national income accounting, purchases of land and rights of way are considered income transfers (not the production of a new good or service) and do not contribute to national GDP or state products. Lease bonuses paid for the right to explore for oil and gas are likewise considered transfers and do not count toward GDP.

CO2, are higher than the 1,000-1,400 psi maximum operating pressure in modern gas transmission pipelines and might require stronger steel or thicker pipe. A secondary difference is that pumps powered by electric motors are used to provide the motive force for the fluids in place of gas compressor.

The total cost of building an oil pipeline is very similar to the cost of building a gas pipeline of the same diameter and length. The breakout of recent capital costs for oil pipelines— as reported in FERC Form 6— is shown in Exhibit 3-17 below. Because less energy is needed to move non-compressible fluids, the portion of costs made up of pumps for oil pipelines is less than the corresponding percent of cost associated with compression in gas pipelines. However those cost savings compared to gas pipelines are largely offset by the need for oil pipelines to have oil storage tanks as well as receipt and delivery facilities to move oil from/to rail cars or trucks.

Exhibit 3-17: Breakout of Typical Oil Pipeline Construction Costs

Typical CAPEX Mix for Oil Pipeline	
Pipe Line	65.4%
Pumps and Other Station Equipment	14.8%
Measurement, Control & Communications Equipment	6.2%
ROW, Land & Land Rights	5.7%
Oil Tanks	4.2%
Structures	2.0%
Receipt & Delivery Facilities	1.8%
Total	**100.0%**

Note: Applies to crude oil, product and NGL pipelines. Source is FERC Form 6 financial reports by oil pipelines.

3.5 Natural Gas Distribution

The number of miles of natural gas distribution mains and service lines (connecting each customer to the mains) by state is shown in Exhibit 3-18. The U.S. has approximately 1.28 million miles of distribution mains and nearly 912,000 miles of service lines.

Natural gas distribution companies usually act as merchants in that they buy gas and resell it on a delivered basis to their residential, commercial and small industrial sales customers. Natural gas distribution companies can also have transportation customers for whom they provide an unbundled distribution service. A transportation customer (or more frequently a gas marketer acting on their behalf) is responsible for procuring the natural gas and delivering it to the LDC citygate. ICF estimates that the total revenue received by gas LDCs for distribution services (revenues from transportation customers plus the revenues from sales customers minus the LDC's costs of procuring gas and transporting it to their citygate for their sales customers) was $39.7 billion in 2015.

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Exhibit 3-18: Miles of Natural Distribution Main and Services by State

State	Miles of Main	Miles of Services
Alabama	30,954	26,598
Alaska	3,405	2,440
Arizona	24,548	15,166
Arkansas	20,184	8,276
California	105,353	94,746
Colorado	35,859	19,844
Connecticut	7,984	5,964
Delaware	3,105	2,178
District of Columbia	1,214	1,129
Florida	28,003	13,671
Georgia	44,493	39,983
Hawaii	610	425
Idaho	8,257	7,010
Illinois	61,629	53,144
Indiana	40,598	35,200
Iowa	18,152	14,905
Kansas	22,456	10,252
Kentucky	18,696	10,860
Louisiana	27,098	13,394
Maine	1,171	494
Maryland	14,806	13,389
Massachusetts	21,576	15,138
Michigan	57,867	54,232
Minnesota	31,891	25,133
Mississippi	16,794	11,201
Missouri	27,348	18,789
Montana	7,147	4,411
Nebraska	12,777	7,292
Nevada	9,905	8,584
New Hampshire	1,920	1,211
New Jersey	34,792	32,966
New Mexico	13,882	6,072
New York	48,684	37,653
North Carolina	30,355	25,334
North Dakota	3,591	2,492
Ohio	57,642	44,239
Oklahoma	26,352	7,645
Oregon	15,615	11,879

State	Miles of Main	Miles of Services
Pennsylvania	47,954	28,711
Rhode Island	3,210	2,436
South Carolina	20,799	16,168
South Dakota	5,645	3,635
Tennessee	39,050	26,113
Texas	106,234	45,459
Utah	17,492	9,839
Vermont	789	631
Virginia	21,298	19,077
Washington	22,704	22,167
West Virginia	10,850	2,288
Wisconsin	39,274	29,812
Wyoming	5,259	1,982
Total	**1,277,270**	**911,651**

Source: PHMSA gas distribution data base 2016. In addition to these mains and service lines, LDCs operate about 26,000 miles of the U.S. gas transmission lines shown in a previous table.

Capital Expenditures for Gas Distribution

Capital expenditures for gas distribution assets are estimated by ICF to have been $11.6 billion in 2015. This figure includes both investor-owned and municipal systems. The approximate breakout of gas LDC capital expenditures by cost category is shown in Exhibit 3-19. The largest cost is for distribution mains that transport the gas over the service territory served by the LDC. Today, new service mains are predominately being built using plastic pipe, but steel pipe is also used when high pressures (above approximately 125 psi) are needed. The next highest cost category is for service lines, which connect individual customers to the mains. New service lines are usually made of plastic pipe. The other categories for expenditure by gas LDCs are customer meters and measurement and regulation equipment that controls how gas flows in the LDC pipe network.

Exhibit 3-19: Breakout of Capital Cost for Natural Gas Distribution

Typical CAPEX Mix for Natural Gas Distribution	
Distribution Mains	65.0%
Service Lines	27.2%
Customer Meters	5.3%
Measurement & Regulation Equipment	2.1%
ROW, Land & Land Rights	0.4%
Structures	0.1%
Total	**100.0%**

Source: FERC Form 2 and ICF estimates.

3.6 Natural Gas Storage

Three types of underground storage facilities are frequently found in the U.S. The most common type is “depleted field” underground gas storage, where abandoned oil and gas fields have been converted to store natural gas. The second most common type, “aquifer” gas storage, is created by displacing water with pressurized natural gas in underground porous rock. The third type is “salt cavern” gas storage, for which a cavern is leached out of solid salt domes or salt formations to provide a place to store the gas.

Exhibit 3-20 shows the capacity of each kind of storage facility found in each state. Total nominal working gas capacity (the maximum volume of gas that can normally be injected and withdrawn from a field in one storage “cycle”) is 4,798 Bcf. According to EIA statistics, actual working gas held in storage has not exceeded 4,022 Bcf[11], so the EIA figure may be a better estimate of practical working gas capacity. Most natural gas storage in the U.S. is used to balance seasonal supply and demand by injecting gas during non-winter months so that it can be withdrawn to supply residential and commercial heating loads in the winter. For the most part, seasonal storage has one “cycle” per year. Gas storage capacity is also used to balance daily and hourly gas demand loads to both match swings in consumption and maintain proper operating pressures in gas transmission and distribution systems. Storage fields used for daily and hourly balancing can have several “cycles” in a year, such that total annual injections (or total annual withdrawals) will be a multiple of working gas capacity.

Exhibit 3-20: Underground Natural Gas Storage Capacity by State and Type 2015

State	Depleted Field	Aquifer	Salt Cavern	Total
Alabama	11.2	0.0	22.0	33.2
Alaska	67.9	0.0	0.0	67.9
Arizona				0.0
Arkansas	12.2	0.0	0.0	12.2
California	365.5	10.0	0.0	375.5
Colorado	63.8	0.0	0.0	63.8
Connecticut				0.0
Delaware				0.0
DC				0.0
Florida				0.0
Georgia				0.0
Hawaii				0.0
Idaho				0.0
Illinois	11.8	291.8	0.0	303.6
Indiana	13.5	20.0	0.0	33.6

[11] The highest working gas value recorded by EIA was 4,022 Bcf in October 2016. https://www.eia.gov/dnav/ng/ng_stor_type_s1_m.htm

State	Depleted Field	Aquifer	Salt Cavern	Total
Iowa	0.0	90.3	0.0	90.3
Kansas	123.0	0.0	0.0	123.0
Kentucky	103.0	4.6	0.0	107.6
Louisiana	292.4	0.0	161.6	453.9
Maine				0.0
Maryland	18.3	0.0	0.0	18.3
Massachusetts				0.0
Michigan	683.6	0.0	2.2	685.7
Minnesota	0.0	2.0	0.0	2.0
Mississippi	69.5	0.0	134.2	203.7
Missouri	0.0	6.0	0.0	6.0
Montana	197.5	0.0	0.0	197.5
Nebraska	12.7	0.0	0.0	12.7
Nevada				0.0
New Hampshire				0.0
New Jersey				0.0
New Mexico	59.7	0.0	0.0	59.7
New York	125.4	0.0	1.5	126.9
North Carolina				0.0
North Dakota				0.0
Ohio	230.8	0.0	0.0	230.8
Oklahoma	193.4	0.0	0.0	193.5
Oregon	15.9	0.0	0.0	15.9
Pennsylvania	424.9	0.9	0.0	425.9
Rhode Island				0.0
South Carolina				0.0
South Dakota				0.0
Tennessee	1.8	0.0	0.0	1.8
Texas	377.1	0.0	169.2	546.3
Utah	54.0	1.0	0.0	54.9
Vermont				0.0
Virginia	1.4	0.0	4.0	5.4
Washington	0.0	24.6	0.0	24.6
West Virginia	259.3	0.1	0.0	259.4
Wisconsin				0.0
Wyoming	72.9	0.8	0.0	73.7
Total U.S.	**3,862.4**	**452.3**	**494.5**	**4,809.2**

Source: DOE EIA

In the U.S. 47% of underground storage working gas capacity is operated by gas pipeline companies, 33% by local gas distribution companies, and 20% by independent storage operators. A substantial share of the storage operations of LDCs and some of the storage operated by pipelines is not offered as a separate service, but instead is rolled into residential, commercial and small industrial distribution rates or into pipeline no-notice and other firm pipeline rates. The annual value of underground gas storage services (if they were to be separately billed) would be approximately $3.1 billion per year.

Capital investment in new and existing storage fields was $785 million in 2015. The specific items purchased with these expenditures would have varied greatly depending on what kinds of storage fields were being built, expanded or refurbished. The table below shows average expenditures for recent years, as reported by storage field operators in FERC Form 2, exclusive of "cushion gas." Cushion gas is natural gas that is injected into the storage field and left there for the life of the field to provide pressure to force the "working gas" volumes out of the storage reservoir at a high flow rate.

Exhibit 3-21: Breakout of Capital Cost for Underground Storage

Typical CAPEX Mix for Underground Natural Gas Storage	
Storage Compressors	30.3%
Storage Wells	30.3%
Pipe Line	20.4%
Storage Reservoir Purchase or Lease	4.9%
Gas Treatment Equipment	4.5%
Structures	4.3%
Measurement & Control Equipment	3.9%
ROW, Land & Land Rights	1.4%
Total	**100.0%**

Note: Excludes cost of working gas. Source of data is FERC Form 2. Mix of costs is mostly representative of depleted oil and gas reservoirs converted to storage duty.

The capital cost components shown in Exhibit 3-21 are mostly representative of depleted oil and gas fields converted to storage service. For these types of fields the main cost categories are gas compressors, storage wells and the pipelines that connect the storage wells to each other and connect the storage field to transmission or distribution pipelines. The other main categories represent the costs associated with purchasing or leasing the reservoir, procuring gas treatment equipment (mostly for dehydration and sometimes to knock out heavy hydrocarbons if the storage field is a converted oil field), structures to house the compressors and other equipment, measurement & control equipment, and land-related costs. If a new salt cavern field is being built, the largest cost item will be for the leaching of the cavern.

3.7 Imports and Supplemental Natural Gas Supplies

As shown in Exhibit 3-22, the U.S. receives gas imports primarily from Canada and Mexico via pipelines and as LNG and CNG. This is in addition to LNG imports from other countries and supplemental gas supplies such as coal gasification, landfill gas, biomass gas, and propane-air mix, provides the additional supplies of natural gas. This dry produced gas supplied to pipelines and additional supplies provide the total supplies of natural gas to pipelines. The supplies and the respective prices were used to estimate the value of total natural gas new supply as $69.0 billion in 2015.

Exhibit 3-22 Domestic Pipeline Deliveries, Imports and Supplementals

Natural Gas Stream	Volume (Bcf)	Price ($/Mcf)	Billion Dollars
U.S. Prod Delivered to Pipeline	25,473	$2.39	$60.78
U.S. Supplemental Gas	59	$2.78	$0.16
Imports from Can. by Pipeline	2,625	$2.84	$7.46
Imports from Can. as LNG	0	$8.69	$0.004
Imports from Can. as CNG	0	$4.18	$0.001
Imports from Mex. by Pipeline	1	$1.71	$0.002
LNG Imports by Ship	91	$7.36	$0.67
Sum of All Imports	2,718	$2.99	$8.13
Sum of New Supplies	**28,250**	**$2.45**	**$69.07**

3.8 Summary of Natural Gas Supply Chain

Exhibit 3-23 shows 2015 consumption volumes and costs by sector. Specifically, the exhibit shows what each sector paid for gas, broken out into three cost categories: (1) the cost of gas delivered to pipelines (includes wellhead costs, gathering, processing and imports); (2) gas transportation, storage and marketing (includes mostly pipeline transportation, some storage fees and fees paid to marketers); and (3) fees paid to local gas distribution companies for distribution services, LDC storage and marketing. For the total U.S. gas bill of $129.7 billion for 2015 consumption, approximately $63.0 billion went to commodity and services up to the point of delivery to a pipeline, $26.7 billion went to gas pipeline transportation and other services, and $40.0 billion went to LDCs.

Exhibit 3-23: Gas Supply Value Chain Revenues 2015

Natural Gas End Use	Deliveries (Bcf/year)	Cost of Gas Delivered to Pipelines (million$)	Transport, Storage and Marketing Payments (million$)	Payments for LDCs Service (million$)	Total Payments (million$)	Gas Cost ($/Mcf)	TS&M Cost ($/Mcf)	LDC Cost ($/Mcf)	Total Cost ($/Mcf)
Residential	4,610	$11,386	$8,793	$26,270	$46,449	$2.47	$1.91	$5.70	$10.08
Commercial	3,199	$7,934	$6,143	$9,729	$23,805	$2.48	$1.92	$3.04	$7.44
Industrial	7,535	$19,095	$5,538	$2,995	$27,627	$2.53	$0.73	$0.40	$3.67
Vehicle	39	$99	$70	$184	$353	$2.52	$1.78	$4.67	$8.97
Power	9,690	$24,502	$6,157	$840	$31,499	$2.53	$0.64	$0.09	$3.25
Subtotal to Domestic End users	**25,072**	**$63,016**	**$26,700**	**$40,017**	**$129,733**	**$2.51**	**$1.06**	**$1.60**	**$5.17**
Exports	1,784	$4,601	$874	$0	$5,475	$2.58	$0.49	$0.00	$3.07
Net Storage Injections	551	$1,383	$551	$0	$1,934	$2.51	$1.00	$0.00	$3.51
Total	**27,407**	**$69,000**	**$28,125**	**$40,017**	**$137,142**	**$2.52**	**$1.03**	**$1.46**	**$5.00**

Source: ICF estimates based on EIA volume and price data, EIA Form 176, private gas price surveys.

The revenue received by the U.S. natural gas industry for exported gas totaled $5.5 billion in 2015. Another $1.9 billion was received for natural gas volumes put into storage in excess of the volume withdrawn in the year. Adding those two components to payments for domestic consumption yields a total of $137.1 billion in revenue in 2015 for all the sectors that play a role in producing, processing and delivering natural gas to U.S. consumers and other buyers.

3.9 Transportation and Distribution of NGLs

As defined for the purposes of this study, the distribution of propane and other NGLs consists of the non-pipeline[12] transport of NGLs from market centers like Mont Belvieu, TX and Conway, KS to large industrial consumers or to wholesale terminals and then the distribution from wholesale terminals to end users. The total revenue received by these industry components is estimated to be approximately $12.2 billion in 2015. Capital expenditures in that year were an estimated $3.1 billion and consisted of terminal and port assets (large pressurized or refrigerated tanks, train and truck loading/unloading facilities, shipping docks), trucks for propane distribution, customer propane tanks (typically 100 to 500 gallons), portable propane cylinders (5 to 10 gallon) and pressurized rail tank cars.

3.10 Crude Oil and Condensate Refinery

Petroleum refineries are primarily associated with crude oil, but intersect with the natural gas value chain in several ways. First, several of the inputs to refineries – including lease condensate, isobutene and butane— are part of the natural gas value chain. In addition, hydrogen, which is sold “over the fence” to refineries by merchant hydrogen plants and also

[12] The transportation of raw mixed and purity NGLs by pipelines is counted as part of the pipeline link of the natural gas value chain.

produced inside refineries, is primarily made from natural gas in steam methane reformers. Hydrogen plays a critical role in refineries as it is used both to desulfurize fuels and as a feed into in other processes like hydrocracking (breaking large hydrocarbon chains into smaller chains). Finally, some of the outputs from refineries, most importantly propane and propylene, enter the same supply chain as propane made in natural gas processing plants and propylene made in crackers and PDH plants from NGLs. It is therefore necessary to track and subtract out refinery-made propane and propylene when calculating value added along the natural gas value chain.

Refineries are complex facilities in which several processes take place; these include distillation, reforming, cracking, and hydrotreating. Atmospheric distillation is used to separate crude oil and condensate into light gases, naphtha, kerosene, distillates, gas oil, and residuum. Light gases are sent to a gas plant that is similar to the natural gas processing plant discussed previously. Naphtha is sent to a catalytic reformer to produce high-octane reformate, which contains cyclical hydrocarbons and aromatics (benzene, toluene, and xylene, commonly referenced together as "BTX"). Gas oil is sent to a fluid catalytic cracker for conversion into lighter hydrocarbons for gasoline blending. The cracker also produces propylene as a byproduct. The residuum is either sold as residual fuel oil or sent to a coker for conversion into gas oil with petroleum coke as a byproduct. Hydrotreating is used to extract sulfur from intermediate or final products. Depending on the crude oil used as feedstock, some refineries also produce lubricants and waxes.

The condensate from the natural gas stream is combined into the crude feed entering the refinery process. Thus, most refinery products contain a contribution from the natural gas value chain. Some of this condensate is used to produce propylene and BTX. ICF determined how much of the propylene and BTX should be attributed to the natural gas value chain by analyzing both the production volumes of these chemicals (from EIA and the ACC statistics) and the distillation curves for refinery processes that reveal a percent yield for each refinery cut from condensates or crudes of different gravities. Given the volumes of domestic condensate and domestic and international crude processed through U.S. refineries in 2015, the distillation yield curves were used to estimate the volumes of naphtha and gas oil derived from each supply source. As shown in Exhibit 3-24 below, domestic condensate produced 12.8% of naphtha and 1.3% of gas oil.

Exhibit 3-24: Condensate Contribution to Refinery Production of Naphtha and Gas Oil

Feed	Naphtha	Gas Oil
Naphtha from Domestic Crude	57.4%	45.9%
Naphtha from Domestic Condensate	12.8%	1.3%
Naphtha from International	29.8%	52.9%

ICF assumed that one-half of the BTXs produced at U.S. refineries come from naphtha processing and the other half from processing gas oils. This means that condensate contributes 7.1% (12.8% x 50% + 1.8% x 50%) of BTXs. ICF assumed that all of refinery propylene comes from processing gas oil, so the condensate accounts for just 1.3% of propylene production. As is discussed in more detail later in this report, ICF used similar logic for other refinery products.

Capital Expenditures for Refining

The value of all outputs from U.S. refineries was $464.3 billion in 2015 and the domestic value added was $95.3 billion. Based on ICF's method of accounting for the natural gas value chain, we attribute $7.4 billion of that value added to domestic natural gas and its associated liquids.

Total capital investment in refineries in 2015 was $14.2 billion, including new capacity refurbishment and replacement of old facilities. Much of this capital investment is for products fabricated from iron and steel such as pipes, valves, boilers, fluid heaters, pressure vessels, distillation towers, heat exchangers, tanks, etc. The other major components of capital cost are construction labor, measurement and control equipment, and engineering services.

4. Natural Gas and Natural Gas Liquids End-Uses

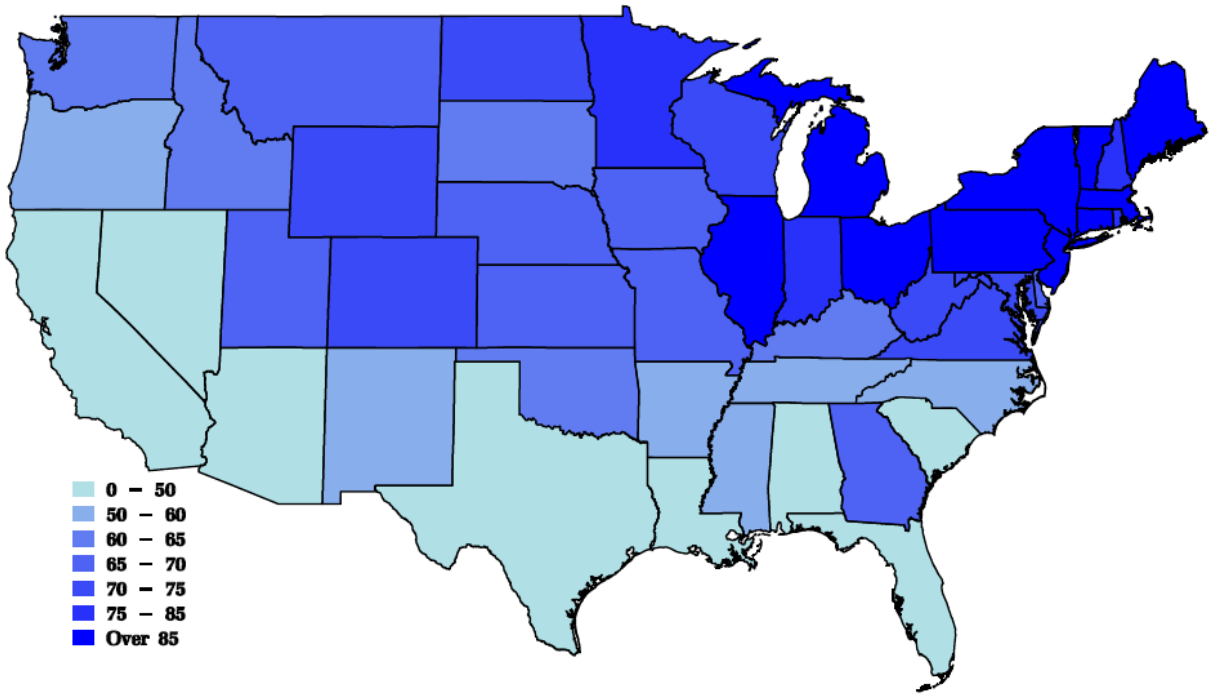
4.1 Natural Gas Combustion End-Uses

Natural gas is burned in various kinds of appliances and equipment in the residential, commercial and industrial sectors to make hot water and steam, to heat living and work spaces, cook food, dry clothes, and to provide heat for various industrial processes. Natural gas also serves as a feedstock for the production of several common chemicals, plastics and resins. These combustion and feedstock uses are the subject of this chapter.

4.1.1 Residential

The largest portion of natural gas used by residential customers is for space heating, followed by water heating, cooking, clothes dryers and space cooling. Space heating use varies by state with colder climates requiring more energy to heat their homes resulting in southern states typically using less natural gas per customer, as displayed in Exhibit 4-1.

Exhibit 4-1: Residential Consumption per Natural Gas Residential Customer by State (Mcf per Residential Customer)



EIA's Residential Energy Consumption Survey (RECS)[13] from 2009 was used to estimate the natural gas consumption by end use within 27 sub-regions within the Northeast, Midwest, South and West. The states groupings for these sub-regions are displayed in Exhibit 4-2, where the size of the sub-region varies from one to five states.

[13] Residential Energy Consumption Survey. https://www.eia.gov/consumption/residential/

Exhibit 4-2: Residential Energy Consumption Survey Categorizations [14]

Region	Division	Sub-Region
Northeast	New England	Massachusetts
		Connecticut, Maine, New Hampshire, Vermont, and Rhode Island
	Middle Atlantic	New Jersey
		New York
		Pennsylvania
Midwest	East North Central	Illinois
		Michigan
		Wisconsin
		Indiana and Ohio
	West North Central	Missouri
		Iowa, Minnesota, North Dakota, and South Dakota
		Kansas, and Nebraska
South	South Atlantic	Virginia
		Georgia
		Florida
		Delaware, the District of Columbia, Maryland, and West Virginia
		North Carolina and South Carolina
	East South Central	Tennessee
		Alabama, Kentucky, and Mississippi
	West South Central	Texas
		Arkansas, Louisiana, Oklahoma
West	Mountain	Colorado
		Idaho, Montana, Utah, and Wyoming
		Arizona
		Nevada and New Mexico
	Pacific	California
		Alaska, Hawaii, Oregon, and Washington

Consumption by end-use within the 27 sub-regions was then apportioned according to EIA's Natural Gas Annual's 2015 distribution of consumption by state. For sub-regions with a single state, 100% of the consumption was allocated to that state, while in sub-regions with two or more states, the breakout was based on the proportion of total consumption within a state

[14] Residential Energy Consumption Survey Methodology: https://www.eia.gov/consumption/residential/terminology.php

compared to the total consumption of all the states within that sub-region. An example of how the state breakout was calculated is outlined in the equation below:

$$EU_{KS} = EUR_{KS\ \&\ NE} * \frac{EIA_{KS}}{EIA_{NE} + EIA_{KS}}$$

Where:

EU_{KS} = Consumption of natural gas in Kansas for a given end-use including: space heating, water heating, space cooling, cooking, clothes drying and miscellaneous use

$EUR_{KS\ \&\ NE}$ = Consumption of natural gas in Kansas and Nebraska as specified in RECS for a given end use including: space heating, water heating, space cooling, cooking, clothes drying and miscellaneous use

EIA_{KS} = Total residential natural gas consumption volumes within the state of Kansas, as specified by EIA's Natural Gas Annual

EIA_{NE} = Total residential natural gas consumption volumes within the state of Nebraska, as specified by EIA's Natural Gas Annual

After completing the breakout of RECS consumption figures by end-use from the 27 sub-regions into the 50 states, the state totals for a given state differed from EIA's total figures. Additionally, the totals for a particular end-use across all states varied from the National Energy Modeling System (NEMS) estimates. Therefore, the calculated values were normalized to match the NEMS model figures and EIA's state totals. These consumption volumes were then multiplied by the average price within that state to determine the delivered cost of natural gas consumed as displayed in Exhibit 4-3.

Exhibit 4-3: Residential Natural Gas Consumption Volumes and Cost

Unit Type	Consumption Volume (Tcf)	Natural Gas Cost (Billion $)
Space Heating	2.87	$28.6
Space Cooling	0.02	$0.2
Water Heating	1.21	$12.4
Cooking	0.21	$2.1
Clothes Dryers	0.05	$0.5
Other	0.25	$2.5
Total	**4.61**	**$46.4**

This consumption by residential customers is used in equipment including furnaces, water heaters, clothes dryers, stoves, ranges, fireplaces, and miscellaneous other uses. EIA's RECS provides estimates for the number of natural gas consumers by type for select categories in 2009[15], while other sources including the Air Conditioning, Heating, & Refrigeration Institute (AHRI)[16], Association of Home Appliance Manufacturing (AHAM)[17], Hearth, Patio & Barbecue

[15] Residential Energy Consumption Survey for 2015 was not published by the time of this report.
[16] http://www.ahrinet.org/Home.aspx
[17] https://www.aham.org/

Association (HBPA)[18] and ENERGY STAR® Unit Shipment and Market Penetration Report, provide estimates for the sales of natural gas units in 2015. This information, coupled with the natural gas consumption estimated by category as outlined above yields a gas firing rate per unit of equipment, is presented in Exhibit 4-4.

Exhibit 4-4: Residential Equipment

Units Type	Consumption in Base Year (Tcf)	Inventory of Installed Units in Base Year (Million Units)	Gas Firing Rate per Unit (MMBtu/ hr)		Aggregate Firing Rate of all Units (TBtu/hr)	New Unit Sales (Million Units)	Aggregate Firing Rate of New Units (bil. Btu/hr)
Space Heating	2.9	60.8	0.09		5.36	2.81	171.09
Water Heating	1.2	61.7	0.04		2.47	4.37	269.68
Space Cooling	0.02	0.5	0.09		0.04	0.02	0.01
Cooking	0.2	54.6	0.02		1.09	3.19	174.15
Clothes Dryer	0.1	17.3	0.01		0.14	1.33	22.93
Other Uses	0.2	38.8	0.01		0.31	1.55	60.10
Total	**4.6**	**233.6**	**0.07**		**9.41**	**13.28**	**697.95**

Source: ICF estimates based on government and industry association data.

Additionally, the value of the equipment outlined in Exhibit 4-4 was estimated using information from the Association of Home Appliance Manufacturing (AHAM), Home Advisor[19], retail vendors like Home Depot and Lowes, and the Annual Survey of Manufacturers (ASM) to determine the value of residential natural gas products. The total value estimated by these sources coupled with the counts of new equipment from Exhibit 4-4 resulted in the cost of equipment estimated in Exhibit 4-5 below.

18 http://nficertified.org/admin/ExpoFiles/3438%20Johnson%20Hearth%20Industry%20Facts%20Figures.pdf

19 http://www.homeadvisor.com/

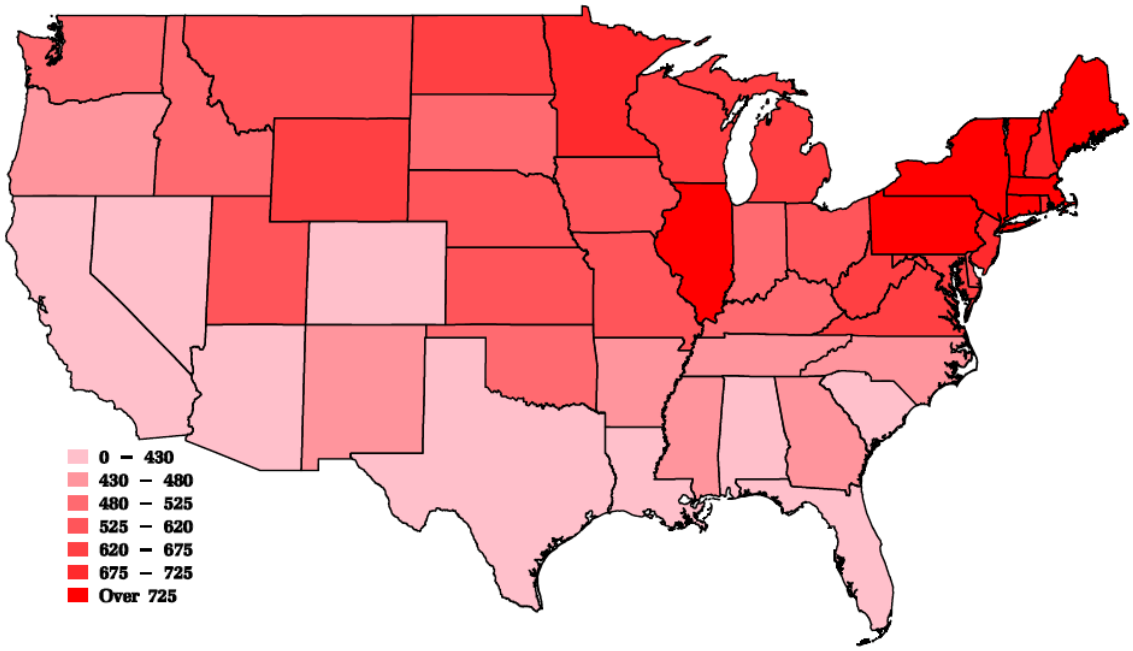
Exhibit 4-5: Residential Natural Gas Equipment and Installation Cost

Units Type	Domestic Equipment Production (Billion $)	Imputed Equipment Imports (Billion $)	Total Equipment Markup (Billion $)	Total Installation Costs (Billion $)	Total Maintenance Cost (Billion $)
Space Heating	$2.71	-$0.12	$0.83	$6.67	$2.22
Water Heating	$1.36	$0.29	$0.53	$2.01	$0.92
Space Cooling	$0.00	$0.05	$0.02	$0.05	$0.04
Cooking	$1.06	$0.64	$0.54	$0.69	$1.15
Clothes Dryer	$0.32	$0.17	$0.16	$0.23	$0.26
Other Uses	$0.52	-$0.01	$0.16	$0.80	$0.50
Total	**$5.98**	**$1.02**	**$2.24**	**$10.45**	**$5.10**

4.1.2 Commercial

Natural gas is also used in commercial industries for space heating, space cooling, water heating, cooking, and cogeneration. The largest use of commercial natural gas use can be attributed to space heating of offices, health care clinics, education institutions, and warehouses[20]. The total consumption per commercial natural gas customer is displayed in Exhibit 4-6.

Exhibit 4-6: Commercial Consumption per Natural Gas Commercial Customer by State (Mcf per Commercial Customer)



[20] http://www.c2es.org/technology/factsheet/natural-gas

This report estimates the 2015 commercial consumption of natural gas by various end-uses including space heating, water heating, space cooling, cooking, cogeneration and miscellaneous use. EIA's Commercial Buildings Energy Consumption Survey (CBECS)[21] from 2012 determined estimates of natural gas consumption by end use within nine divisions within the Northeast, Midwest, South and West. The states included in these nine divisions are outlined in Exhibit 4-7.

Exhibit 4-7: Commercial Building Energy Consumption Survey [22]

Region	Division	States included in Divisions
Northeast	New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
	Middle Atlantic	New Jersey, New York, and Pennsylvania
Midwest	East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
South	South Atlantic	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
	East South Central	Alabama, Kentucky, Mississippi, and Tennessee
	West South Central	Arkansas, Louisiana, Oklahoma, and Texas
West	Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
	Pacific	Alaska, California, Hawaii, Oregon, and Washington

The consumption by end-use within the 9 divisions was apportioned according to EIA's Natural Gas Annual's 2015 distribution of consumption by state for commercial consumption. The consumption for each division, composed of four or more states, was apportioned based on the total commercial consumption within a state compared to the total commercial consumption of all the states within that division. An example of how the state breakout was implemented is outlined in the equation below:

$$EU_{LA} = EUC_{AR,LA,OK,TX} * \frac{EIA_{LA}}{EIA_{AR} + EIA_{LA} + EIA_{OK} + EIA_{TX}}$$

Where:

EU_{LA} = Consumption of natural gas in Louisiana for a given end use including: space heating, water heating, space cooling, cooking, cogeneration and miscellaneous use

$EUC_{AR, LA, OK, TX,}$ = Consumption of natural gas in Kansas and Nebraska as specified in CBECs for a given end use including: space heating, water heating, space cooling, cooking, cogeneration and miscellaneous use

[21] Commercial Buildings Energy Consumption Survey (CBECs). Retrieved from: http://www.eia.gov/consumption/commercial/data/2012/

[22]

EIA_{LA}, EIA_{AR}, EIA_{OK}, EIA_{TX} = Total commercial natural gas consumption volumes within the state of Louisiana, Arkansas, Oklahoma, and Texas respectively, as specified by EIA's Natural Gas Annual

After completing the breakout of CBECS' consumption figures by end-use from the nine divisions into the 50 states, the total for each state differed from EIA's total state commercial figures. Additionally, the totals for a particular end-use across all states varied from the National Energy Modeling System (NEMs) estimates. Therefore, the consumption volumes were normalized by end-use such that the state totals aligned with EIA's values and end-use figures matched the National Energy Modeling System (NEMs). These consumption volumes were then multiplied by the average price within that state to determine the value of natural gas consumed as displayed in Exhibit 4-8.

Exhibit 4-8: Commercial Natural Gas Consumption Volumes and Cost

Units Type	Consumption Volume (Tcf)	Natural Gas Cost (Billion $)
Space Heating	1.74	$12.7
Space Cooling	0.04	$0.3
Water Heating	0.55	$4.1
Cooking	0.21	$1.6
Cogeneration	0.07	$0.5
Other	0.60	$4.5
Total	**3.20**	**$23.6**

Commercial customers use gas in equipment similar to that of residential consumers, but typically in larger units. These units can include furnaces, boilers, water heaters, stoves and ranges, as well as miscellaneous other uses. EIA's CBECS provides estimates for the number of natural gas consumers by type for select categories in 2012. These categories include space heating, water heating and space cooling. Other sources, including the Air Conditioning, Heating, & Refrigeration Institute (AHRI)[23] and the ENERGY STAR® Unit Shipment and Market Penetration Report, provide estimates for the sales of natural gas units in 2015. For sources without data, assumptions of the equipment lifetime were made, based on similar residential equipment lifetimes, which allowed ICF to estimate the missing unit sales figures. The estimates for the equipment counts coupled with the natural gas consumption estimated by category— as outlined in Exhibit 4-9 — yields a gas firing rate per equipment type.

[23] http://www.ahrinet.org/Home.aspx

Exhibit 4-9: Commercial Equipment

Units Type	Consumption in Base Year (Tcf)	Inventory of Installed Units in Base Year (Million Units)	Gas Firing Rate per Unit (MMBtu/hr)	Aggregate Firing Rate of all Units (TBtu/hr)	New Unit Sales (Million Units)	Aggregate Firing Rate of New Units (bil. Btu/hr)
Space Heating	1.7	2.7	1.2	3.25	0.12	0.33
Water Heating	0.5	1.8	0.4	0.80	0.10	0.18
Space Cooling	0.0	0.0	5.8	0.07	0.001	0.00
Cooking	0.2	1.6	0.2	0.34	0.14	0.22
Cogeneration	0.1	0.2	0.1	0.02	0.01	0.00
Other Uses	0.6	0.3	3.6	0.98	0.01	0.00
Total	**3.2**	**6.6**	**1.5**	**9.88**	**0.38**	**2.48**

The cost for the equipment outlined in Exhibit 4-9 was estimated using the cost per gas firing rate ($/Mcf). The cost per firing rate was determined for each piece of residential equipment, and this was applied with some assumptions about the economies of scale in order to apply the costs to commercial equipment. The cost per firing rate was then applied to firing rate of new equipment to determine the total cost of new commercial equipment, including installation costs, displayed in Exhibit 4-10 below:

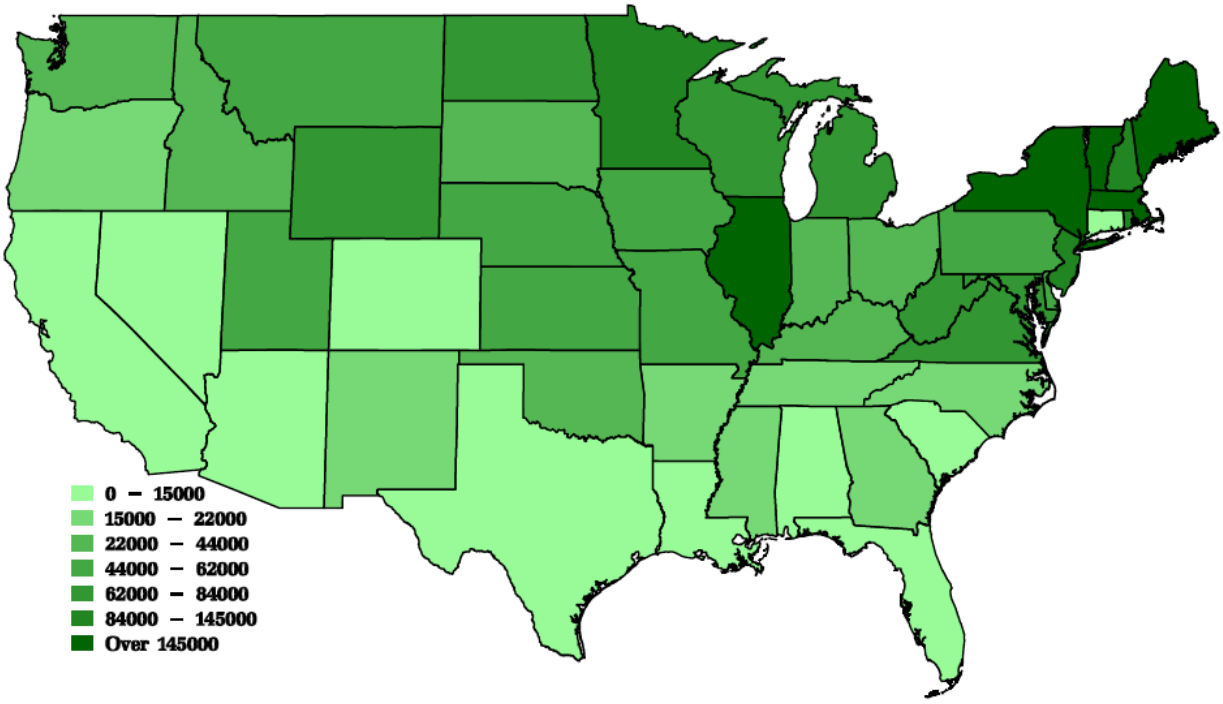
Exhibit 4-10: Commercial Natural Gas Equipment and Installation Cost

Units Type	Domestic Equipment Production (Billion $)	Imputed Equipment Imports (Billion $)	Total Equipment Markup (Billion $)	Total Installation Costs (Billion $)	Total Maintenance Cost (Billion $)
Total	$4.25	$1.28	$2.90	$3.62	$9.79

4.1.3 Industrial

The most significant application of natural gas in the industrial sector is for process heating. Another important use of natural gas is steam production, which is primarily used in boilers and combined heat and power systems. Natural gas is also used for building space heating. The average industrial consumption (total consumption per industrial natural gas customer) is displayed in Exhibit 4-11.

Exhibit 4-11: Industrial Consumption per Natural Gas Industrial Customer by State (Mcf per Industrial Customer)



This report estimates the 2015 industrial consumption of natural gas by various end-uses within manufacturing, agriculture, mining, and construction. Natural gas used in manufacturing was broken out into boilers, combined heat and power, process heating, process cooling, machine drive, other process use, facility HVAC, other facility support, conventional electricity generation, other non-process use, end use not reported, feedstock for ammonia, feedstock for methanol, feedstock for hydrogen production at merchant plants and refineries as well as feedstock for metals and other industries. Manufacturing natural gas consumption volumes by end use and NAICs code are first based on EIA's 2010 Manufacturing Energy Consumption Survey (MECS).

The consumption by NAICs code from the 2010 MECS was scaled to 2015 using employee counts by NAICs code and value added by NAICs code from the Annual Survey of Manufacturers (ASM)[24]. The same end-use split from 2010 was applied to the scaled 2015 NAICs code consumption figure to estimate the 2015 consumption by end-use. Additionally, the consumption by NAICs code was apportioned to states based on the Bureau of Labor Statistics (BLS) employee counts in the various states.[25] This apportioning was then normalized to match EIA's total industrial consumption by state as well as the consumption by NAICs code.

[24] Annual Survey of Manufacturers (ASM). Retrieved from: http://www.census.gov/programs-surveys/asm.html
[25] Bureau of Labor Statistics. Retrieved from: https://www.bls.gov/cew/datatoc.htm

In addition to estimating the consumption in the industrial sector, the consumption of gas in 2015 within the construction, mining, and agricultural sectors is estimated using estimates contained in our Industrial Sector Technology Use Model (ISTUM). Construction consumption totals for 2015 were split to the state level based on residential and commercial heating volumes. Mining consumption totals for 2015 were split based on the payroll in the various states, as determined by the U.S. Census Bureau in 2012.[26] Lastly, the consumption totals in agriculture were apportioned based on the market value of corn, wheat, other agriculture, nursery, poultry and eggs, and dairy cattle with adjustment for heating degree days among the states. The consumption by end use and the delivered cost of natural gas used within the industrial sector is provided in Exhibit 4-12.

Exhibit 4-12: Industrial Natural Gas Consumption Volumes and Cost

Industry	End Use Category	Consumption Volume (Tcf)	Natural Gas Cost (Billion $)
Manufacturing	Conventional Boiler Use	0.80	$2.81
	CHP and/or Cogeneration Process	1.46	$5.14
	Process Heating	2.55	$9.01
	Process Cooling and Refrigeration	0.03	$0.09
	Machine Drive	0.11	$0.38
	Other Process Use	0.13	$0.45
	Facility HVAC (g)	0.34	$1.24
	Other Facility Support	0.03	$0.13
	Onsite Transportation	0.00	$0.00
	Conventional Electricity Generation	0.02	$0.07
	Other Non-process Use	0.01	$0.02
	End Use Not Reported	0.06	$0.22
Feedstock	Ammonia	0.34	$1.18
	Methanol	0.10	$0.35
	H2 (Merchant)	0.09	$0.30
	H2 (refinery)	0.07	$0.25
	Metals	0.03	$0.10
	Others	0.01	$0.03
Agriculture	Agriculture	0.11	$0.39
Mining	Mining	0.07	$0.24
Construction	Construction	0.03	$0.11
Other	Other	1.16	$4.10
Total	**Total**	**7.53**	**$26.60**

[26] Census Data. Retrieved from: https://www.census.gov/programs-surveys/economic-census.html

In order to estimate the cost of new equipment in the base year, we first estimated the average utilization for every equipment type. This was done by estimating specific industries' operating hours and making assumptions as to whether an industry typically runs at full capacity twenty four hours a day or if that industry typically operates at full capacity for portions of the day. An aggregate utilization rate for an end use was calculated using the various assumed utilization rates for each industry and each industry's gas consumption for a particular end use. The aggregate gas firing rate of the equipment was simply the gas consumption divided by the utilization rate. The estimated gas firing rate for new equipment was then calculated by assuming an average lifetime of the equipment and applying the inverse of the project lifetime to the total aggregate gas firing rate.

The cost for the equipment was estimated using the cost per gas firing rate. The cost per firing rate was determined for each piece of industrial equipment. The costs were estimated by applying economies of scale from commercial equipment, using industry rules of thumb and other assumptions. The cost per firing rate was then applied to firing rate of new equipment to determine the total cost of new commercial equipment including installation costs displayed in Exhibit 4-13 below:

Exhibit 4-13: Industrial Natural Gas Equipment and Installation Cost

Units Type	Domestic Equipment Production (Billion$)	Imputed Equipment Imports (Billion$)	Total Equipment Markup (Billion$)	Total Installation Costs (Billion$)	Total Maintenance Cost (Billion$)
Total	$3.10	$0.08	$1.55	$2.25	$7.61

4.1.4 Historical Value of Gas-fired Power Generation

Exhibit 4-14 below shows that the value of U.S. gas-fired electricity generation in 2015 was $77.7 billion. This is the wholesale value of generation only and does not include transmission and distribution charges paid by electricity consumers. Also shown in the exhibit is that the total value of all electricity generation was $219.2 billion and the value of non-gas generation was $141.5 billion. On a $/MWh basis, the value of gas-fired electricity generation ($58.39/MWh) is higher than that of non-gas generation ($51.83/MWh). This difference reflects the fact that gas-fired generation – due to its disadvantage relative to the dispatch costs of renewables, nuclear and some coal during periods of low electricity demand and the ease of ramping up electricity generation from gas turbines in peak hours – tends to operate in peak hours for electricity demand, when prices are highest.

Exhibit 4-14: U.S. 2015 Value of Gas-fired and Non-gas Electricity Generation [27]

	Category	$ (Millions)	$/MWh
	Retail Sales Revenue	389,767	104.12
+	Self-Generation Value	11,311	71.96
+	Electricity Export Revenue	629	69.10
=	Total Retail Revenue	401,707	
-	Import Costs	5,236	69.10
-	T&D Overhead Costs	177,290	
=	Value of Generation	219,182	53.97
-	Value of Non Gas Generation	141,541	51.83
=	Value of Gas Generation	77,682	58.39

Additional information on the use of natural gas for power generation and the value-added attributable to this sector for 2015 is provided in section 5.3.

4.2 Natural Gas Use as a Feedstock

This section presents information on the use of natural gas and natural gas liquids as feedstocks to make chemicals and other products. The discussion begins with the two main chemical lines made from natural gas, ammonia and its derivatives and methanol and its derivatives. The discussion then turns to natural gas plant liquids and the chemicals and derivatives that can be made from them, primarily ethylene, propylene and other olefins.

4.2.1 Ammonia

Ammonia (NH_3) is a colorless inorganic compound comprised of nitrogen and hydrogen. It is produced primarily by the Haber process, in which nitrogen from the air reacts exothermically with hydrogen from natural gas.

$$N2(g) + 3H2(g) \rightarrow 2NH3$$

One of the most important uses of ammonia is in the nitrogenous fertilizer industry. About 80% of all U.S. ammonia production is used to produce fertilizers, while the remaining 20% is used for non-fertilizer applications such as organic compounds. The nitrogen in ammonia is essential for crop growth. Although it varies depending on the crop type, approximately 200 pounds of ammonia are used for every acre of land during crop season.[28] Ammonia is used either directly as ammonia in nitrogenous fertilizers, or is first converted into other chemicals such as

[27] U.S. value added of gas generation includes the value added from gas generation in the contiguous 48 states

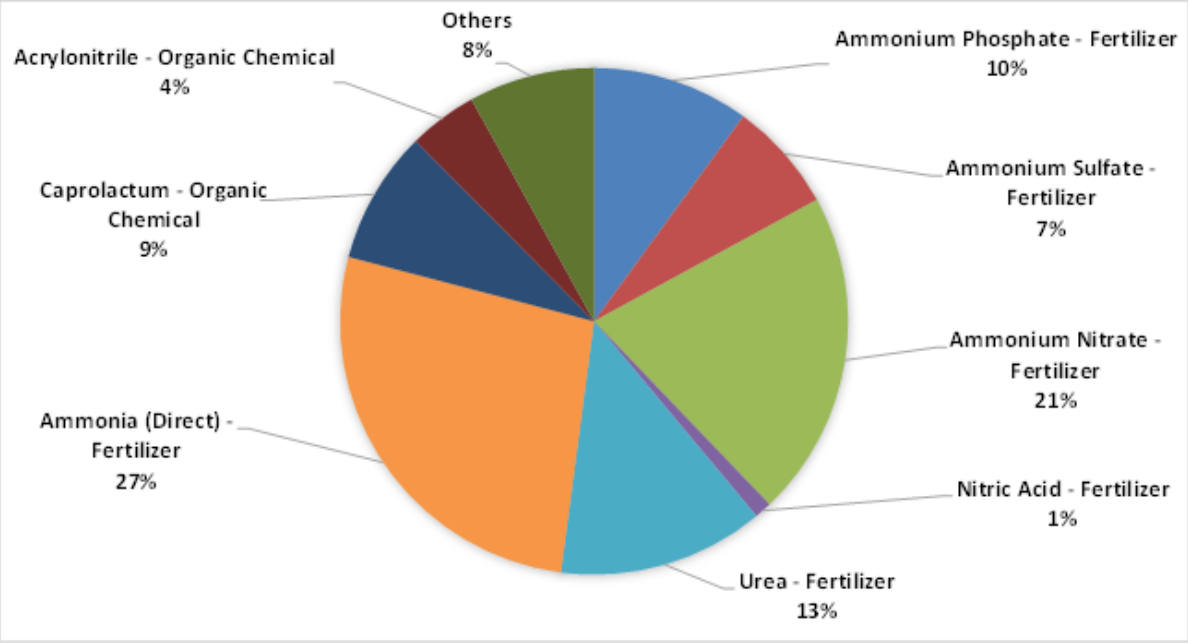
[28] http://www.rmtech.net/uses_of_ammonia.htm

ammonium sulfate, nitric acid, urea, ammonium nitrate and diammonium phosphate/ monoammonium phosphate as liquid fertilizer solutions. Ammonium nitrate is produced by reacting ammonia with nitric acid.

In addition, there are several non-fertilizer applications of ammonia. It is used in the production of organic compounds, such as caprolactam and acrylonitrile, which are converted into nylon fibers and acrylic fibers, respectively. These fibers are used in the home, carpet, furnishings, and apparel industries. Ammonia can also be converted into hydrogen cyanide and used to create explosives.

Exhibit 4-15 shows the percentage breakdown of total ammonia used to produce each product:

Exhibit 4-15: Percentage of Ammonia Used to Produce Various Derivatives



Ammonia Methodology

The methodology to determine the ammonia chemical pathways consisted of calculating the total volume of natural gas required to make all of the ammonia produced in the United States. The total year 2015 ammonia production was obtained from the American Chemistry Council's 2016 Guide to the Business of Chemistry. There are seven main ammonia producers in the United States: CF Industries, LSB Industries, PCS Nitrogen, Dyno Nobel, Iowa Fertilizer Company, Mosaic, and CHS Inc. The ratio of total ammonia output volume from the ammonia manufacturers to the total natural gas consumed from these plants was calculated. This ratio was used to determine the volume of natural gas required to make all of the ammonia in 2015 in the United States.

The major ammonia derivatives include ammonium phosphate, ammonium sulphate, ammonium nitrate, nitric acid, urea, caprolactam, and acrylonitrile. The chemical reactions and stoichiometric balances between ammonia, any additional reactants required, and its derivative

products was used to estimate the amount of ammonia and additional reactants required to produce the ammonia derivatives, and volumes of ammonia derivatives produced. For example, ammonia reacts with sulfuric acid (additional reactant) to produce ammonium sulfate (derivative). The value added of the ammonia derivatives was calculated by using prices of natural gas, ammonia, additional reactants, and ammonia derivatives in combination with their calculated chemical volumes. The prices were obtained from several price databases including Bloomberg and the International Trade Center.

Several assumptions were used for the conversion factors used to produce ammonia derivative products. Ammonium phosphate is assumed to be 10% of total ammonia production, and 27% of all ammonia production goes to "direct" ammonia applications. In addition, 95% of all ammonia produced is converted into ammonium nitrate, while only 5% is converted into nitric acid. Ammonium nitrate is assumed to be the main chemical produced from nitric acid. The amount of ammonia required to produce the rest of the derivative products (ammonium sulfate, urea, caprolacam, and acrylonitrile) is based on stoichiometric ratios and the ammonia production value from the American Chemistry Council's 2016 Guide to the Business of Chemistry.

To calculate the U.S. value added for each ammonia derivative, the dollar/volume value of each product was multiplied by its total production. Ammonia imports and exports were taken into account and were obtained from the United States Census Bureau and the Energy Information Administration. It was assumed that 25% of all ammonia imports are used to produce ammonium nitrate, 10% towards nitric acid, and 65% towards ammonium phosphate. The amount of ammonia used to produce all other derivative product (grouped into an "others" category), was calculated by subtracting the ammonia required to make the major derivative products from the total ammonia production.

Exhibit 4-16 shows the ammonia balance for ammonia-based commodities. The value in each box represents the volume of chemicals produced from ammonia. For example, ammonia produces 24.7 million metric tons of nitrogenous fertilizer. The dollar value represents the mass of product produced multiplied by the unit price of the product.

Exhibit 4-16: Ammonia Production Flow Diagram

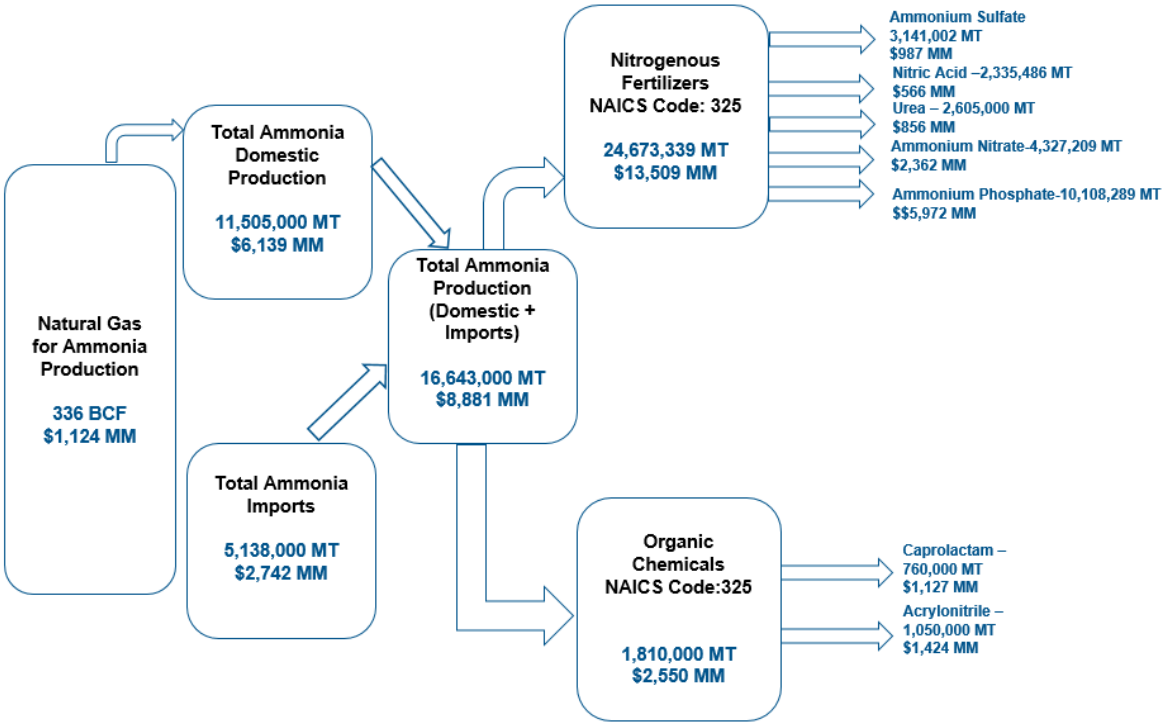


Exhibit 4-17 outlines the consumption of the reactants reacting with ammonia to produce the final products. ICF determined the conversion factors between the final products and additional reactants through stoichiometry. The amount of additional reactant consumption and U.S. value added are summarized below.

Exhibit 4-17: Reactant Volumes and Value for Ammonia Reactions and Ammonia Derivative Reactions

Product	Additional Reactant	Additional Reactant Consumption (metric tons)	Additional Reactant Value ($million)
Ammonium Sulfate	Sulfuric Acid	2,333,830	197
Ammonium Nitrate	Nitric Acid	2,333,830	565
Nitric Acid	Oxygen	2,184,130	33
Urea	Carbon Dioxide	1,953,788	NA[29]
Ammonium Phosphate	Phosphoric Acid	8,620,754	1,288

[29] Carbon Dioxide's value is trivial and not calculated as part of this analysis.

4.2.2 Methanol

Methanol (CH_3OH) is an alcohol that is produced in a catalytic reaction called synthesis gas, which is a mixture of carbon monoxide and hydrogen. The synthesis gas is converted into methanol at high temperatures and pressures in a fixed bed reactors, such as using alumina pellets coated with copper and zinc oxides[30]. The methanol synthesis chemical reaction is as follows:

$$CO + 2H2 \rightarrow CH3OH$$

The predominant use of methanol in the United States is as a feedstock used in the manufacture of basic organic chemicals. The majority of methanol produced in the United States goes towards the production of formaldehyde, followed by acetic acid production. Formaldehyde is primarily used in the production of materials such as plywood, insulation, and particle board. Acetic acid is used to produce several chemicals, including paints, pigments, fungicides, pesticides, adhesives, inks, coatings, synthetic textile, photographic film, food preservatives, mordant for dyes, and even as a catalyst for organic coupling reactions. Methanol also produces a small amount of other chemicals such methyl tertiary butyl ether (MTBE) fuel additive; chloromethane for use in the electronics, metal cleaning agents, paint removers, silicones, and in the insulation industries; and methyl-methacrylate used in glazing, signs, and other acrylics production.

Methanol Methodology

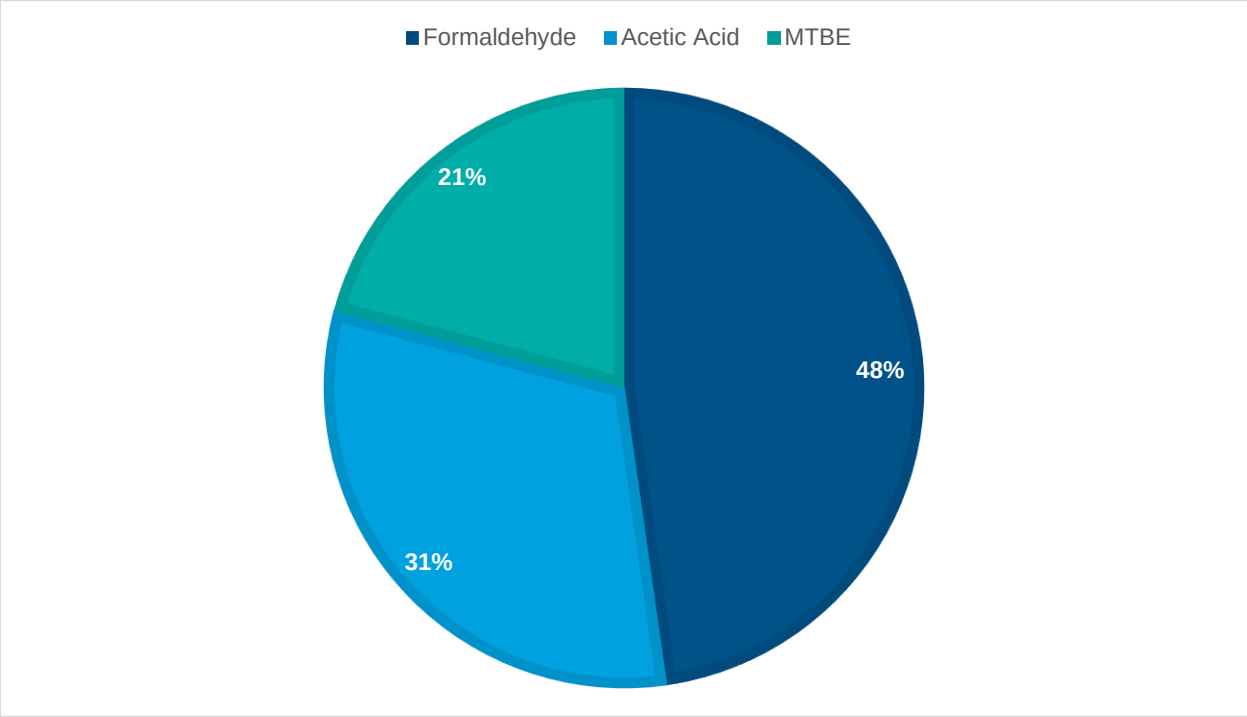
The methodology to determine the methanol chemical pathways consisted of calculating the total volume of natural gas required to make all of the methanol produced in the United States. The total year 2015 methanol production was obtained from the American Chemistry Council's 2016 Guide to the Business of Chemistry. There are five main methanol plants in the United States: Celanese Corporation, LyondellBasell Industries, and Orascom, and two Methanex plants. ICF applied an industry average product yield ratio (Mcf of natural gas per ton of methanol) to determine the volume of natural gas required to make all of the methanol in 2015 in the United States.

The percentage breakdown between formaldehyde, acetic acid production, and MTBE was determined by first calculating the amount of methanol required to produce MTBE. The volume of MTBE produced in the United States in 2015 was obtained from EIA. MTBE is produced by reacting methanol and isobutylene. The stoichiometric relationship between methanol and isobutylene was used to calculate the volume of methanol required.

Several assumptions for the methanol analysis were made. It was assumed that only formaldehyde, acetic acid, and MTBE are produced from methanol. This is because these are the majority methanol derivatives. In addition, it was assumed that 65% of acetic acid is made from methanol.[31] This was used in solver calculations to estimate formaldehyde volumes. Exhibit 4-18, below, outlines the estimated share of methanol used to produce each of the three chemical derivatives.

[30] http://www.essentialchemicalindustry.org/chemicals/methanol.html
[31] https://www.icis.com/resources/news/2007/10/31/9074780/acetic-acid-production-and-manufacturing-process/

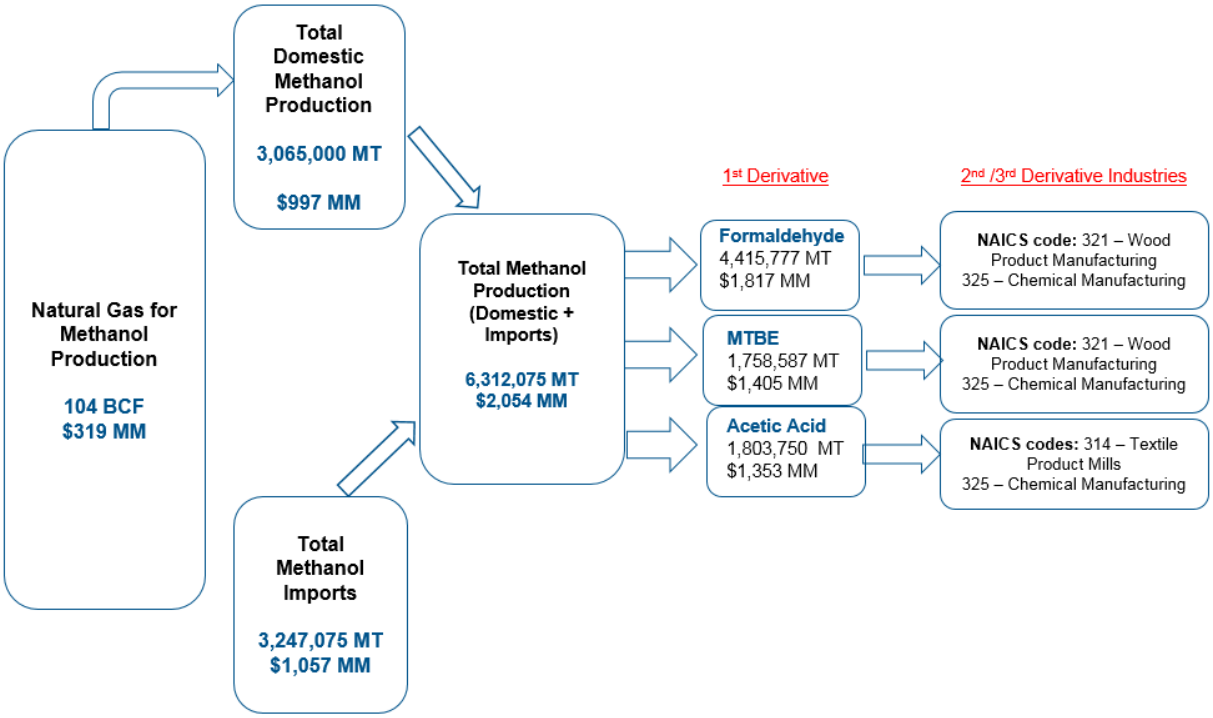
Exhibit 4-18: Percentage of Methanol Used to Produce Derivatives



To calculate the U.S. value added for each methanol derivative, the dollar/volume value of each product was multiplied by its total production volume. Methanol imports and exports were taken into account and were obtained from the United States Census Bureau and the Energy Information Administration. It was assumed that 100% of all methanol imports are going towards producing formaldehyde.

Exhibit 4-19 shows the methanol balance for methanol-based commodities. The value in each box represents the volume of chemicals produced from methanol. For example, ammonia produces 4.4 million metric ton of formaldehyde. The dollar value represents the mass of product produced multiplied by the unit price of the product.

Exhibit 4-19: Methanol Production Flow Diagram

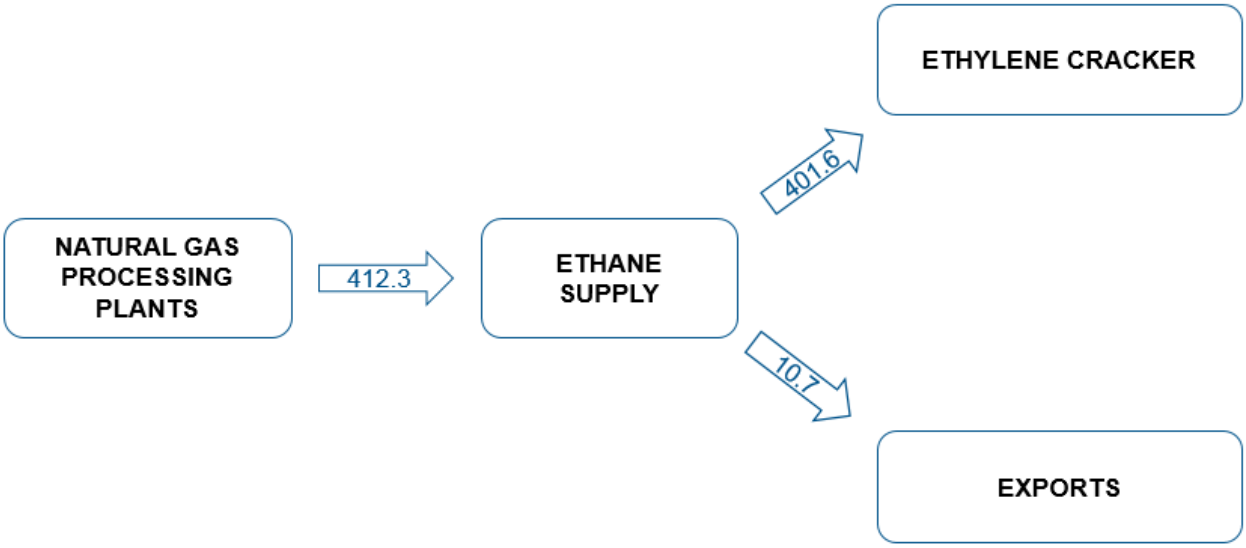


4.3 Natural Gas Liquids Used as a Feedstock

4.3.1 Ethane

Ethane is a natural gas liquid component extracted from raw natural gas at processing facilities. According to EIA, 412 MMbbl of ethane were produced in 2015. Ethane is primarily consumed in ethylene crackers, which produce ethylene in addition to other beneficial olefin products. The primarily product of ethane is ethylene, which acts as a feedstock for the widely used plastic polyethylene. The U.S. was a net exporter of ethane with 10.7 MMbbl being exported in 2015. Exhibit 4-20 shows the various pathways of ethane within the U.S.

Exhibit 4-20: Ethane 2015 Balance (MMbbl)

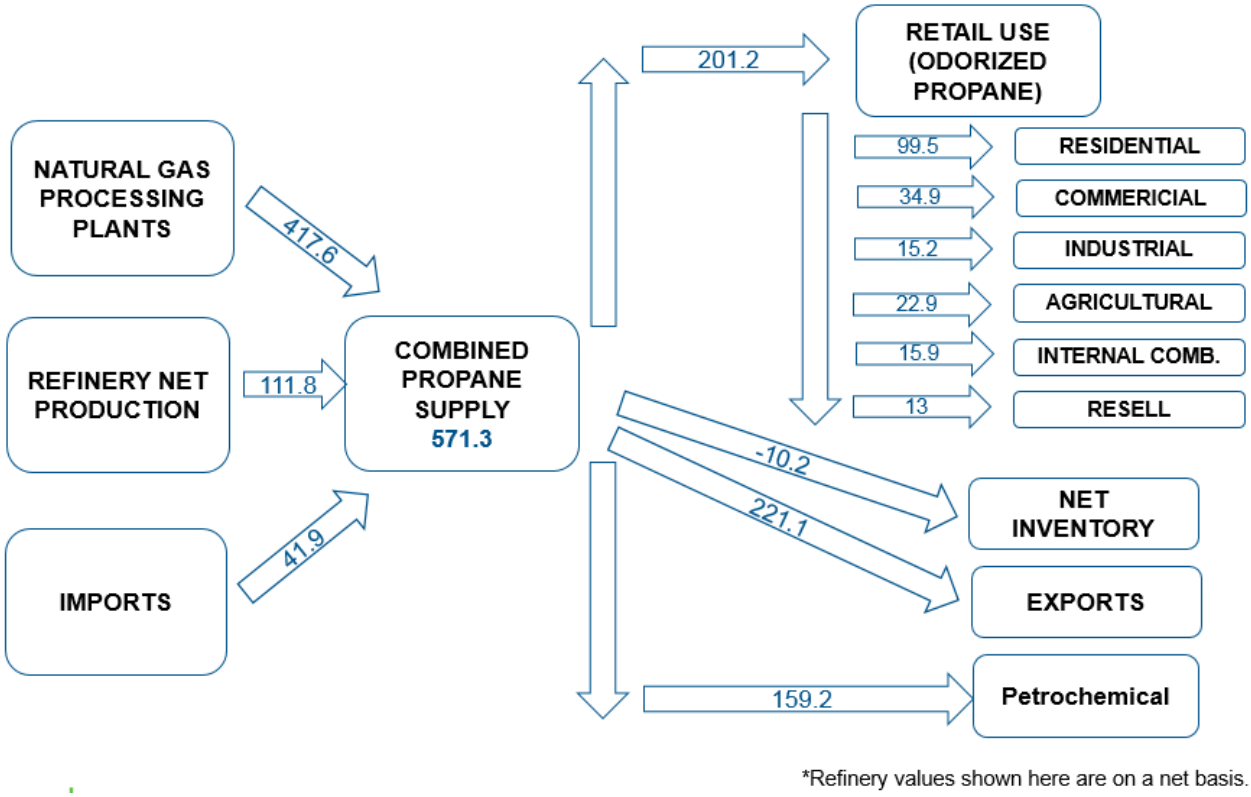


4.3.2 Propane

Propane is one of the main NGL constituents available through (1) the processing of natural gas to remove heavy hydrocarbons at processing facilities and the fractionation of those liquids at fractionation plants and (2) the production of propane at crude oil refineries. Due to increases in domestic natural gas production, natural gas processing plant production of propane has increased dramatically in recent years to over 1,144,000 barrels per day in 2015 while refinery production has remained largely stable with roughly 306,000 barrels per day of production.

Propane is the most widely used NGL as it is consumed in a variety of residential, commercial, industrial, and petrochemical applications. In recent years propane has also become one of the largest hydrocarbon exports. In 2015 propane exports surpassed domestic consumption for the first time. In 2015, the U.S. exported 605,000 barrels per day while domestic retail propane consumption declined to 551,000 barrels per day due to a warm winter season that reduced residential heating demand. The U.S. continues to import propane from Western Canada, accounting for 7.3% of domestic supply. Canadian exports of propane account for a large portion of regional usage in several Midwestern and Northern states. The pathway of uses for propane are shown in Exhibit 4-21 below.

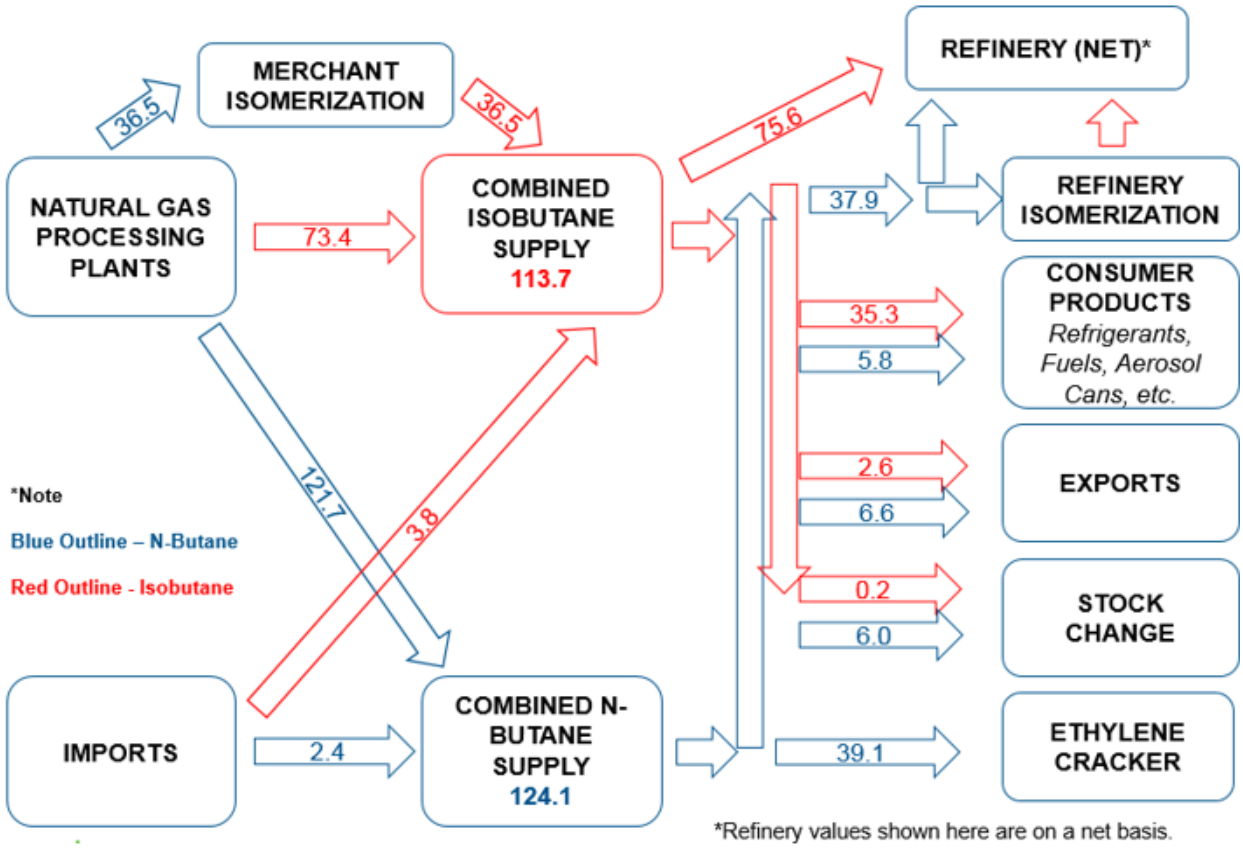
Exhibit 4-21: Propane 2015 Balance (MMbbl)



4.3.3 n-Butane/Isobutane

n-Butane and isobutane are two NGL constituents available through the fractionation of natural gas performed at processing facilities. The pathway of uses for both of these chemicals is shown in the Exhibit 4-22. Some n-butane is converted into isobutane through merchant isomerization. Both normal butane and isobutane are sent to refineries where they are used as blendstocks with 31% and 66% of total supply sent in 2015 respectively. Again, normal butane is sometimes isomerized to isobutane at refineries and some is sent to ethylene crackers. Butane and isobutane have uses in some consumer products including refrigeration, as fuel, and in aerosol cans. Below, the refinery net estimation is the difference between the total gross production value of 21.8 MMbblyr and the total gross consumption value of 135.3 MMbbl.

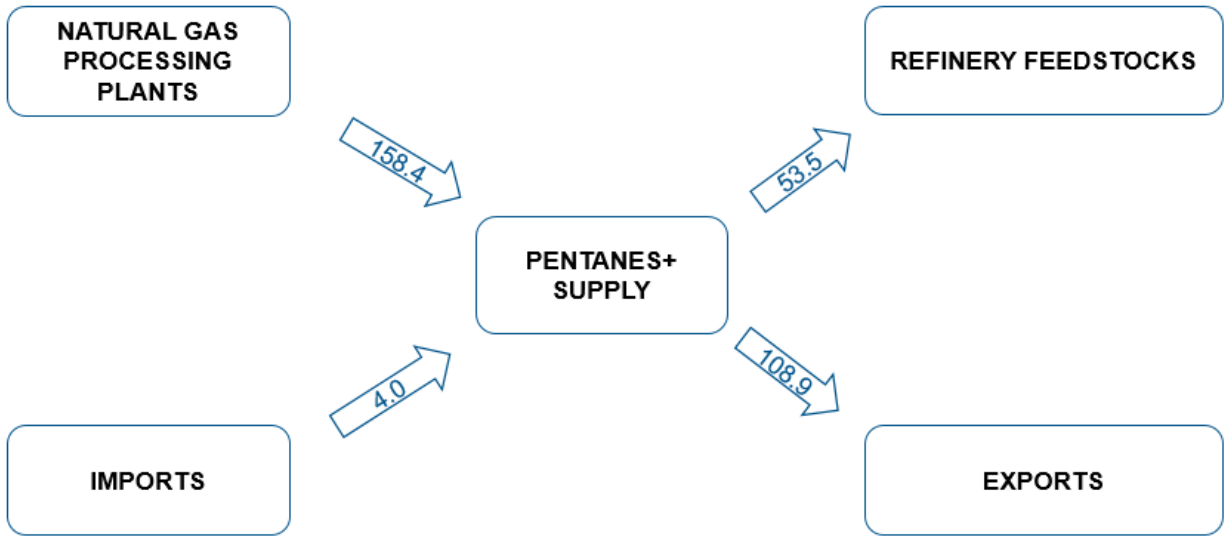
Exhibit 4-22: Butane/Isobutane 2015 Balance (MMbbl)



4.3.4 Pentanes Plus

Pentanes plus represent a mixture of heavier hydrocarbons produced from raw natural gas in processing plants using fractionation. According to EIA, 158 MMbbl of pentanes plus were extracted from natural gas in 2015 at processing plants. The allocation of both domestically-produced and imported pentanes plus to refinery feedstocks and exports is displayed below in Exhibit 4-23. Pentanes plus are generally used as a blending component in mixtures of gasoline within crude oil refineries. The U.S. is also a net exporter of pentanes, with a large volume exported to Canada for use as diluent.

Exhibit 4-23: Pentanes Plus 2015 Balance (MMbbl)



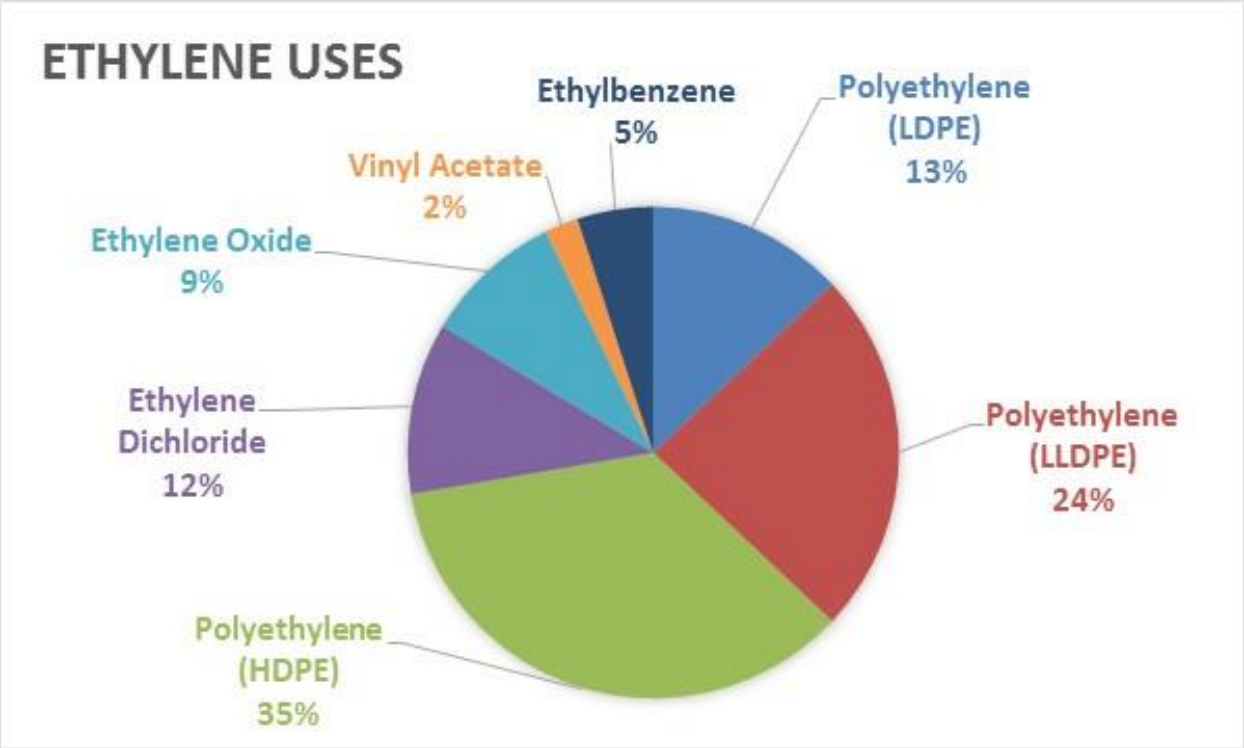
4.3.5 Ethylene

Ethylene is an olefin gas which is used as a major feedstock for a number of intermediate products in the petrochemical industry. Ethylene crackers are the primary source of ethylene. Ethane, propane, butane, and naphtha are all fed to the ethylene cracker, producing mainly ethylene with propylene, butylene, butadiene, methane, gasoline, and gas/oil as coproducts. The process involves the thermal cracking of each paraffin molecule, effectively breaking bonds and creating olefins.

Ethylene is primary converted to polyethylene, a plastic used in a large number of packaging applications. Ethylene can also be converted into other major intermediate products including ethylene oxide or ethylene dichloride. For instance, ethylene oxide has a number of different uses in consumer products including demand for uses in antifreeze, engine coolants and polyesters among others[32]. Ethylene dichloride primarily acts as an intermediate product which eventually converts into polyvinyl chloride (PVC). Exhibit 4-24 contains a breakdown of ethylene uses in intermediate products.

[32] "DOW Ethylene Oxide"; http://www.dow.com/ethyleneoxide/applications/

Exhibit 4-24: Percentage of Ethylene Used to Produce Derivatives



Ethylene Methodology

The first step in this methodology involved determining the volume of ethylene produced from crackers within the U.S. available for use in further derivatives. This involved using natural gas liquid feed rates to ethylene crackers from OGJ[33]. These rates were used to determine the volume of coproducts created using an in-versus-out yield table[34] and then compared with OGJ reported data for ethylene. For comparison and assurance, the yields within the in-versus-out table were varied slightly to match OGJ reported data and were deemed to be reasonable.

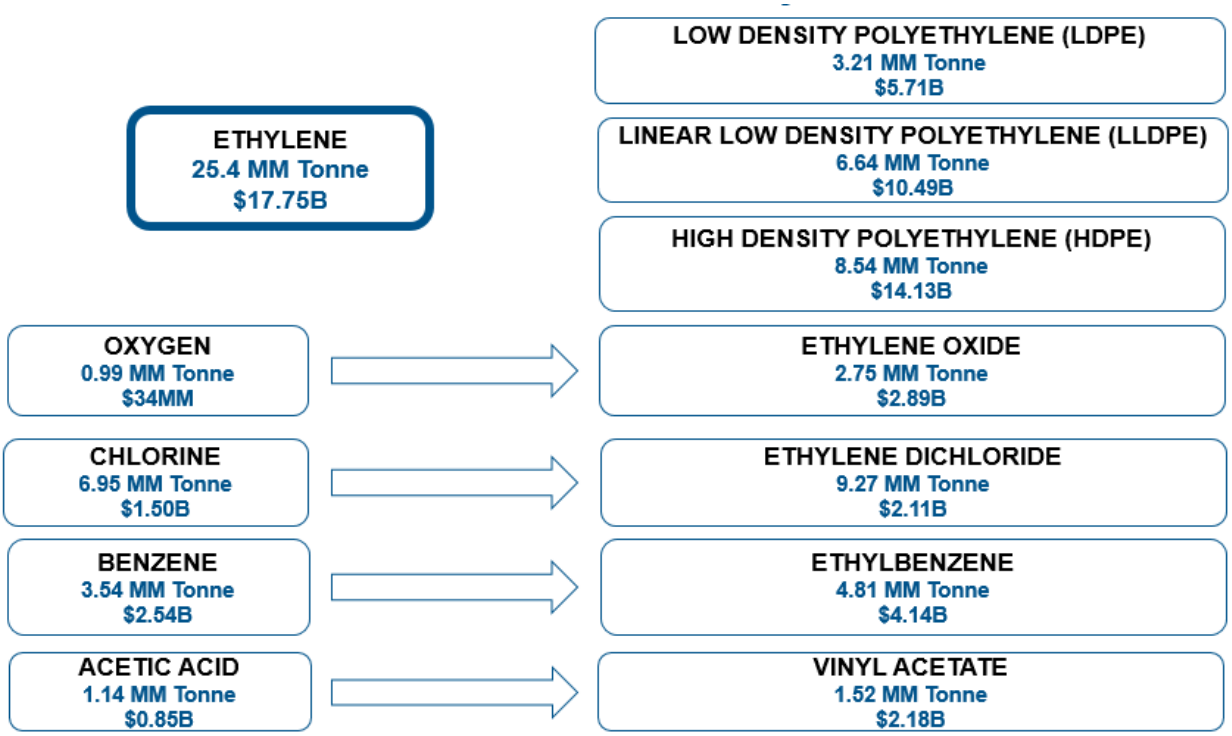
The next step involved identifying and determining intermediate derivative volumes. The major derivatives include polyethylene, ethylene dichloride, ethylene oxide, vinyl acetate, and ethylbenzene. Based on chemical reactions between ethylene and any additional reactants required, each derivative product volume was used to estimate the amount of ethylene and additional reactants required. For example, ethylene reacts with oxygen (additional reactant) to produce ethylene oxide (derivative).

The value added from ethylene derivatives was calculated by using the price of ethylene, additional reactants, and derivatives in combination with each derivative production volume. The prices were obtained from several price databases including Bloomberg and the International

[33] Oil and Gas Journal (OGJ) 2016, U.S. midstream Report
[34] ICF estimates used for input/output modeling of cracker plants. Matrix represent unit weight on input versus unit weight of outputs for different feedstocks.

Trade Center. Imports and exports from the United States Census Bureau and the Energy Information Administration were also taken into account. Exhibit 4-25 below shows the ethylene balance including intermediate derivatives. Each value shown is determined by multiplying the product volume product by the price of the product.

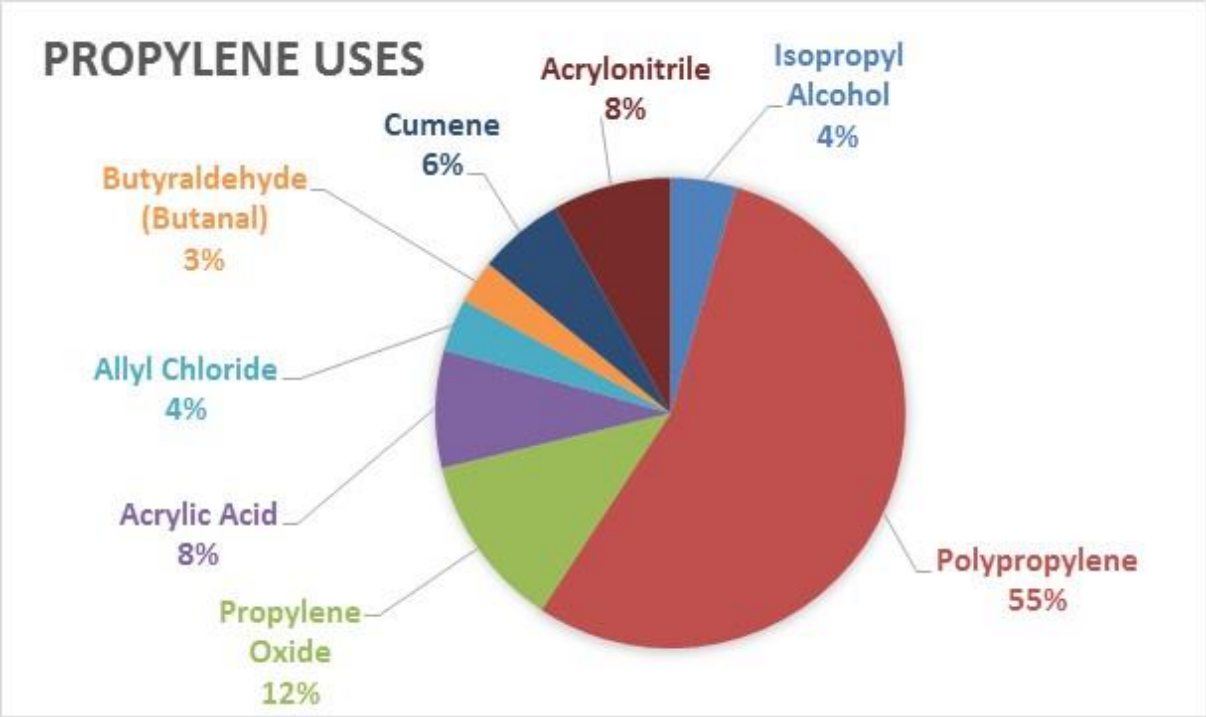
Exhibit 4-25: Ethylene Derivatives Flow Chart and Value Added



4.3.6 Propylene

Propylene is a colorless gas, and is a byproduct of oil refining and natural gas processing. The gas is an olefin produced from propane fed through a propane dehydrogenation (PDH) plant as well as a coproduct from natural gas liquids through ethylene crackers. Propylene is a major feedstock for a number of important products in industry. Propylene is primarily converted to polypropylene, a widely used packaging polymer. Additionally, propylene can be used to make acrylonitrile, propylene oxide, or cumene for a number of different applications. Exhibit 4-26 below shows the percentage breakdown of propylene uses in intermediate products.

Exhibit 4-26: Percentage of Propylene Used to Produce Derivatives



Propylene Methodology

Propylene is created mainly from three sources: a product of PDH plants, a coproduct from ethylene crackers, and from refineries as a byproduct. In PDH plants, propane is fed and selectively dehydrogenated to create propylene directly in a single feed, single product approach.[35] Ethylene crackers receive natural gas liquids in the form of ethane, propane, butane, and naphtha and produce a number of coproducts from each feed. While ethylene is the primary product from this process, propylene is also created and collected for beneficial use.

The propylene methodology involved a number of steps. First, the volume of propylene produced from crackers within the U.S. was determined. This involved using natural gas liquid feed rates to ethylene crackers from OGJ[33]. These rates were used to determine the volume of coproducts created using an in-versus-out yield table[34] and then compared with OGJ reported data for propylene. The next portion of this methodology involves determining volumes of propylene from PDH plants which was also determined from OGJ data above. The net refinery production value from EIA was used to determine the propylene byproduct volume from refineries.

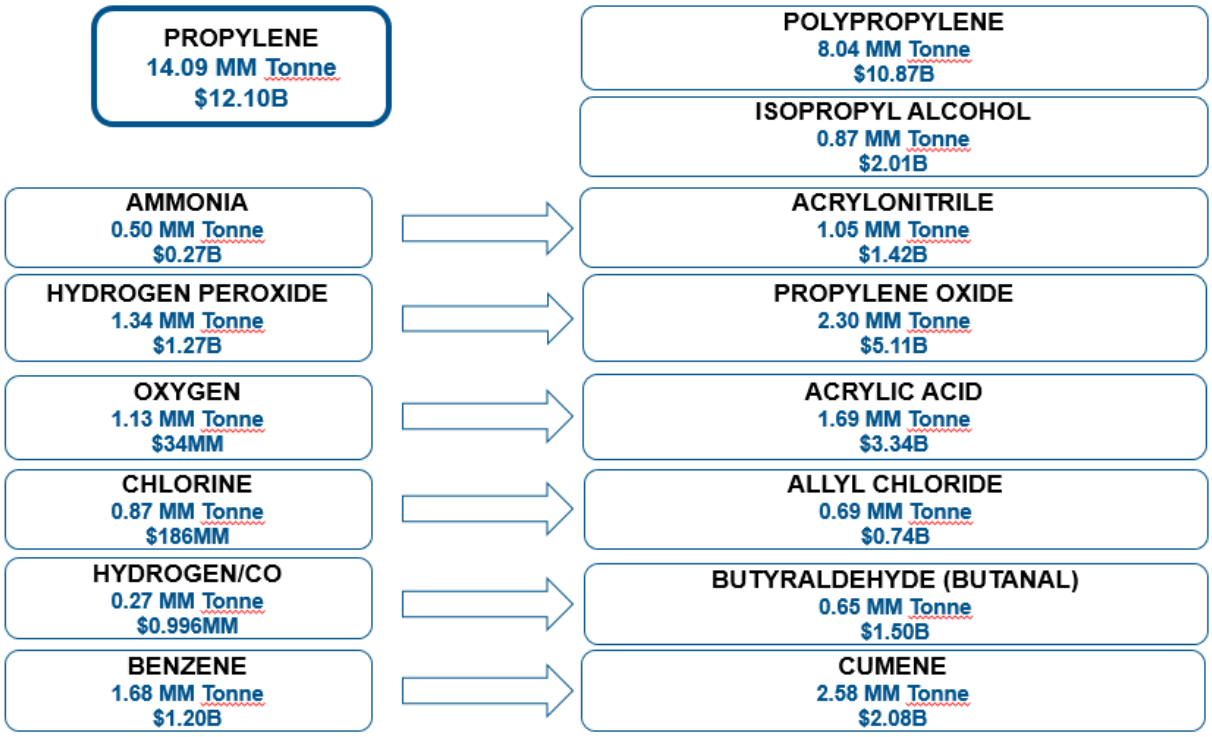
The next step involved determining intermediate derivative volumes from propylene use. The major derivatives include isopropyl alcohol, polypropylene, propylene oxide, acrylic acid, allyl chloride, butyraldehyde (butanal), cumene, and acrylonitrile. Based on chemical reactions between propylene and any additional reactants required, each derivative product volume was

[35] "Propane Dehydrogenation Process Technologies"; https://www.ihs.com/products/chemical-technology-pep-propane-dehydrogenation-process-technologies-267a.html

used to estimate the amount of propylene and additional reactants required. For example, propylene reacts with oxygen (additional reactant) to produce propylene oxide (derivative).

The value added from propylene derivatives was calculated by using the price of propylene, additional reactants, and derivatives in combination with each derivative production volume. The prices were obtained from several price databases including Bloomberg and the International Trade Center. Imports and exports from the United States Census Bureau and the Energy Information Administration were also taken into account. Exhibit 4-27 below shows the propylene balance including intermediate derivatives. Each value shown is determined by multiplying the product volume product by the price of the product.

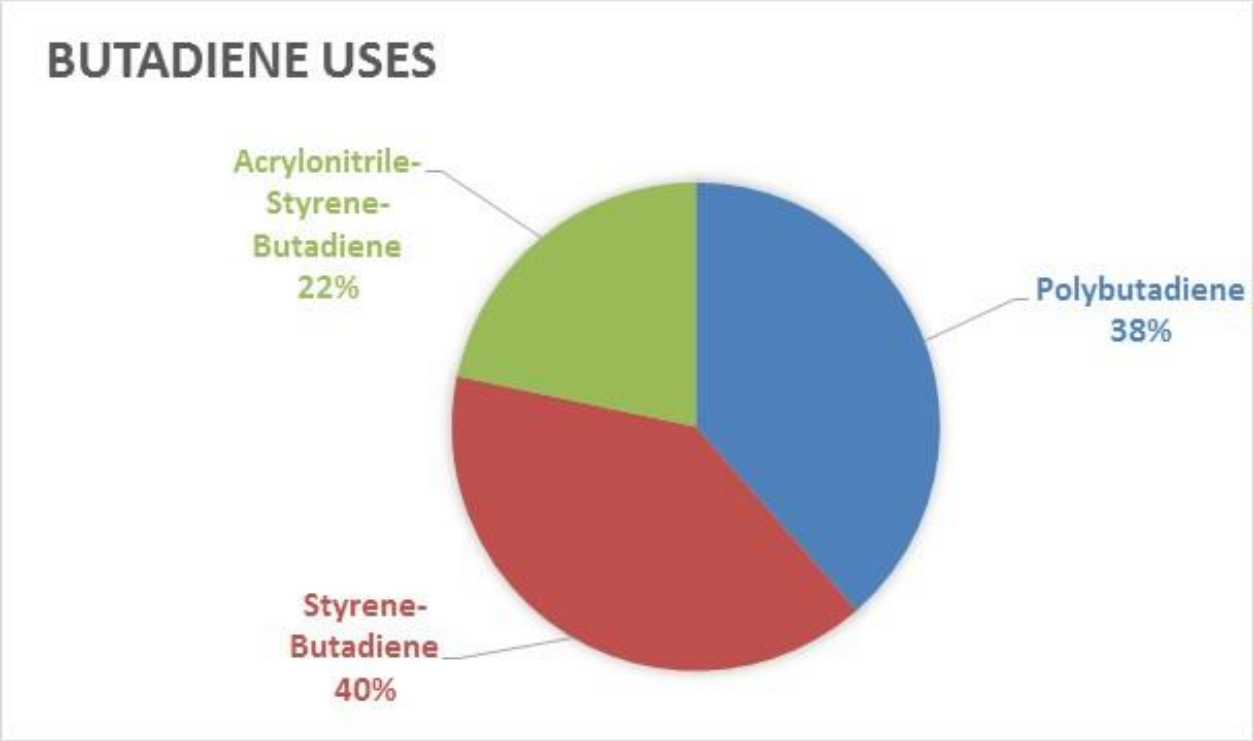
Exhibit 4-27: Propylene Derivatives Flow Chart and Value Added



4.3.7 Butadiene

Butadiene is an industrial chemical often used in synthetic rubbers. It is produced as a coproduct of ethylene cracking, or through the catalytic dehydrogenation of butylene. Butadiene is used to create a number of products such as styrene-butadiene rubber and acrylonitrile butadiene styrene (ABS) resin. Exhibit 4-28 below shows the percentage breakdown of chemicals produced from butadiene. As the estimation butadiene requires consideration for butylene, the methodology for estimating this chemical is also fist briefly discussed in this section.

Exhibit 4-28: Percentage of Butadiene Used to Produce Derivatives



Butylene Methodology

Butylene is a colorless olefin gas that is found in crude oil. Butylene is produced either through catalytic cracking done in petroleum refining or as a coproduct of NGLs fed through ethylene crackers. Butylene is primarily used as a gas blending component within a refinery or dehydrogenated to butadiene for use in rubbers. Ethane and propane yield butylene through the cracker, but butane and naphtha are the largest contributors. In this analysis, butylene is calculated as product from NGLs through ethylene crackers. EIA[36] data is then leveraged to consider the amount sent to refineries through net production. The remaining volume is then considered to be dehydrogenated to butadiene. Butadiene then has two sources: from NGLs through ethylene crackers and from the dehydrogenation of butylene.

[36] Energy Information Agency (EIA) Refinery Net Production; https://www.eia.gov/dnav/pet/pet_pnp_refp2_dc_nus_mbbl_m.htm

Butadiene Methodology

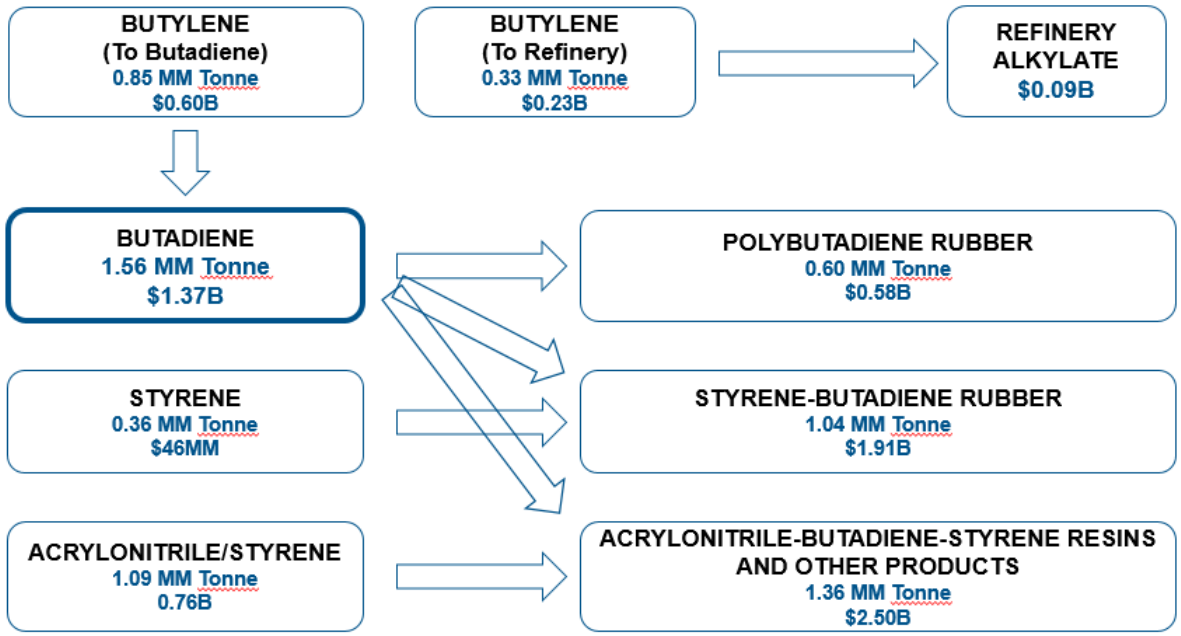
The first step in determining butadiene volumes and uses involved determining the volume produced from crackers within the U.S. This involved using natural gas liquid feed rates to ethylene crackers from OGJ[33]. These rates were used to determine the volume of coproducts created using an in-versus-out yield table[34] and then compared with OGJ reported data for butadiene.

Using the same methodology, the volume of butylene coproduct from ethylene crackers was also determined, with a portion of the volume considered sent to refineries based on data from EIA[36]. The remaining butylene volume was considered to be dehydrogenated to butadiene. The volume of butadiene from ethylene crackers and from dehydrogenation of butylene was then combined for consideration in intermediate products.

The next step in the butadiene methodology was to identify and determine intermediate derivative volumes. The major derivatives include polybutadiene, styrene-butadiene rubber, and acrylonitrile-styrene-butadiene resin. Based on chemical reactions between butadiene and any additional reactants required, each derivative product volume was used to estimate the amount of butadiene and additional reactants required. For example, butadiene reacts with styrene (additional reactant) to produce styrene-butadiene rubber (SBR) (derivative).

The value added from butadiene derivatives was calculated by using the price of butadiene, additional reactants, and derivatives in combination with each derivative production volume. The prices were obtained from several price databases including Bloomberg and the International Trade Center. Imports and exports from the United States Census Bureau and the Energy Information Administration were also taken into account. Exhibit 4-29 below shows the butadiene balance including intermediate derivatives. Each value shown is determined by multiplying the product volume product by the price of the product.

Exhibit 4-29: Butadiene Derivatives Flow Chart and Value Added



5. Jobs and Value Added in 2015

5.1 Introduction and Summary

This chapter presents ICF's estimates for jobs and wages related to the natural gas value chain derived from data appearing in the Bureau of Labor Statistics (BLS) Quarterly Job and Wage Report[37] and input-output relationships developed with the Impact Analysis for Planning (IMPLAN)[38] model of the U.S. economy. IMPLAN is an input-output (I-O) model that incorporates all monetary flows within the U.S. economy among households, government and individual business and non-profit sectors. For example, natural gas production requires oil and gas drilling and support services, equipment, and materials. Those direct impacts will lead to indirect impacts as intermediate inputs for those items (e.g., steel production to make casing and iron mining to make steel) also will see higher demand. The IMPLAN model also estimates induced impacts due to consumers' consumption expenditures rising from the new household incomes that are generated by the direct and indirect effects flowing through to the general economy.

This chapter also presents data for the 2015 contribution to Gross Domestic Product (GDP) by each link in the natural gas value chain. The contribution to GDP can also be called value added and is computed here as value of shipments minus the value of imported intermediate goods and services (all along the supply chain). In other words, the value added estimates presented here include domestic intermediate goods and services (all along the supply chain) because they also are part of U.S. GDP, and so, only imported intermediate goods are subtracted.

Another point of information is that the convention used in this report is to estimate the value added associated with capital stock in the year in which the capital expenditures are made. In this way the value added (GDP contribution) occurs in the same years as the jobs associated with the construction of the capital stock and the mining and manufacturing of materials and equipment used in the capital stock. To avoid double counting of the GDP contribution from the capital stock, depreciation of the capital stock is subtracted (along with foreign capital and intermediate goods) from the value of shipments when production occurs.

ICF estimated capital and operating expenditures in each industry in 2015 and then used the I/O relationships in IMPLAN to estimate the related number of direct, indirect and induced jobs and wages and the associated value added. The results of this base year analysis are shown in Exhibit 5-1 and Exhibit 5-2 on a "100% Basis" and a "Natural Gas Value Chain Basis." The "100% Basis" shown in Exhibit 5-1 counts all U.S. activity in a relevant link (that is, in each U.S. industrial sector that is part of the U.S. natural gas value chain) related to converting oil, gas

[37] For information of the Quarterly Census of Employment and Wages (QCEW) see https://www.bls.gov/cew/home.htm
[38] For more information on IMPLAN see http://www.implan.com/

and NGL into chemical products, electricity, LNG or other energy services regardless of the origin of the primary feedstock or intermediate petrochemical. These "100% Basis" results will be directly comparable many industry and government statistical reports (wherein the origin of the fuel/feedstocks is seldom relevant). On the other hand, the Natural Gas Value Chain Basis in Exhibit 5-2 presents only economic impact measures of U.S. activity that can be traced back to domestic natural gas feedstocks and fuels (dry gas, lease condensate and NGLs).

Exhibit 5-1: U.S. Jobs and Value Added for 2015: 100% Basis

	100% Basis ($million, job counts)			
	Value Added in Sector (Direct & Indirect)	Direct, Indirect & Induced Value Added	Direct & Indirect Jobs	Direct, Indirect and Induced Jobs
Upstream	$203,556	$308,088	1,254,386	2,427,461
Gathering	$10,878	$16,749	57,521	121,544
Processing	$10,437	$15,691	61,502	118,796
Pipelines	$58,478	$90,042	333,965	678,154
Natural Gas Distribution	$42,803	$64,261	277,396	514,903
Propane & Other NGL/LPG Distribution	$12,767	$19,658	59,737	134,880
Petrochemical Manufacturing	$110,515	$176,785	380,980	1,134,907
Petroleum Refining	$95,380	$147,739	327,180	906,327
LNG Export Terminals	$9,076	$14,471	81,532	142,080
Helium Refining & Distribution	$572	$888	1,467	4,941
CO2 Distribution	$80	$123	348	818
Gas-fired Electricity Generation	$46,897	$72,046	163,558	449,616
Industrial Gas-fired Equipment	$14,107	$21,919	59,338	145,806
Res. & Com. Gas Appliances and Equip.	$43,038	$64,192	180,862	415,005
Sum of All Links in Chain	**$658,584**	**$1,012,651**	**3,239,772**	**7,195,239**
Entire US GDP	***18,036,650***			
Value Added as % of US GDP	***3.7%***	***5.6%***		
Entire US non-farm employment	***141,813,083***			
Jobs as % of U.S. Jobs			***2.3%***	***5.1%***

In 2015 the industrial sectors that participated in the natural gas value chain had a combined direct plus indirect contribution to the GDP of $658.6 billion dollars on a 100% Basis, which includes the economic activity associated with the use of oil and imported natural gas. Adding in induced effects, the contribution to GDP on a 100% Basis is $1,012.7 billion. Employment measured on a 100% Basis is 3.24 million direct and indirect jobs and 7.20 million jobs when induced effects are included. Another way of looking at these numbers is that these sectors on a

100% Basis represent 5.6% of the U.S. GDP and 5.1% of total non-farm employment when direct, indirect and induced activities are counted.

Exhibit 5-2: U.S. Jobs and Value Added for 2015: Natural Gas Value Chain Basis

	U.S. Natural Gas Value Chain Basis ($million, job counts)			
	Value Added in Sector (Direct & Indirect)	Direct, Indirect & Induced Value Added	Direct & Indirect Jobs	Direct, Indirect and Induced Jobs
Upstream	$73,596	$111,390	609,382	1,033,510
Gathering	$10,878	$16,749	57,521	121,544
Processing	$10,437	$15,691	61,502	118,796
Pipelines	$33,402	$51,431	213,837	410,435
Natural Gas Distribution	$38,694	$58,092	250,766	465,473
Propane & Other NGL/LPG Distribution	$8,886	$13,682	41,429	93,730
Petrochemical Manufacturing	$71,133	$113,788	244,122	729,387
Petroleum Refining	$7,419	$11,492	25,449	70,497
LNG Export Terminals	$9,076	$14,471	81,532	142,080
Helium Refining & Distribution	$572	$888	1,467	4,941
CO2 Distribution	$20	$31	87	204
Gas-fired Electricity Generation	$42,395	$65,130	147,857	406,453
Industrial Gas-fired Equipment	$12,752	$19,814	53,642	131,808
Res. & Com. Gas Appliances and Equip.	$38,907	$58,029	163,499	375,165
Sum of All Links in Chain	**$358,167**	**$550,677**	**1,952,091**	**4,104,023**
Entire U.S. GDP	***18,036,650***			
Value Added as % of U.S. GDP	***2.0%***	***3.1%***		
Entire U.S. non-farm employment	***141,813,083***			
Jobs as % of U.S. Jobs			***1.4%***	***2.9%***

Subtracting out the economic effects associated with domestic oil and imported natural gas yields the Natural Gas Value Chain Basis GDP and job counts shown in Exhibit 5-2. The total value added by these direct, indirect and induced activities sums to $550.7 billion in 2015, which is 3.1% of the entire U.S. GDP for that year. The exhibit shows that the direct and indirect jobs that can be attributed to domestic natural gas value chain total 1.95 million. Adding another 2.15 million jobs that can be attributed to induced economic activity produces a total job count of 4.10 million or 2.9% of all non-farm jobs reported by the BLS for 2015.

Exhibit 5-3 shows the number of jobs for both the 100% Basis and the Natural Gas Value Chain Basis for North American Industry Classification System (NAICS) sectors with the largest number of direct and indirect jobs. Also shown in the table are the number of total jobs in the NAICS in 2015 and what percent of those jobs are represented by the 100% Basis and Natural Gas Value Chain Basis. The rows of the exhibit are sorted by the number of jobs on a 100% Basis. As would be expected, the largest number of jobs are associated with sectors natural gas and oil production, processing and transportation and the large end-use sectors of chemicals and gas-fired power generation. For the sectors the make up the upstream sector and its support industries, the 100% Basis usually encompasses all of the reported jobs.

Exhibit 5-3: NAICS Codes with Largest Number of Direct & Indirect Jobs in 2015

NAICS Code	Sector	Employees 100% Basis	Employees NGVC Basis	Total From BLS Table	100% Basis as Fraction	NGVC Basis as Fraction
213112	Support Activities for Oil & Gas Operations	278,538	134,530	278,538	100%	48%
211111	Crude Petroleum & Natural Gas Extraction	187,539	90,579	187,539	100%	48%
325	Chemical Manufacturing	177,916	114,505	805,945	22%	14%
237120	Oil & Gas Pipeline Construction	135,472	97,220	135,472	100%	72%
4841	Freight Truck	95,152	33,515	989,410	10%	3%
221210	Natural Gas Distribution	93,154	84,211	93,154	100%	90%
213111	Drilling Oil & Gas Wells	70,143	33,878	70,143	100%	48%
811310	Industrial Equip. & Machinery Repair & Maint.	70,113	54,205	205,458	34%	26%
324110	Petroleum Refineries	59,923	4,661	59,923	100%	8%
236210	Industrial Construction	53,856	41,651	162,830	33%	26%
333132	Oil & Gas Field Machinery & Equipment Manufacturing	48,331	23,343	53,701	90%	43%
45431NGL	NGL Retail	39,909	27,678	39,909	100%	69%
486210	Pipeline Transportation of Natural Gas	26,059	23,808	26,059	100%	91%
221112	Gas-fired Electric Power Generation	25,802	23,325	82,966	31%	28%
331210	Iron & Steel Pipe & Tube Manufacturing	22,480	13,759	24,074	93%	57%
4821	Freight Rail	19,947	7,812	181,264	11%	4%
33241	Power Boiler & Heat Exchanger Manufacturing	18,762	15,973	22,040	85%	72%
333611	Turbine and Turbine Generator Manufacturing	17,002	14,735	19,077	89%	77%

NAICS Code	Sector	Employees 100% Basis	Employees NGVC Basis	Total From BLS Table	100% Basis as Fraction	NGVC Basis as Fraction
811412	Household Appliance Repair & Maintenance	14,747	13,332	19,663	75%	68%
336611	Ship Building and Repairing	10,516	5,079	104,315	10%	5%
4247NGL	NGL Wholesale	9,700	6,727	9,700	100%	69%
333994	Industrial Process Furnace & Oven Manufacturing	9,472	7,892	9,971	95%	79%
211112	Natural Gas Liquid Extraction	8,730	8,730	8,730	100%	100%
486110	Pipeline Transportation of Crude Oil	7,520	706	7,520	100%	9%
331110	Iron and Steel Mills	6,819	3,669	88,277	8%	4%
335228	Other Major Household Appliance Manufacturing	6,232	5,634	10,387	60%	54%
333415	Air-Conditioning and Warm Air Heating Equipment	6,176	5,583	88,880	7%	6%
326122	Plastics Pipe & Fittings manufacturing	6,165	5,691	24,659	25%	23%
333414	Heating Boilers & Fireplace Manufacturing	6,099	5,513	16,521	37%	33%
333912	Air & Gas Compressor Manufacturing	5,470	4,378	17,026	32%	26%
486910	Pipeline Transportation of Refined Petroleum Products	5,148	2,600	5,148	100%	50%
332420	Metal Tank Manufacturing	3,774	2,618	37,744	10%	7%
335221	Household Ovens Manufacturing	3,094	2,797	12,374	25%	23%
332911	Industrial Valve Manufacturing	2,879	1,411	26,175	11%	5%
327310	Cement Manufacturing	2,661	1,285	10,644	25%	12%
333911	Pump and Pumping Equipment Manufacturing	2,477	1,828	20,645	12%	9%
212322frac	Frac Sand Mining	1,982	957	1,982	100%	48%
335312	Motor and Generator Manufacturing	1,692	855	33,843	5%	3%
45431CNG	CNG Stations	1,629	1,473	1,629	100%	90%
335224	Household Dryers Manufacturing	1,071	968	7,141	15%	14%

Source: ICF estimates for the 100% Basis and NGVC Basis. Total jobs are usually from BLS except where ICF had to estimate missing data. Some the sector reported here (Frac Sand Mining, NGL Wholesale, NGL Retail, and CNG Stations) were created by ICF from larger BLS sectors to reflect more accurately the distribution of relevant jobs among the states.

The distribution of 2015 total jobs, wages and value added by state is shown in Exhibit 5-4. A similar table for the Natural Gas Value Chain Basis appears as Exhibit 5-5. (Additional breakdown by state is provided in Appendix A.) Texas has the largest number of jobs in total due to the fact it is a large natural gas producer and has a large number of gas-using industries and power plants. California has the second highest number of jobs due to its large population and a manufacturing base that contributes indirect jobs to the production and other segments. All states, including those that do not produce any natural gas, have at least some number of jobs related to (1) the distribution of natural gas and propane, (2) production of intermediate goods used in the three segments and (3) production of consumer goods and services purchased through induced activity.

Exhibit 5-4: Economic Impacts by State 2015: 100% Basis (Direct, Indirect and Induced)

State	Employees 100% Basis	Wages 100% Basis ($million)	Value Added 100% Basis ($million)
Alabama	91,897	5,298	13,267
Alaska	43,721	4,214	8,521
Arizona	65,407	3,630	7,505
Arkansas	64,507	3,614	8,602
California	687,439	44,487	91,662
Colorado	134,750	10,891	19,727
Connecticut	56,716	3,294	6,684
Delaware	13,159	746	1,521
District of Columbia	8,909	468	918
Florida	154,378	8,388	18,854
Georgia	141,895	7,986	17,404
Hawaii	8,301	424	777
Idaho	17,485	945	1,861
Illinois	261,255	15,585	34,053
Indiana	179,803	10,376	19,620
Iowa	77,021	4,406	8,690
Kansas	79,168	4,552	11,055
Kentucky	91,658	5,224	11,841
Louisiana	349,311	24,579	63,222
Maine	12,446	680	1,271
Maryland	64,395	3,547	7,627
Massachusetts	106,594	6,209	12,063

State	Employees 100% Basis	Wages 100% Basis ($million)	Value Added 100% Basis ($million)
Michigan	203,371	12,202	26,025
Minnesota	108,852	6,387	13,567
Mississippi	64,246	3,991	12,148
Missouri	96,349	5,359	11,418
Montana	24,824	1,603	4,497
Nebraska	36,118	2,060	3,934
Nevada	25,914	1,444	3,316
New Hampshire	17,364	981	2,033
New Jersey	131,663	8,088	17,277
New Mexico	72,407	4,132	10,500
New York	250,671	14,811	29,906
North Carolina	191,217	10,619	21,663
North Dakota	67,637	4,973	13,689
Ohio	307,074	18,384	43,158
Oklahoma	215,789	15,703	31,654
Oregon	79,436	4,518	8,091
Pennsylvania	289,340	17,720	39,208
Rhode Island	11,865	675	1,469
South Carolina	94,327	5,289	12,541
South Dakota	11,447	615	1,199
Tennessee	137,993	7,901	18,986
Texas	1,514,108	124,640	248,454
Utah	54,080	3,256	7,824
Vermont	6,359	360	720
Virginia	118,864	6,716	14,702
Washington	117,507	6,973	14,533
West Virginia	54,996	3,494	8,662
Wisconsin	127,711	7,019	14,389
Wyoming	53,495	3,565	10,342
Total	**7,195,239**	**473,023**	**1,012,651**

Exhibit 5-5: Economic Impacts by State 2015: Natural Gas Value Chain Basis (Direct, Indirect and Induced)

State	Employees NGVC Basis	Wages NGVC Basis ($million)	Value Added NGVC Basis ($million)
Alabama	56,542	3,338	7,750
Alaska	21,677	1,949	3,113
Arizona	39,580	2,282	5,024
Arkansas	40,621	2,439	5,293
California	378,589	23,182	45,505
Colorado	75,598	5,859	10,459
Connecticut	33,001	1,979	4,341
Delaware	7,965	467	1,021
District of Columbia	5,129	278	575
Florida	91,150	5,138	12,557
Georgia	85,201	4,961	11,343
Hawaii	4,127	223	416
Idaho	10,392	581	1,203
Illinois	149,445	8,955	18,817
Indiana	105,676	6,233	12,169
Iowa	47,034	2,763	5,589
Kansas	43,150	2,550	5,335
Kentucky	56,463	3,289	7,757
Louisiana	201,972	14,218	28,718
Maine	7,174	407	791
Maryland	38,254	2,198	4,892
Massachusetts	63,357	3,846	7,950
Michigan	121,219	7,522	16,729
Minnesota	61,017	3,592	7,170
Mississippi	35,461	2,151	5,501
Missouri	58,011	3,325	7,334
Montana	11,487	708	1,482
Nebraska	21,029	1,261	2,426
Nevada	16,154	942	2,318

State	Employees NGVC Basis	Wages NGVC Basis ($million)	Value Added NGVC Basis ($million)
New Hampshire	10,092	591	1,315
New Jersey	79,529	5,130	11,560
New Mexico	40,168	2,598	5,110
New York	151,911	9,459	20,095
North Carolina	112,705	6,410	13,590
North Dakota	32,639	2,556	3,885
Ohio	188,381	11,654	26,691
Oklahoma	118,088	8,803	16,745
Oregon	46,090	2,697	5,018
Pennsylvania	178,420	11,393	24,555
Rhode Island	7,360	434	1,032
South Carolina	58,826	3,406	8,186
South Dakota	6,535	370	725
Tennessee	86,664	5,035	12,932
Texas	789,100	63,207	114,657
Utah	29,447	1,802	3,669
Vermont	3,970	228	476
Virginia	73,159	4,255	9,712
Washington	64,392	3,748	7,509
West Virginia	35,898	2,605	5,851
Wisconsin	74,466	4,187	9,097
Wyoming	29,708	2,283	4,689
Total	**4,104,023**	**269,486**	**550,677**

Estimated taxes generated by the direct, indirect and induced economic activity is shown on Exhibit 5-6 by state. On the 100% Basis state and local taxes and fees are $149.6 billion while federal taxes and fees are $185.5 billion. The Natural Gas Value Chain Basis shows state and local revenues of $81.2 billion and federal revenues of $100.9 billion. The federal revenues are computed based on the income estimated to originate in each state and do not reflect the state where corporate headquarters might be located.

Exhibit 5-6: Tax Impacts by State 2015: 100% Basis & NGCV Basis (Direct, Indirect and Induced)

	100% Basis		NGVC Basis	
State	Contribution to State & Local Taxes & Fees ($million)	Contribution to Federal Taxes & Fees	Contribution to State & Local Taxes & Fees ($million)	Contribution to Federal Taxes & Fees
Alabama	1,957	2,430	1,143	1,420
Alaska	2,756	1,561	1,007	570
Arizona	1,021	1,375	684	920
Arkansas	1,225	1,576	754	970
California	14,433	16,790	7,165	8,335
Colorado	2,859	3,614	1,516	1,916
Connecticut	924	1,224	600	795
Delaware	266	279	179	187
District of Columbia	164	168	103	105
Florida	2,530	3,454	1,685	2,300
Georgia	2,296	3,188	1,496	2,078
Hawaii	139	142	75	76
Idaho	250	341	162	220
Illinois	5,093	6,238	2,814	3,447
Indiana	2,917	3,594	1,809	2,229
Iowa	1,404	1,592	903	1,024
Kansas	1,743	2,025	841	977
Kentucky	1,662	2,169	1,089	1,421
Louisiana	9,330	11,581	4,238	5,260
Maine	202	233	126	145
Maryland	1,048	1,397	672	896
Massachusetts	1,619	2,210	1,067	1,456
Michigan	3,883	4,767	2,496	3,064
Minnesota	2,187	2,485	1,156	1,313
Mississippi	2,002	2,225	906	1,008
Missouri	1,503	2,091	965	1,343
Montana	645	824	212	271
Nebraska	582	721	359	444
Nevada	467	607	326	425
New Hampshire	245	372	158	241
New Jersey	2,565	3,165	1,717	2,118
New Mexico	1,812	1,923	882	936
New York	5,825	5,478	3,914	3,681
North Carolina	3,265	3,968	2,048	2,489
North Dakota	2,921	2,508	829	712

	100% Basis		NGVC Basis	
Ohio	6,629	7,906	4,100	4,889
Oklahoma	4,173	5,798	2,208	3,067
Oregon	1,303	1,482	808	919
Pennsylvania	5,616	7,182	3,517	4,498
Rhode Island	228	269	161	189
South Carolina	2,081	2,297	1,358	1,499
South Dakota	142	220	86	133
Tennessee	2,305	3,478	1,570	2,369
Texas	32,225	45,511	14,871	21,002
Utah	1,217	1,433	570	672
Vermont	117	132	78	87
Virginia	1,929	2,693	1,274	1,779
Washington	2,071	2,662	1,070	1,376
West Virginia	1,476	1,587	997	1,072
Wisconsin	2,259	2,636	1,428	1,666
Wyoming	2,138	1,894	969	859
Total	**149,649**	**185,493**	**81,161**	**100,870**

5.2 2015 Impacts by Natural Gas Value Chain Segment

The next few tables show jobs, wages and value added by one of three natural gas value chain "segments" made up of "end use," "infrastructure," and "production." The end-use segment aggregates the activity related to how the natural gas and related liquids are used to provide energy services or are converted to other products such as electricity or petrochemicals The economic impacts related to the end-use of natural gas and its associated liquids encompass gas-fired power generation; residential and commercial appliances and equipment manufacturing, wholesaling/retailing, installation, and maintenance; industrial gas-fired equipment and manufacturing, wholesaling/retailing, installation, and maintenance; the chemical sector using natural gas and NGLs as feedstocks; and the sectors that make CNG/LNG/propane vehicle fuel tanks and retail refueling systems. The economic impacts for the end-use segment are shown in Exhibit 5-7 for 2015.

Exhibit 5-7: NGVC Basis Economic Impacts 2015: End-use Segment

NGVC Basis	Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Category in End-use Segment	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Power Generation	147,857	258,596	406,453	11,419	12,891	24,311	42,395	22,735	65,130
Industrial	297,763	563,432	861,195	23,354	28,228	51,582	83,885	49,717	133,602
Residential/ Commercial	163,499	211,665	375,165	10,934	10,946	21,880	38,907	19,123	58,029
Export	81,532	60,548	142,080	5,965	3,075	9,040	9,076	5,396	14,471
Transportation	1,751	1,564	3,315	82	81	130	284	146	430
Sum	**692,402**	**1,095,805**	**1,788,207**	**51,753**	**55,221**	**106,941**	**174,547**	**97,116**	**271,663**

The end-use segment is the largest of the three segments with 1.79 million total jobs, which is 43.6% of the total jobs for the Natural Gas Value Chain Basis in 2015. Jobs associated with industrial natural gas and NGL use is the largest portion of the end-use segment, followed by gas- fired power generation and then residential/commercial end-use.

Exhibit 5-8 shows 2015 data for the infrastructure segment, which is made up of gatherers, gas processing, petroleum refining, natural gas distribution and propane distribution. The infrastructure segment supported 1.28 million total jobs or 31.2% of the 2015 total jobs in the Natural Gas Value Chain in 2015. The greatest number of jobs in the infrastructure segment is associated with natural gas and other (propane, helium, CO2) distribution to consumers. The next largest category is represented by pipelines, including most importantly natural gas pipelines and NGL pipelines but also including a small portion of crude oil, petroleum product and CO2 pipelines.

Exhibit 5-8: NGVC Basis Economic Impacts 2015: Infrastructure Segment

NGVC Basis	Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Category in Infrastructure Segment	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Processing	86,951	102,342	189,293	7,211	5,296	12,508	17,856	9,327	27,183
Pipelines	268,373	257,754	526,128	21,702	13,409	35,111	43,793	23,637	67,430
Distribution	287,063	264,488	551,552	21,992	13,693	35,717	47,079	23,962	71,041
Wholesalers, Marketers, Other	7,920	7,414	15,333	619	385	1,005	1,296	675	1,971
Sum	**650,307**	**631,998**	**1,282,306**	**51,525**	**32,783**	**84,341**	**110,024**	**57,600**	**167,624**

The last of the three segments making up the Natural Value Chain is the production segment, which consists of oil and gas production companies and their suppliers of goods and services. The production segment supported 1.03 million jobs or 25.2% of total Natural Gas Value Chain jobs in 2015; these figures are shown in detail in Exhibit 5-9.

Exhibit 5-9: NGVC Basis Economic Impacts 2015: Production Segment

NGVC Basis	Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Category in Production Segment	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Natural Gas/ NGLs	609,382	424,129	1,033,510	56,667	21,537	78,204	73,596	37,794	111,390

5.3 Natural Gas End Uses

5.3.1 Power Generation

As introduced in section 4.2, one key use for natural gas is as feedstock to gas-fired power plants. These facilities combust gas to produce steam, which in turn powers a turbine that generates electricity. In combined heat and power facilities, this steam may serve the secondary purpose of providing space heating services. Exhibit 5-10 below includes figures first introduced in section 4.2 that represent the value of gas generation and the value added by gas-fired electricity generation in 2015 at the U.S. level, as well as the average total value of electricity generation and the value of non-gas generation.

Historical Value Added of Gas in the Electric Power Sector

The value added by gas fired electricity generation in 2015 was calculated for each of the contiguous 48 states. These calculations were based largely on publicly available data and assumptions taken from EIA, FERC Form 1, the 2016 Annual Energy Outlook (AEO 2016), and EPA's NEEDS database. The value added figures for gas in the electric sector calculations are composed of four main components: the value of gas, fuel costs, depreciation costs, and capital expenditures. Each factor contributes to the value added of gas for electricity, such that:

Electric Sector Gas Value Added = Electric Sector Value of Gas - Fuel Costs - Depreciation of Existing Fleet + Capital Expenditures

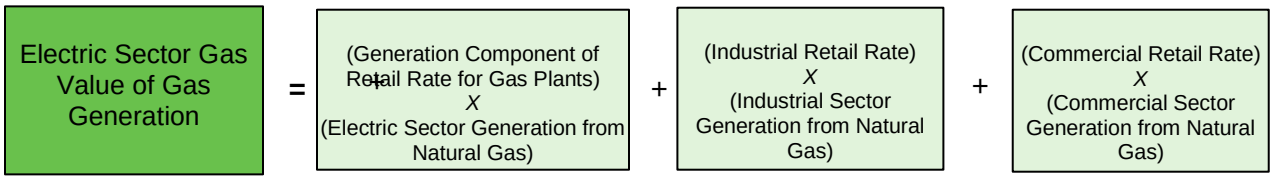
The methodology used to determine the various components is detailed below.

Electric Sector Value of Gas

The value of gas used for electricity generation was calculated using historical data on state gas-fired generation and electricity prices. State level revenues from natural gas generation were calculated for the Industrial, Commercial, and Electric Power sector. State level natural gas generation from each sector, as well as retail electricity prices, were collected from EIA state data.[39] For the value of gas generation calculation, gas generation in the Industrial and Commercial sectors received revenues based on the industrial and commercial retail price of electricity. Natural gas generation in the Electric Power Sector received revenue based on a calculated wholesale equivalent price for gas. FERC Form 1 data was used to calculate the 2015 cost of service for gas plants at a national level, which was then used to derive the

[39] https://www.eia.gov/electricity/data/state/

generation share of the U.S. total retail price of electricity. This generation share was applied to the 2015 state retail prices to calculate a wholesale equivalent price for gas generators. The formula used to estimate the value added of natural gas fired electricity generation is:



Fuel Costs

Fuel costs associated with gas generation from the Industrial, Commercial, and Electric Power sectors were calculated. Fuel costs were based on EIA data on historical state natural gas fuel consumption for each sector, and ICF's estimates for delivered natural gas prices in each state for each sector.[40]

Depreciation Costs of Existing Units

The depreciation cost of existing natural gas capacity in each state was calculated using the existing gas unit's capital costs and book life. Existing gas plants online years and capacity were taken from EPA's NEEDS v515, while capital costs for each plant were based off of EIA's Annual Energy Outlook $/kW capital costs assumptions for CC and CT units.[41] A 20 year book life for each plant was assumed and the depreciation was spread evenly over those 20 years.

Capital Expenditure of New Units

Capital expenditure during the construction period for planned and economic gas builds were calculated for each state. Planned natural gas build data was collected from SNL and capital costs for each plant were based off of EIA's Annual Energy Outlook $/kW capital costs assumptions. A two year lead time for combustion turbine units, and a three year lead time for combined cycle units were assumed. Capital expenditures on gas units for each state were similarly calculated for unplanned economic builds based on yearly combined cycle and combustion turbine unplanned build additions from EIA's 2016 Annual Energy Outlook.[42]

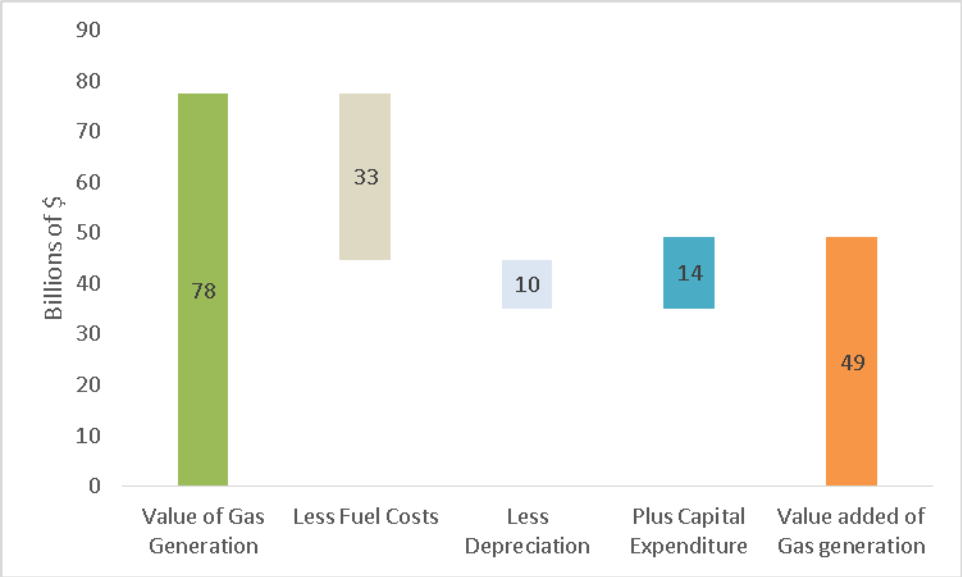
[40] https://www.eia.gov/electricity/data/state/
[41] NEEDS 5.15 is available: https://www.epa.gov/airmarkets/power-sector-modeling-platform-v515. EIA's Annual Energy Outlook is available: http://www.eia.gov/outlooks/archive/aeo16/.
[42] Combined Cycle and Combustion turbine unplanned build additions were collected from the AEO 2016 Reference Case without the Clean Power Plan

Exhibit 5-10: U.S. 2015 Value Added by Gas-fired Electricity Generation

	Category	$ (Millions)	$/MWh
	Retail Sales Value	389,767	104.12
+	Self-Generation Value	11,311	71.96
+	Export Value	629	69.10
=	**Total Retail Value**	**401,707**	
-	Import Costs	5,236	69.10
-	T&D Overhead Costs	177,290	
=	Value of Generation	219,182	53.97
-	Value of Non Gas Generation	141,500	51.82
=	**Value of Gas Generation**	77,682	58.39
-	Gas Depreciation Costs	9,637	7.24
-	Gas Fuel Costs	32,856	24.70
+	Gas Capital Expenditure	14,048	10.56
=	**Value Added of Gas Generation**	**49,236** (42,395 after adjustments for foreign content, etc.)	**37.01**

On a $/MWh basis, the value of gas-fired electricity generation is higher than the total value of generation and the value of non-gas generation. This reflects the fact that gas tends to operate in more of the peak hours when prices are highest. While the value of gas generation is $77.7 billion, the value added is only $49 billion due to costs associated with the depreciation of the gas fleet and gas fuel costs. Exhibit 5-11 shows the breakdown of the 2015 value added of gas generation into its component pieces.

Exhibit 5-11: 2015 U.S. Value Added of Gas Generation



As illustrated in the figure above, fuel costs associated with gas generation are 42% of the value of gas generation, while gas depreciation costs are 12% of the value of gas generation. While the depreciation cost of existing gas units decreases the value added of gas generation, the capital expenditure on the construction of new unit adds to the value. In 2015 the value from the capital expenditure on new gas capacity exceeds the costs associated with the depreciation of the existing gas fleet at a national level.

At a state level, the relative share and size of the component pieces of the value added of gas generation differ. In turn, the historical value added by gas fired electricity generation varies among the states. Exhibit 5-12 and Exhibit 5-13 show the 2015 value added by gas fired electricity generation by state, broken out into the states with the highest value added and the states with the lowest.

Exhibit 5-12: 2015 Value Added by Gas-fired Electricity Generation – Top 50% of States

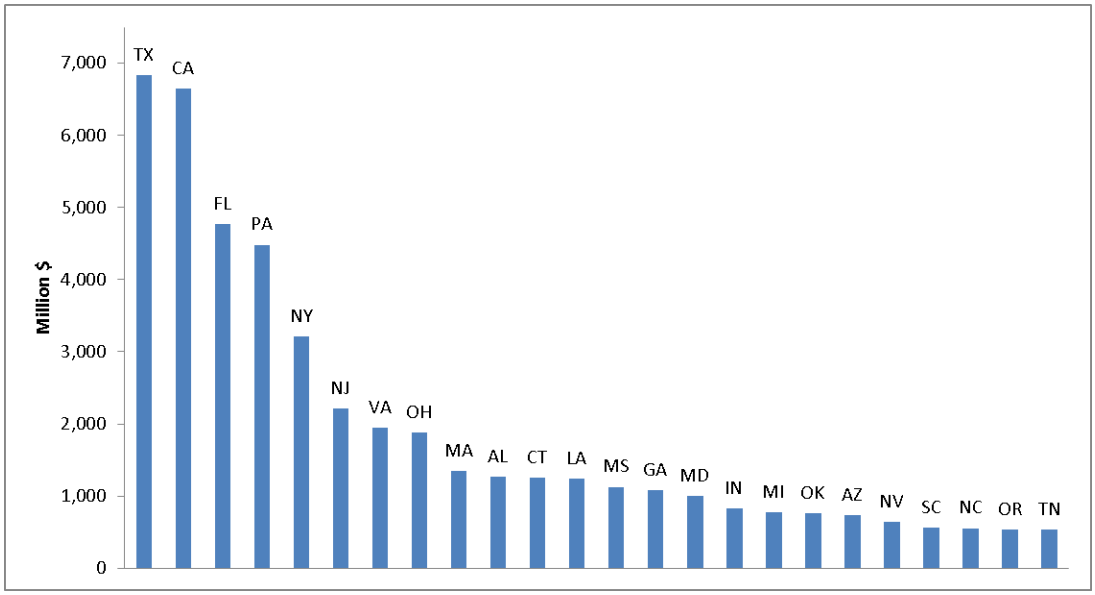
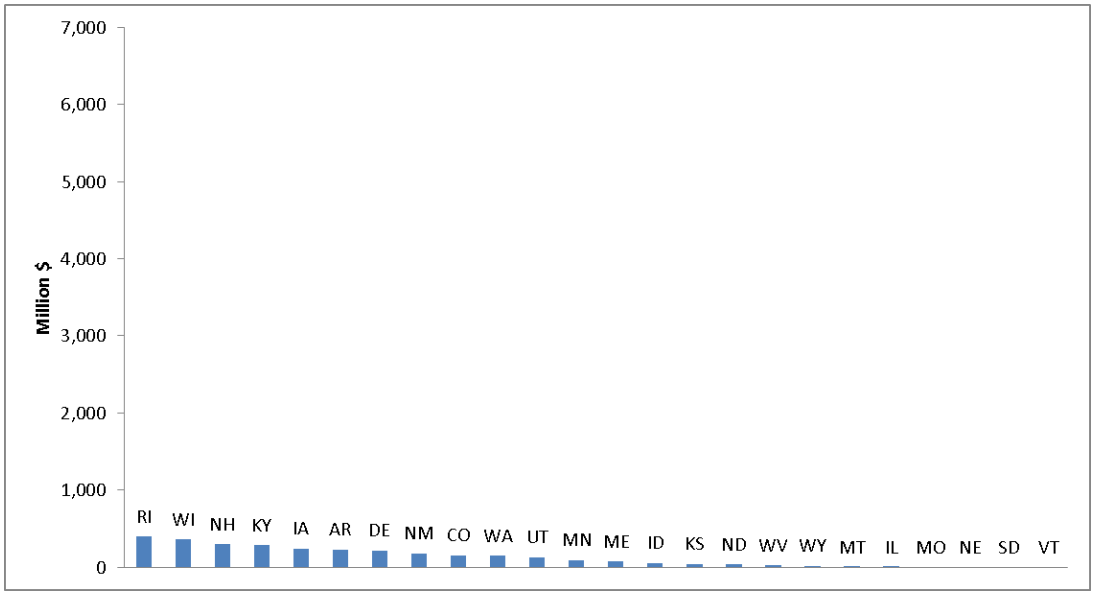


Exhibit 5-13: 2015 Value Added by Gas-fired Electricity Generation – Bottom 50% of States



State level value added from gas generation in 2015 spans from a high of $6.8 billion in Texas to near zero in Montana, Nebraska, South Dakota, and Vermont. The near-zero value added from gas generation in these four states is driven mainly by high depreciation costs. The wholesale price for gas generation is still higher than the per-MWH fuel cost plus variable costs in these four states, making gas dispatch still economic. Conversely, states like Texas, California, Florida, and Pennsylvania have high value added from gas-fired generation. These four states have a high value of gas generation, and a majority have capital expenditure exceeding depreciation costs.

The large spread in the historical value added by gas fired electricity generation among the states reflect differing markets for gas generation in the states. Power prices, existing resource mix, gas prices, and market structure all affect the relative economics of gas-fired generation. As a result the value added by gas fired electricity generation varies among the different states.

6. Forecast Activity, Jobs and Value Added to 2040

6.1 Introduction and Summary

This chapter presents ICF's estimates of future jobs, wages and value added through the year 2040 associate with the natural gas value chain. These estimates are based on energy supply, energy demand, and prices for both fuels and electricity contained in three cases produced by the EIA as part of its Annual Energy Outlook[43]. We use the 2016 AEO Reference Case, the 2016 High Oil and Gas Resource Case, and the 2015 High Oil and Gas Resource Case. The 2015 High Oil and Gas Resource Case was included to maintain consistency with prior API reports that used that case and because it has a U.S natural gas production forecast that generally falls between the two 2016 cases.

Each of the three cases has projections of future energy consumption (purchased electricity, natural gas, distillate fuel oil, propane, etc.) for residential, commercial, industrial, and power generation customers. The Reference Case assumes resource endowment, demographics, economic growth, and technology improvements that are intended to reflect the central expectations of government and private forecasters. The High Oil and Gas Resource Case assumes easier access to resources, larger resource endowment and greater upstream technology improvements, all of which contribute to greater production of oil and gas at lower prices in comparison to the Reference Case in the given year.

Exhibit 6-1 on the following page includes selected key results of the three cases. The 2016 Reference Case has the lowest U.S. gas production and the highest natural gas prices. The highest U.S. natural gas production and the lowest price are seen in the 2016 High Oil and Gas Resource Cases. The 2015 High Oil and Gas Resource Case falls in between the two 2016 cases in terms of both natural gas prices. Because the more optimistic supply-side assumptions in the High Oil and Gas Resource Cases apply to oil and gas exploration and development worldwide, world oil production is greater in those cases and world oil prices are lower.

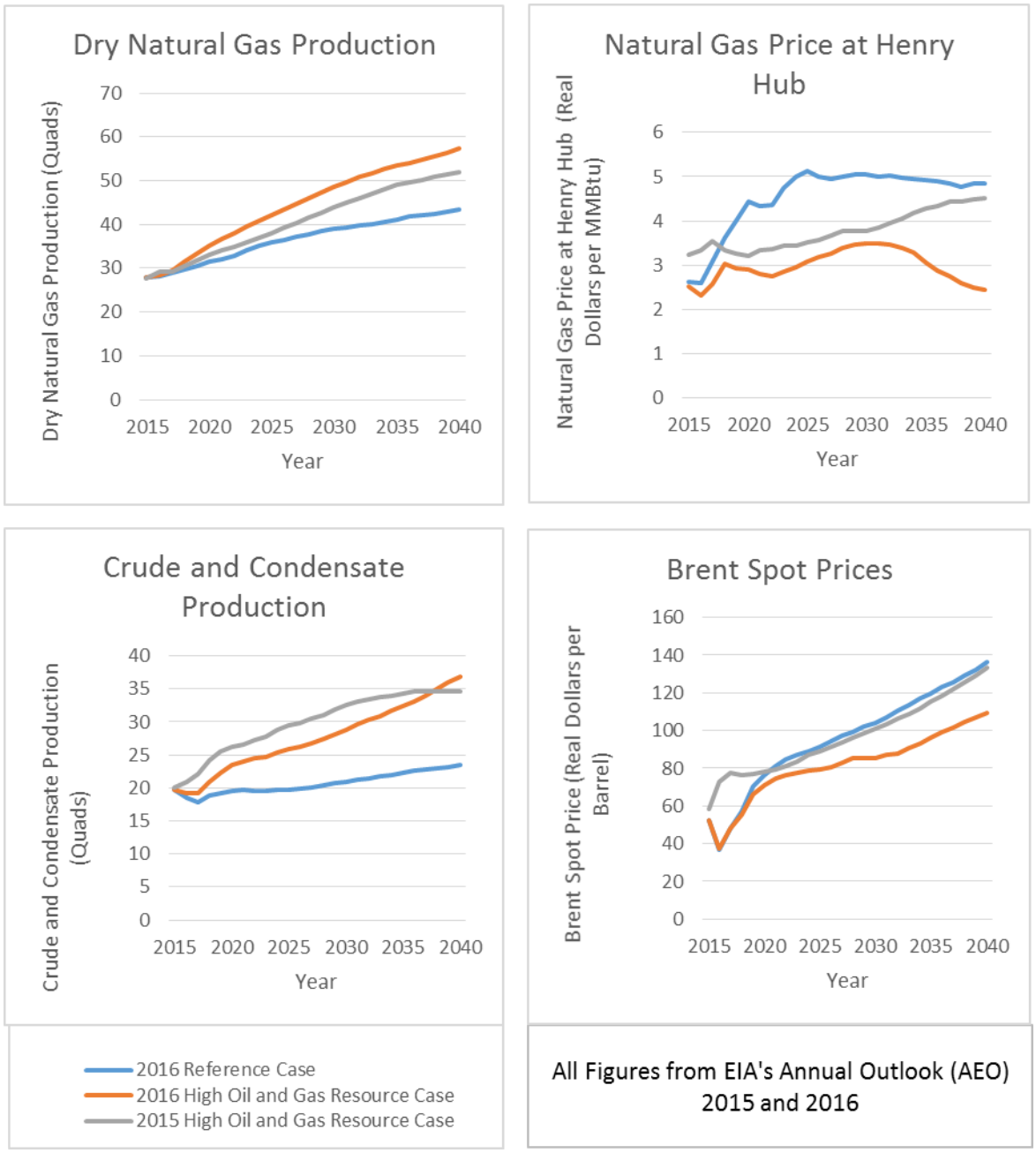
The AEO energy market forecasts were translated into estimates of jobs, wages and value added. The results for the 2016 Reference Case are shown in Exhibit 6-2, Exhibit 6-3, and Exhibit 6-4. The growth rate in employment for the Reference Case is 0.91% per year from 2015 to 2040 when total jobs reach 5.15 million. Due to the increased amount of oil and gas produced and consumed in the 2016 High Oil and Gas Resource Case, the rate of growth in employment is higher in that case at 1.46% per year. (See Exhibit 6-5.) By 2040 there are 0.75 million more jobs compared to the Reference case. The 2015 High Oil and Gas Resource Case falls in between the other two cases with an average growth rate in total employment of 1.21% per year. (See Exhibit 6-8.)

The rate of growth in jobs related to the end-use segment changes the least among the three cases, with the growth rates being 0.62%, 0.78% and 0.13% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases respectively. There are wider differences among the three cases in the number of jobs and the growth rate in those jobs in the infrastructure and production segments. In the infrastructure segment, the rate of growth in jobs is 1.10%, 1.91% and 1.68% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases

[43] Energy Information Administration (EIA), https://www.eia.gov/outlooks/aeo/

respectively. The corresponding growth rates in the production segment are 1.16%, 1.94% and 2.12%.

Exhibit 6-1: Natural Gas and Crude Oil AEO Forecasts



The pattern for wages is very similar to the pattern shown for employment in that the widest variation among the cases occurs in the production and infrastructure segments and the least variation occurs in the end-use sector. The rate of growth in wages across all segment is 0.99%, 1.57% and 1.34% for the Reference and the 2016 and 2015 High Oil and Gas Resource Cases respectively. Wages summed for all segments grow from $269 billion in 2015 to $345 billion in the Reference Case. The 2016 High Oil and Gas Resource Case has 2040 wages of

$398 billion and the 2015 High Oil and Gas Resource Case has wages of $376 billion in that year.

Exhibit 6-2: Projection of Jobs to 2040 NGVC Basis: AEO 2016 Reference Case

Direct, Indirect & Induced Employment: AEO 2016 Reference (million jobs)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	1.78	1.87	1.83	1.94	2.05	2.08	0.90%	-0.39%	1.13%	1.13%	0.32%
Infrastructure	1.29	1.41	1.51	1.58	1.63	1.69	1.90%	1.36%	0.90%	0.68%	0.69%
Production	1.03	1.16	1.26	1.31	1.35	1.38	2.42%	1.54%	0.88%	0.53%	0.43%
All Segments	4.10	4.44	4.60	4.83	5.03	5.15	1.60%	0.69%	0.99%	0.82%	0.47%

Exhibit 6-3: Projection of Wages to 2040 NGVC Basis: AEO 2016 Reference Case

Direct, Indirect & Induced Wages: AEO 2016 Reference ($million)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	106,812	111,408	109,066	115,396	122,078	124,059	0.85%	-0.42%	1.13%	1.13%	0.32%
Infrastructure	84,470	92,764	99,337	103,965	107,605	111,421	1.89%	1.38%	0.91%	0.69%	0.70%
Production	78,204	88,921	96,876	102,150	105,849	109,133	2.60%	1.73%	1.07%	0.71%	0.61%
All Segments	269,486	293,093	305,278	321,511	335,533	344,613	1.69%	0.82%	1.04%	0.86%	0.54%

Exhibit 6-4: Projection of Value Added to 2040 NGVC Basis: AEO 2016 Reference Case

Direct, Indirect & Induced Value Added: AEO 2016 Reference ($million)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	271,232	292,195	315,597	343,141	368,884	390,058	1.50%	1.55%	1.69%	1.46%	1.12%
Infrastructure	168,055	184,607	197,352	206,359	213,440	220,884	1.90%	1.34%	0.90%	0.68%	0.69%
Production	111,390	190,459	249,231	275,025	297,185	322,910	11.32%	5.53%	1.99%	1.56%	1.67%
All Segments	550,677	667,262	762,179	824,526	879,509	933,852	3.92%	2.70%	1.58%	1.30%	1.21%

Exhibit 6-5: Projection of Jobs to 2040: AEO 2016 High Oil & Gas Resource Case

Direct, Indirect & Induced Employment: AEO 2016 HOGR Case (million jobs)								Annual Rate of Change				
	2015	2020	2025	2030	2035	2040		15>20	20>25	25>30	30>35	35>40
End-Use	1.78	1.92	2.10	2.24	2.34	2.31		0.22%	1.50%	1.40%	1.01%	-0.21%
Infrastructure	1.31	1.55	1.71	1.86	1.98	2.09		3.42%	2.06%	1.70%	1.30%	1.08%
Production	1.01	1.19	1.31	1.50	1.59	1.62		3.36%	2.00%	2.81%	1.16%	0.38%
All Segments	4.10	4.65	5.12	5.60	5.92	6.03		2.06%	1.82%	1.89%	1.15%	0.40%

Exhibit 6-6: Projection of Wages to 2040: AEO 2016 High Oil & Gas Resource Case

Direct, Indirect & Induced Wages: AEO 2016 HOGR Case ($million)								Annual Rate of Change				
	2015	2020	2025	2030	2035	2040		15>20	20>25	25>30	30>35	35>40
End-Use	106,812	107,590	115,939	124,360	130,606	129,235		0.15%	1.51%	1.41%	0.98%	-0.21%
Infrastructure	84,470	99,923	110,827	120,698	128,845	136,032		3.42%	2.09%	1.72%	1.31%	1.09%
Production	78,204	93,114	103,732	120,255	128,527	132,192		3.55%	2.18%	3.00%	1.34%	0.56%
All Segments	269,486	300,627	330,498	365,313	387,978	397,459		2.21%	1.91%	2.02%	1.21%	0.48%

Exhibit 6-7: Projection of Value Added to 2040: AEO 2016 High Oil & Gas Resource Case

Direct, Indirect & Induced Value Added: AEO 2016 Reference ($million)								Annual Rate of Change				
	2015	2020	2025	2030	2035	2040		15>20	20>25	25>30	30>35	35>40
End-Use	271,232	306,172	348,832	383,572	419,168	446,289		2.45%	2.64%	1.92%	1.79%	1.26%
Infrastructure	168,055	198,923	220,170	239,570	255,711	270,014		3.43%	2.05%	1.70%	1.31%	1.09%
Production	111,390	171,385	219,532	268,763	285,454	291,323		9.00%	5.08%	4.13%	1.21%	0.41%
All Segments	550,677	676,481	788,534	891,905	960,333	1007625		4.20%	3.11%	2.49%	1.49%	0.97%

Exhibit 6-8: Projection of Jobs to 2040: AEO 2015 High Oil & Gas Resource Case

Direct, Indirect & Induced Employment: AEO 2015 HOGR Case (million jobs)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	1.78	1.75	1.80	1.87	1.89	1.84	-0.35%	0.47%	0.78%	0.20%	-0.44%
Infrastructure	1.29	1.45	1.58	1.74	1.87	1.95	2.49%	1.69%	1.90%	1.48%	0.83%
Production	1.03	1.25	1.41	1.58	1.71	1.74	3.91%	2.47%	2.28%	1.59%	0.38%
All Segments	4.10	4.46	4.79	5.19	5.47	5.54	1.68%	1.44%	1.60%	1.06%	0.26%

Exhibit 6-9: Projection of Wages to 2040: AEO 2015 High Oil & Gas Resource Case

Direct, Indirect & Induced Wages: AEO 2015 HOGR Case ($million)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	106,812	104,621	107,134	111,385	112,309	109,819	-0.41%	0.48%	0.78%	0.17%	-0.45%
Infrastructure	84,470	95,541	103,969	114,305	123,074	128,319	2.49%	1.71%	1.91%	1.49%	0.84%
Production	78,204	95,590	108,966	123,043	134,320	138,112	4.10%	2.65%	2.46%	1.77%	0.56%
All Segments	269,486	295,751	320,069	348,733	369,703	376,250	1.88%	1.59%	1.73%	1.17%	0.35%

Exhibit 6-10: Projection of Value Added to 2040: AEO 2015 High Oil & Gas Resource Case

Direct, Indirect & Induced Value Added: AEO 2015 HOGR Case ($million)							Annual Rate of Change				
	2015	2020	2025	2030	2035	2040	15>20	20>25	25>30	30>35	35>40
End-Use	271,232	304,402	328,770	357,026	371,044	376,306	2.33%	1.55%	1.66%	0.77%	0.28%
Infrastructure	168,055	190,363	207,055	227,439	244,718	255,062	2.52%	1.70%	1.90%	1.48%	0.83%
Production	111,390	153,269	196,794	240,973	294,245	335,449	6.59%	5.13%	4.13%	4.08%	2.66%
All Segments	550,677	648,034	732,619	825,438	910,007	966,817	3.31%	2.48%	2.41%	1.97%	1.22%

The forecasted direct, indirect and induced value added for the three AEO cases are shown in Exhibit 6-4, Exhibit 6-7, and Exhibit 6-10. The value added for all three segments combined grows from $551 billion in 2015 to $934 billion in the Reference Case, an annual growth rate of 2.14%. The 2016 High Oil and Gas Resource Case has a higher growth rate of 2.45% per year

and reaches $1,008 billion by 2040. The 2015 High Oil and Gas Resource Case also grows faster (2.28% per year) than the Reference Case and reaches $967 billion by 2040.

An interesting feature of the value added trends is that the growth in value added in the production segment lags behind the growth in oil and gas production volumes. This occurs because the assumptions of more accessible resources and better upstream technologies cause the oil and gas prices and upstream capital expenditures to fall relative to the Reference Case, reducing the potential for value added. This is why the production value added in 2030 and 2040 is lower in the 2016 High Oil and Gas Resource Case compared to the 2016 Reference Case.

6.2 Natural Gas End Uses

This section provides additional information on the methodology and results for projections related to the end-use segment. The first end-use discussed is gas-fired power generation followed by the residential and other sectors.

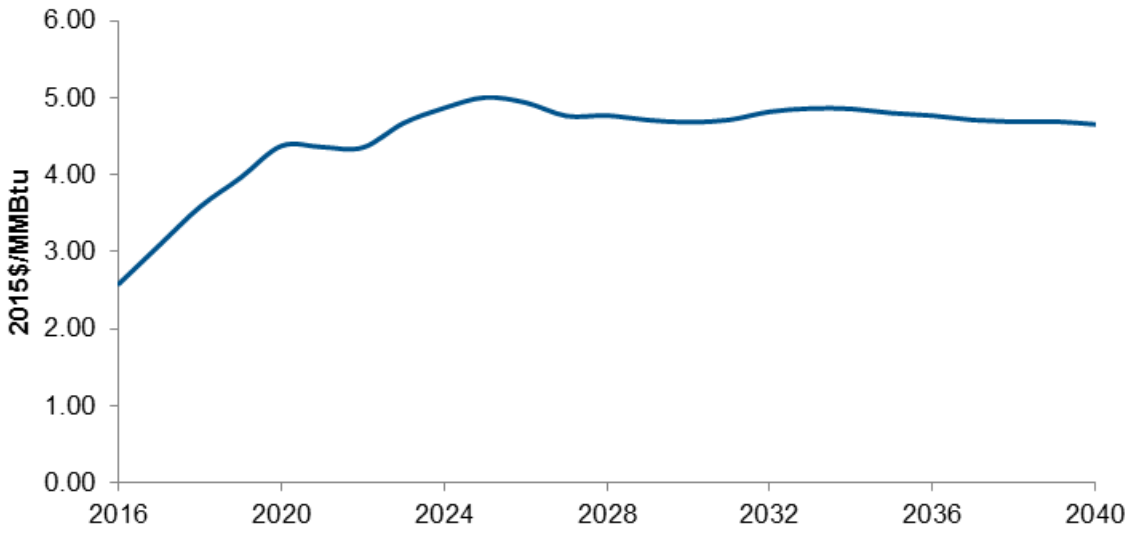
6.2.1 Forecast for Power Generation

The future value added of natural gas in electricity production calculations was based on the AEO 2016's Reference Case without the Clean Power Plan and the two other AEO cases discussed above. Trends in gas prices, gas generation, and gas capacity additions affect the value added from natural gas generation and other measures of economic impact.

Gas Prices in AEO 2016 Reference Case

EIA's Annual Energy Outlook provides Henry Hub price projections, as well as delivered gas price projections for the EMM regions. The exhibit below shows the projections for the price of natural gas at Henry Hub in the Reference Case without the Clean Power Plan.

Exhibit 6-11: Projected Henry Hub Prices in AEO 2016 Reference Case



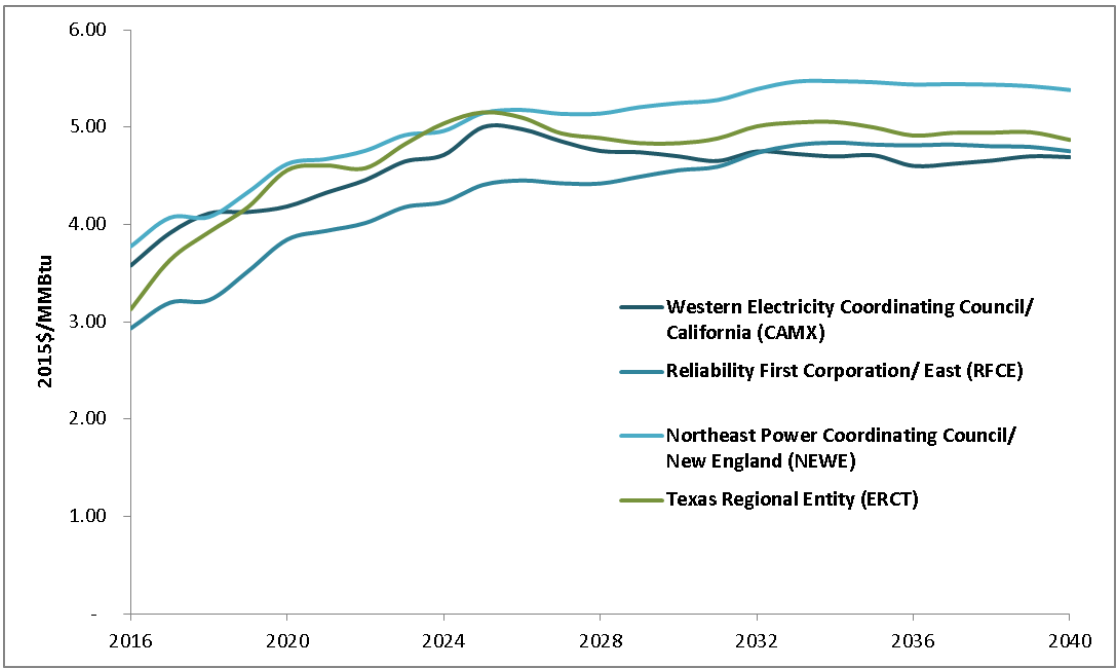
In the above Reference Case Henry Hub prices increase from $2.58/MMBtu in 2016 to a high of $5/MMBtu in 2025). After 2025, Henry Hub prices fluctuate between a high of $4.94/MMBtu in 2026 to a low of $4.65/MMBtu in 2040. Gas prices play a significant role in the value of gas

fired generation. High gas prices raise the cost of generation from gas-fired units, while low gas prices increase the economic competiveness of gas and can lead to higher utilization rates for gas units and increased gas capacity additions.

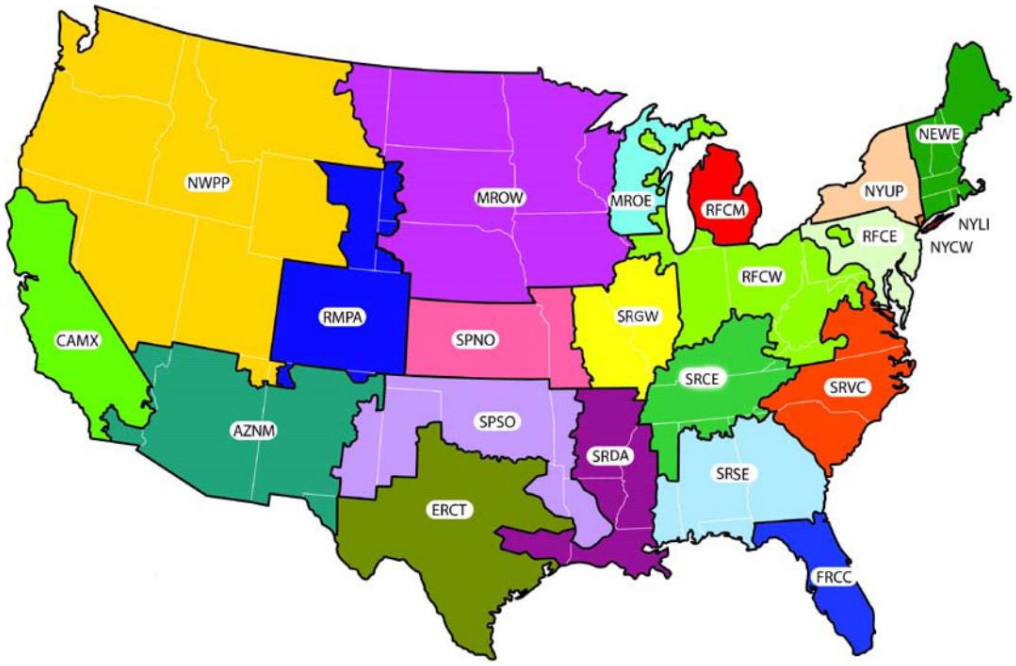
To calculate the projected value added from gas generation, delivered gas prices by the EIA forecasting regions (Electric Market Module or EMM regions) were used. While these gas prices generally follow similar trends to the Henry Hub price, regional differences in gas prices lead to varying costs of generation in different states.

Exhibit 6-12 shows the delivered gas price in the AEO 2016 Reference Case without the Clean Power Plan for four EMM regions in different parts of the country.[44] Gas prices range between $2.93/MMBtu (in RFCE) to $3.78MMBtu (in NEWE) in 2016 and $4.69/MMBtu (in CAMX) to $5/38/MMBtu (in NEWE) in 2040. While gas prices are highest in 2025 in CAMX and ERCT, gas prices reach their peak later in the forecast for NEWE and RFCE. As a result of these differing regional gas prices, gas-fired generators in different states face different costs of generation.

Exhibit 6-12: Projected Natural Gas Prices by EMM Region in AEO 2016 Reference Case and Map of EMM Regions[45]



[44] CAMX (Western Electricity Coordinating Council/ California), RFCE (Reliability First Corporation/ East), NEWE (Northeast Power Coordinating Council/ New England), and ERCT (Texas Reliability Entity) are four of the 22 EMM Regions modeled by NEMS for EIA's Annual Energy Outlook.
[45] Source: https://www.eia.gov/outlooks/aeo/pdf/nerc_map.pdf

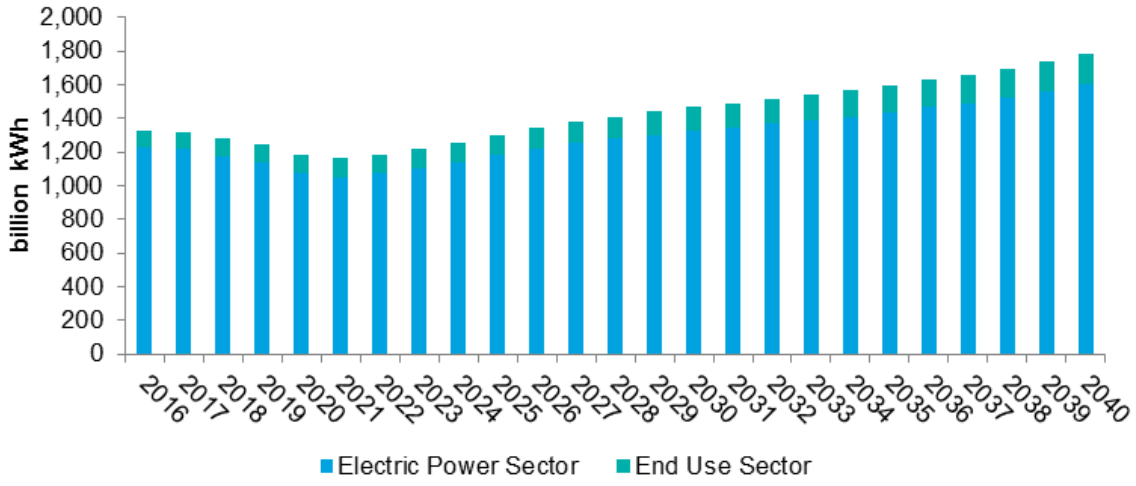


Gas Generation in AEO 2016 Reference Case

The major determinant of the value of gas fired electricity generation is the amount of generation from natural gas units. Exhibit 6-13 shows natural gas-fired electricity generation in the AEO 2016 Reference Case without the Clean Power Plan for the Electric Power Sector and End Use Sector (industrial and commercial combined heat and power).[46] In the AEO 2016 Reference Case without the Clean Power Plan, natural gas generation generally increases over the time horizon. The decline in natural gas fired electricity generation in the short term from 2016-2020 is due to increased solar and wind builds driven by the extension of the production and investment tax credits and falling installation costs.[47] After 2021, natural gas generation picks up and starts to steadily increase. The increasing electricity generation from natural-gas fired units over the forecast period shows the continued economic competitiveness of gas in future years.

[46] End Use Sector generation encompasses CHP and electricity only plants in the industrial and commercial sector, as well as small on-site generating systems (AEO 2016)
[47] Annual Energy Outlook, ES-3

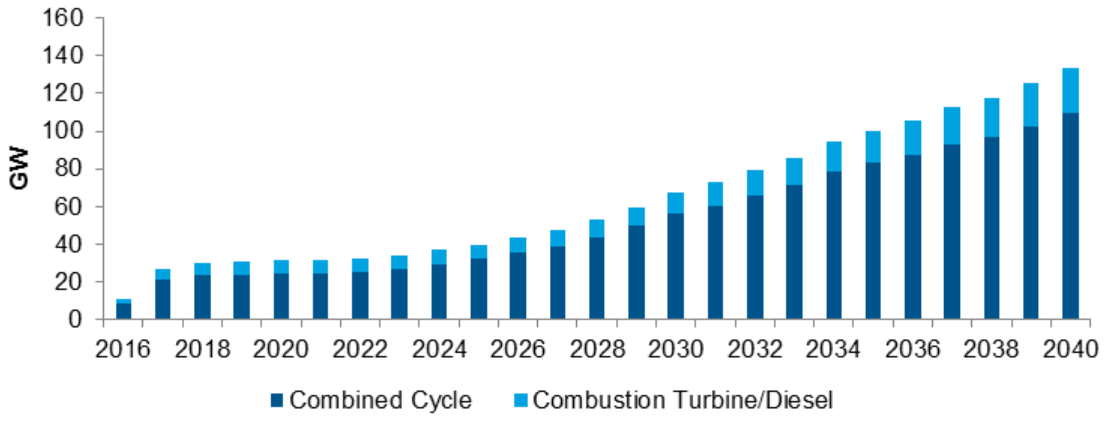
Exhibit 6-13: Projected U.S. Natural Gas-fired Electricity Generation in AEO 2016



Gas Capacity Additions in AEO 2016

In addition to the value from existing gas units, value added from planned and unplanned gas additions over the 2016-2040 time period contributes to the projected value added by gas-fired electricity generation. The AEO 2016 Reference Case without the Clean Power Plan projects the amount of firm and economic gas capacity additions in the United States over the forecast period.

Exhibit 6-14: Projected U.S. Cumulative Combined Cycle and Combustion Turbine Additions in AEO 2016 Reference Case



As shown in the exhibit above, cumulative gas builds increase over the forecast period in order to satisfy demand growth in the electric sector and to replace retiring baseload capacity (primarily coal and nuclear). EIA projects roughly 134 GW of gas builds between 2016 and 2040. Of this total, roughly 81% (109 GW) are NGCC builds and the remaining 19% (24 GW) are NGCT builds. Similar to the increasing natural gas generation, these incremental gas capacity additions throughout the forecast period show the continued economic competitiveness of gas.

Methodology for Estimating Future Valued Added by Gas-fired Power Generation

These projections were based largely on publicly available data and assumptions taken from the reference case without the Clean Power Plan in EIA's 2016 Annual Energy Outlook. The projected natural gas value added for electricity has the same components as the historical value added of gas for electricity:

Electric Sector Projected Gas Value Added	=	Electric Sector Projected Value of Gas	-	Projected Fuel Costs	-	Depreciation of Projected Fleet Over Time	+	Capital Expenditure on projected builds

Electric Sector Projected Cost of Gas

The future value of gas generation was calculated for 2016-2040 using AEO's data on projected gas generation and electricity prices. Similar to methodology for calculating the historical natural gas value added for electricity, industrial and commercial generation received the industrial and commercial retail price, while electric power sector gas generation received a calculated wholesale equivalent price. Total Electric Power Sector gas generation was collected from AEO at the Electric Market Module (EMM) level. The EMM level gas generation was broken out into new and existing gas generation. New gas generation was calculated using the combined cycle and combustion turbine gas additions in AEO, and assumed CC and CT capacity factors based on the 2015 capacity factors in EIA's 2015 Electric Power Annual.[48] Existing gas generation was derived using total and new gas generation. The EMM level existing and new gas generation was then portioned out to the states based on the states 2015 share of EMM gas generation and fossil capacity. Industrial and Commercial generation was calculated using the Total End Use Sector Gas generation from AEO 2016, which was portioned out to states based on the state's share of EMM gas generation, and split between commercial and industrial generation based on historical ratios from EIA. Industrial and commercial retail prices for 2016-2040 were also taken from AEO 2016. The wholesale equivalent price for Electric sector gas generation was calculated using the 2016-2040 total retail price for each EMM region from AEO 2016 and the 2015 generation portion of U.S. total retail price.

Future Heat Rates and Fuel Costs

Fuel costs associated with gas generation were calculated for the 2016-2040 period. To account for the lower heat rates of new gas units, projected fuel costs were broken out for new and existing gas plants. State level existing fuel costs were calculated using EMM level gas prices from AEO 2016, calculated state existing generation, and state capacity weighted heat rates for combined cycle and combustion turbine units from NEEDS v5.15. State existing gas generation was broken out into CC and CT generation based on 2015 ratios from EIA form 923.[49] State level new gas fuel costs were calculated using the EMM levels gas prices, new CC and CT heat rate assumptions from AEO 2016, and calculated state new gas generation.

[48] EIA's 2015 Electric Power Annual available: http://www.eia.gov/electricity/annual/

[49] EIA form 923 available: https://www.eia.gov/electricity/data/eia923/

Depreciation Costs of Existing and New Build Units

During the 2016-2040 time period, the annual depreciation of existing units that was calculated in the historical value added calculations continues until the end of their book life. Additionally, as planned and unplanned gas builds start to come online during the 2016-2040 time period, these units start to depreciate. Unplanned gas builds are collected from AEO 2016. Capital costs for these plants are based on AEO's $/kW capital costs assumptions, and are spread evenly over an assumed 20 year book life.

Capital Expenditures

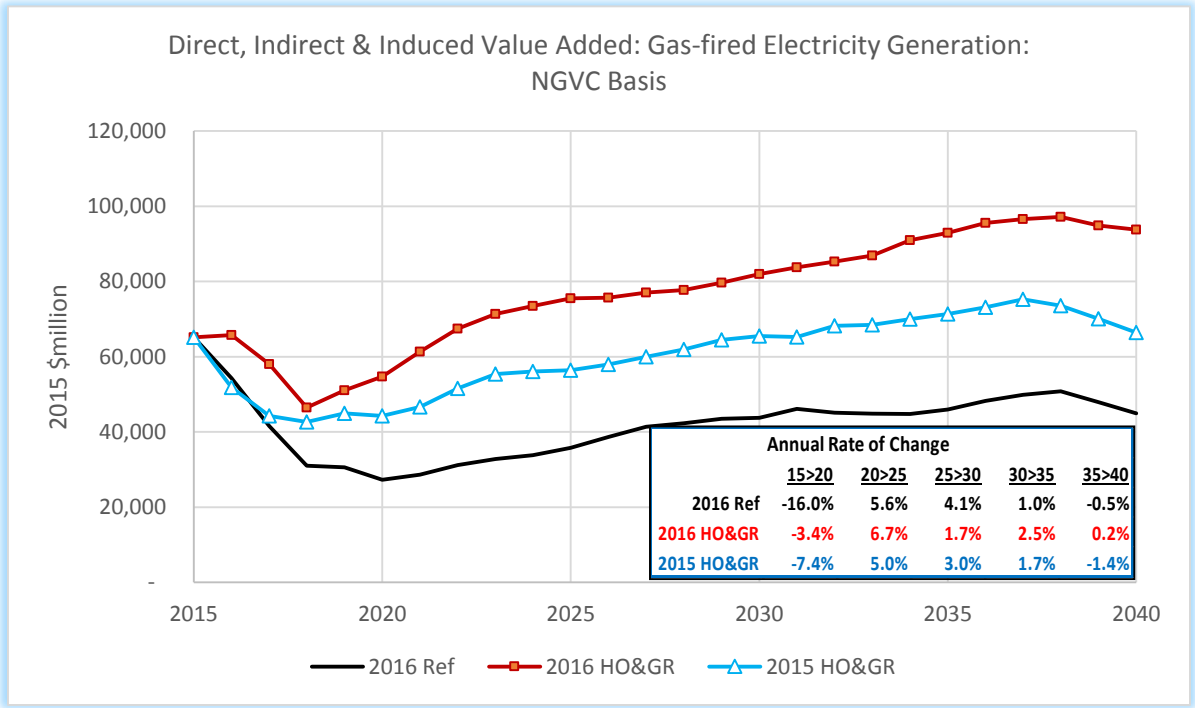
Capital expenditure was calculated for the construction periods of planned and unplanned builds coming online during 2016-2040. Planned gas builds were compiled from SNL Energy, while unplanned gas builds were collected from AEO 2016. A three-year lead time for combined cycle, and a two-year lead time for combustion turbines was assumed. Capital costs for these plants are based on AEO's $/kW capital costs assumptions, and capital expenditure was spread evenly over the construction period.

Projected Value Added and Employment for Gas-fired Electricity Generation

The projected value added of gas for electricity was calculated for each of the contiguous 48 states for the 2016-2040 time period for the 2016 Reference Case and the other two cases. Exhibit 6-15 below shows the U.S. value added by gas-fired electricity generation through 2040. In the Reference Case the value added dips in the first few years as the construction costs for new gas-fired power plants fall off. After 2020, the value added trends upward until the last few years. Higher fuel costs and depreciation costs, as well as lower capital expenditure in 2020 contribute to the decreases in U.S. value added by gas generation seen between 2015 and 2020. In 2015 the value from capital expenditure more than offsets the depreciation costs of the gas fleet. However, in 2020 the U.S. experiences depreciation costs of approximately $10.6 billion while capital expenditure is only $0.8 billion. Additionally higher gas prices in 2020 compared to 2015 increase the costs of gas generation. 2020 is also a low year for gas generation in the AEO 2016 forecast due to the high level of solar and wind builds, leading to a lower value of gas generation compared to 2015.[50]

[50] Annual Energy Outlook, ES-3

Exhibit 6-15: U.S. Value Added by Gas-fired Electricity Generation (million$)



After the initial drop in gas generation in the early years of the forecast, gas generation starts to pick up and as a result the value of gas generation increases. Additionally, in later forecast years depreciation starts to fall as the twenty year book life of the existing units near their end. By 2035 the existing (pre-2016 online year) gas fleet has finished depreciating, and the only depreciation costs come from builds which came online starting in 2016. In 2040 the depreciation costs at a national level are approximately $4.9 billion compared to $10.6 billion in 2020, and $9.6 billion in 2015.

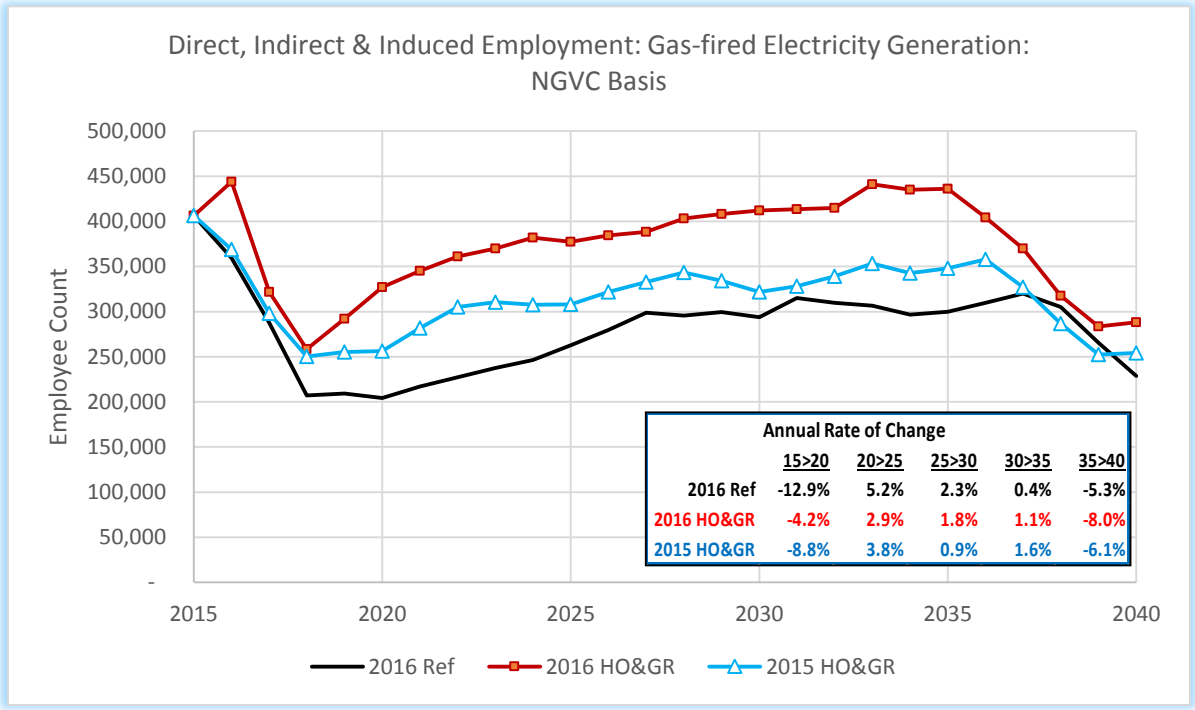
While the depreciation costs are lower in 2040 compared to 2015, there is no capital expenditure in 2040, which contributes to the lower 2040 U.S. value added by gas generation.[51] Higher gas generation and gas prices also lead to higher fuel costs in 2040 compared to 2015.

The pattern for valued added by gas-fired electricity generation is higher in both the 2016 and 2015 High Oil and Gas Resource Cases compared to the 2016 Reference Case. The reason for this is that the lower gas prices in those cases lead to greater amounts of capital expenditures on new gas-fired generation capacity and greater generation volumes,

The pattern for employment related to gas-fired power generation is shown on Exhibit 6-16. The ups and downs in employment are largely a function of capital expenditures for power generation (as operating and maintenance expenditures are relatively smooth). Construction decreases in the first few years of the forecast before picking up again until the end of the forecast.

[51] Lack of capital expenditure in 2040 is due to 2040 being the last year of the AEO 2016 forecast. Builds online in 2040 in the AEO forecast are assumed to have already received value from capital expenditure during their construction period.

Exhibit 6-16: Forecasted Employment Related to Gas-fired Electricity Generation



Annual Rate of Change

	15>20	20>25	25>30	30>35	35>40
2016 Ref	-12.9%	5.2%	2.3%	0.4%	-5.3%
2016 HO&GR	-4.2%	2.9%	1.8%	1.1%	-8.0%
2015 HO&GR	-8.8%	3.8%	0.9%	1.6%	-6.1%

6.2.2 Forecast for Residential Sector

The AEO forecasts natural gas consumption by residential customers and equipment counts for space heating, space cooling, water heating, cooking, clothes dryers, and other uses. For space heating, water heating and space cooling, the model estimates efficiency improvements over time and it also estimates the total square footage of residential housing in future years.

The base year natural gas equipment counts were forecasted into the future using AEOs projected equipment counts. First, the growth between 2014 and 2015 was used to determine the fraction of the new equipment installed in 2015 that was a result of new customer growth (as opposed to replacement). The figure for new customer growth was then compared to the base year (2015) total shipments to determine the percentage of equipment purchased by new customers and the percentage purchased to replace old gas appliances. The projected equipment purchased by consumers was then calculated using the percentage of equipment replaced coupled with the projected growth in equipment counts from the AEO.

Exhibit 6-17 shows the breakdown for new equipment from 2015 to 2040 for the 2016 AEO reference case. The table then shows the total count of equipment for the 2016 AEO High Oil and Gas Resources Case as well as the 2015 AEO High Oil and Gas Resource Case. As shown in the exhibit, the counts of residential appliances do not vary much between the two 2016 AEO cases, which are slightly higher than the 2015 High Oil and Gas Resources Case.

Exhibit 6-17: Residential Equipment Annual New Units Sold (Million Units)

	2015	2020	2025	2030	2035	2040
Space Heating	2.8	3.3	3.5	3.6	3.7	3.9
Water Heating	4.4	4.9	5.1	5.2	5.4	5.6
Space Cooling	0.0	0.0	0.0	0.0	0.0	0.0
Cooking	3.2	3.4	3.5	3.6	3.7	3.7
Clothes Dryer	1.3	1.5	1.5	1.6	1.6	1.7
Other Uses	2.0	2.0	2.0	2.0	2.0	2.1
Total 2016 Reference Case	**13.7**	**15.1**	**15.6**	**16.0**	**16.5**	**17.0**
Total 2016 High Oil and Gas Resource Case	**13.7**	**15.1**	**15.7**	**16.1**	**16.6**	**17.1**
Total 2015 High Oil and Gas Resource Case	**13.7**	**14.9**	**15.5**	**15.9**	**16.2**	**16.6**

Future domestic spending on residential equipment was calculated using the same methodology as in the base year but using projected equipment counts. The total domestic spending for each end-use includes the domestic equipment cost, the retail markup on domestic and imported products, the installation costs for all new equipment, and the maintenance costs for all equipment. The results of this analysis are shown in Exhibit 6-18 for the 2016 AEO Reference Case by appliance type along with total spending for the 2016 AEO High Oil and Gas Resource Case and the 2015 High Oil and Gas Resource Case. As with new appliance sales, the results for spending are similar among the three cases.

Exhibit 6-18: Residential Equipment Domestic Spending (billion$)

	2015	2020	2025	2030	2035	2040
Space Heating	$12.4	$14.6	$15.3	$15.8	$16.5	$17.1
Water Heating	$4.8	$5.4	$5.6	$5.7	$5.9	$6.1
Space Cooling	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Cooking	$3.4	$3.7	$3.8	$3.9	$3.9	$4.0
Clothes Dryer	$1.0	$1.1	$1.1	$1.2	$1.2	$1.2
Other Uses	$2.0	$2.0	$2.0	$2.0	$2.1	$2.1
Total 2016 Reference Case	**$23.8**	**$26.8**	**$27.9**	**$28.8**	**$29.7**	**$30.7**
Total 2016 High Oil and Gas Resource Case	**$23.8**	**$26.9**	**$28.1**	**$29.0**	**$29.9**	**$30.9**
Total 2015 High Oil and Gas Resource Case	**$23.8**	**$26.5**	**$27.6**	**$28.5**	**$29.1**	**$30.0**

6.2.3 Forecast for Commercial Sector

The AEO forecasts natural gas consumption of commercial customers for space heating, space cooling, water heating, cooking, cooking, and other uses. For space heating, water heating and space cooling, and cooking the model estimates efficiency improvements over time. Additionally, the model estimates the total square footage of commercial buildings in future years.

The base year natural gas equipment as determined previously was forecasted utilizing a combination of the forecasted consumption, commercial building growth and the efficiency gains. The total inventory of equipment was calculated by taking the projected consumption and dividing by the average consumption per piece of equipment in the base year multiplied by an efficiency adjustment factor. For the space heating case, the change in the commercial building square footage was also used as an adjustment factor. Once the estimates for the equipment inventories were calculated by end use, the average growth over time was used in conjunction with the base year's shipment count to determine the fraction of the new equipment in 2015 that was a result of new customers and the percentage of equipment from replacements. The projected equipment purchased by consumers was then calculated using the percentage of equipment replaced coupled with the projected growth of equipment.

Exhibit 6-19 shows the breakdown for new equipment from 2015 to 2040 for the 2016 AEO Reference Case. The table then shows the total count of equipment for the 2016 AEO High Oil and Gas Reference Case as well as the 2015 AEO High Oil and Gas Resources Case. The counts of equipment do not vary much among the three cases as they are driven more by assumptions for growth in commercial floor space than by energy prices.

Exhibit 6-19: Commercial Equipment Annual New Units Sold (Thousand Units)

	2015	2020	2025	2030	2035	2040
Space Heating	123	130	135	140	146	151
Water Heating	98	103	107	113	119	124
Space Cooling	1	1	1	1	1	1
Cooking	135	140	145	152	160	168
Cogeneration	10	10	10	11	11	11
Other Uses	11	12	13	14	15	17
2016 Reference Case	**378**	**397**	**411**	**430**	**452**	**472**
2016 High Oil and Gas Resource Case	**378**	**404**	**426**	**442**	**465**	**490**
2015 High Oil and Gas Resource Case	**378**	**391**	**401**	**420**	**431**	**437**

Similar to residential domestic spending, ICF forecasted commercial domestic spending using the same methodology as in the base year but using projected equipment counts. The total domestic spending for each end-use includes the domestic equipment cost, the retail markup on domestic and imported products, the installation costs for all new equipment, and the maintenance costs for all equipment. The results of this analysis are outlined in Exhibit 6-20 for the 2016 AEO Reference Case by category with the total spending for the 2016 AEO High Oil and Gas Resource Case and the 2015 High Oil and Gas Resource Case included.

Exhibit 6-20: Commercial Equipment Domestic Spending (billion $)

	2015	2020	2025	2030	2035	2040
Space Heating	$11.9	$12.7	$13.1	$13.7	$14.3	$14.9
Water Heating	$3.2	$3.4	$3.6	$3.8	$4.0	$4.2
Space Cooling	$0.2	$0.2	$0.2	$0.2	$0.2	$0.2
Cooking	$2.3	$2.4	$2.5	$2.6	$2.8	$2.9
Cogeneration	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Other Uses	$2.8	$3.1	$3.3	$3.5	$3.9	$4.3
2016 Reference Case	**$20.56**	**$21.99**	**$22.84**	**$24.00**	**$25.38**	**$26.71**
2016 High Oil and Gas Resource Case	**$20.56**	**$22.55**	**$23.91**	**$24.97**	**$26.46**	**$28.17**
2015 High Oil and Gas Resource Case	**$20.56**	**$21.19**	**$21.84**	**$22.98**	**$23.79**	**$24.49**

Projected Value Added and Employment for Residential and Commercial End-uses

The projected value added of gas for residential and commercial end-uses was calculated for each of the contiguous 48 states for the 2016-2040 time period for the 2016 Reference Case and the other two cases. Exhibit 6-21 below shows the U.S. value added by gas-fired residential and commercial appliances and equipment forecast through 2040. Exhibit 6-22 shows the projected direct, indirect and induced employment impacts associated with the use of gas-fired residential and commercial appliances and equipment over the same time period.

Exhibit 6-21: Forecasted Value Added Related to Gas-fired Residential and Commercial Appliances and Equipment (million$)

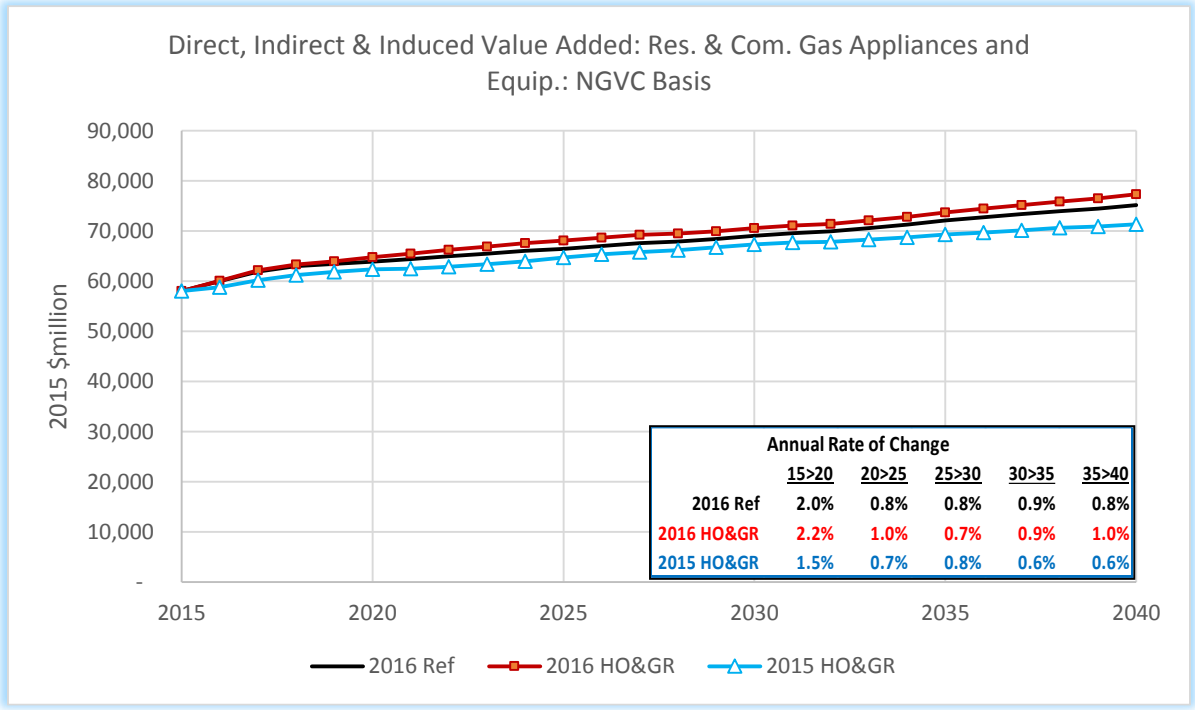
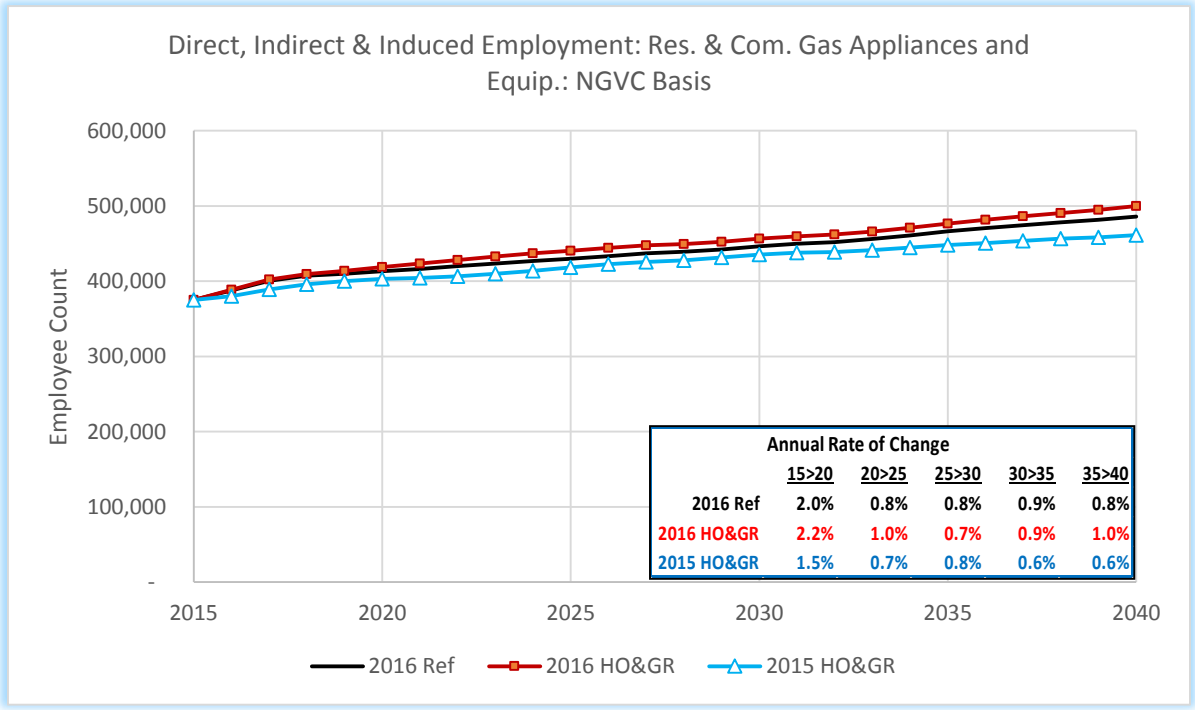


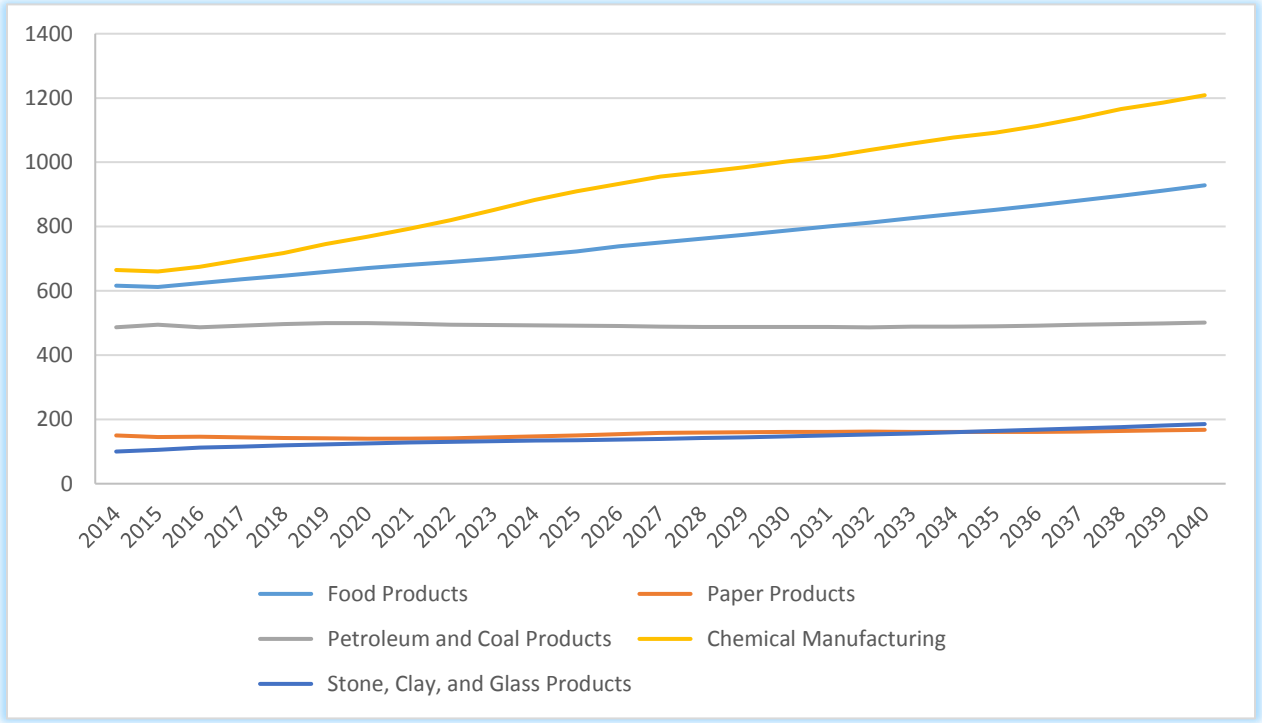
Exhibit 6-22: Forecasted Employment Related to Gas-fired Residential and Commercial Appliances and Equipment



6.2.4 Forecast for Industrial Combustion

The AEO forecasts natural gas consumption for heat and power separately from natural gas use for feedstocks in the industrial sector. Additionally, the AEO forecasts the value of products shipped in various industries over time, for which the top five manufacturing natural gas users are displayed in Exhibit 6-23. Chemical manufacturing and food products utilize over 2 Tcf of gas alone and are expected to have shipments grow 83% and 51% respectively through 2040.

Exhibit 6-23: AEO Reference Case Projection for Value of Shipments (billion 2009 dollars)



The equipment costs in the industrial sector were forecasted utilizing a combination of the AEO's forecasted industrial gas consumption by category (combustion versus feedstock) and the forecasted shipments by industry group (from EIA's macroeconomic modeling of the U.S. economy). The projected growth rate in shipments by industry sector was applied to base year natural gas consumption to initially project growth in natural gas consumption in each industry. These initial estimates were then scaled to match the EIA projection of natural gas consumption for combustion uses in all industries in total.

To develop both base year and forecasted inventories of gas-fired industrial equipment, ICF assumed that each industry operates a given number of shifts each week and that different kinds of equipment operate at assumed capacity utilization rates during those shifts. This allowed us to calculate average equipment utilization rate for each industry sector and each end-use application. This utilization rate was then applied to the total gas consumption volumes in projected years to estimate the aggregate gas firing rate of equipment measured in MMBtu/hour.

As with the residential and commercial sectors, ICF estimated new equipment spending for new capacity separately from spending to replace worn out or obsolescent existing capacity. The

estimated gas firing rate for new equipment was calculated by assuming an average lifetime of the equipment. The cost of the equipment purchased in the forecasted years was calculated by multiplying the cost of equipment per MMBtu/hour firing rates times the capacity purchased each year. The total domestic spending for each end-use includes the domestic equipment cost, the retail markup on domestic and imported products, the installation costs for all new equipment, and the maintenance costs for all equipment. The total domestic spending for the 2016 AEO Reference Case, the 2016 AEO High Oil and Gas Resource Case, and the 2015 High Oil and Gas Resource Case are outlined in Exhibit 6-24.

Exhibit 6-24: Forecasted Domestic Spending on Gas-fired Industrial Equipment (billion$)

	2015	2020	2025	2030	2035	2040
2016 Reference Case	$14.51	$16.62	$18.04	$19.20	$20.82	$22.67
2016 High Oil and Gas Resource Case	$14.51	$16.56	$18.27	$19.41	$20.80	$22.64
2015 High Oil and Gas Resource Case	$14.51	$15.75	$17.15	$18.82	$20.50	$22.45

Projected Value Added and Employment for Industrial Combustion End-uses

The projected value added of gas used in industrial combustion processes was calculated for each of the contiguous 48 states for the 2016-2040 time period for the 2016 Reference Case and the other two cases.

Exhibit 6-25 below shows the U.S. value added related to industrial combustion through 2040. Following that, Exhibit 6-26 details the projected direct, indirect and induced employment impacts associated with the use of natural gas for industrial combustion uses over the same time period.

Exhibit 6-25 Forecasted Value Added Related to Industrial Combustion (million $)

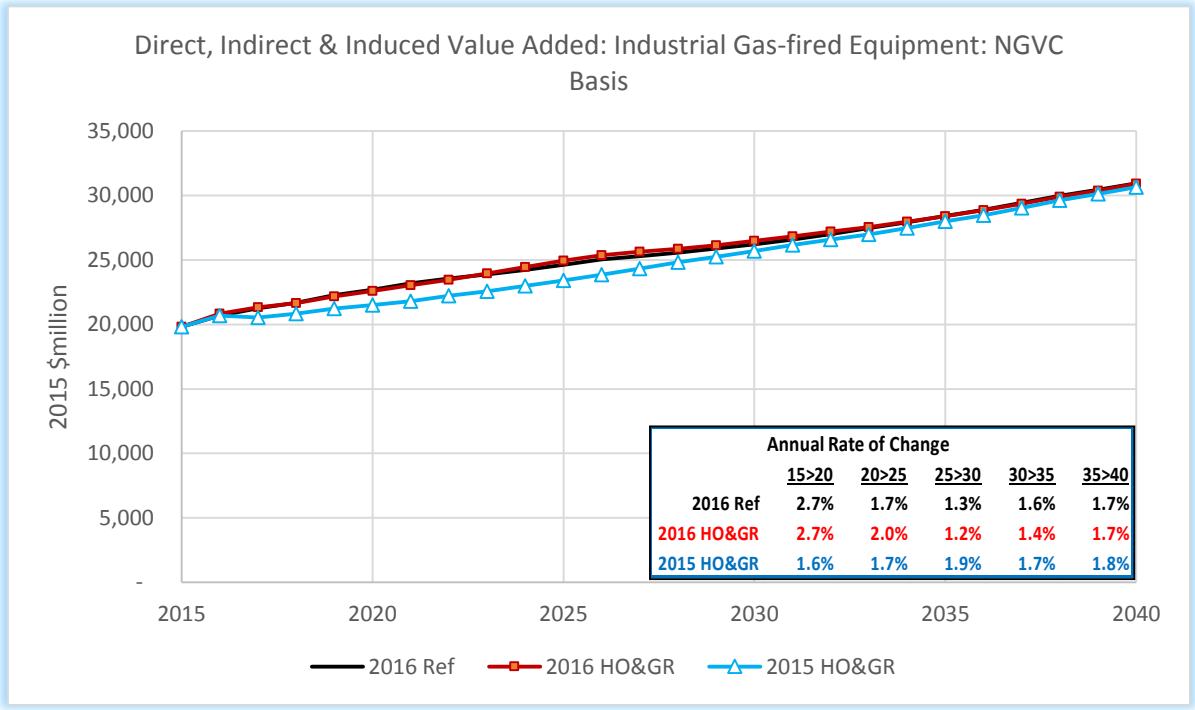
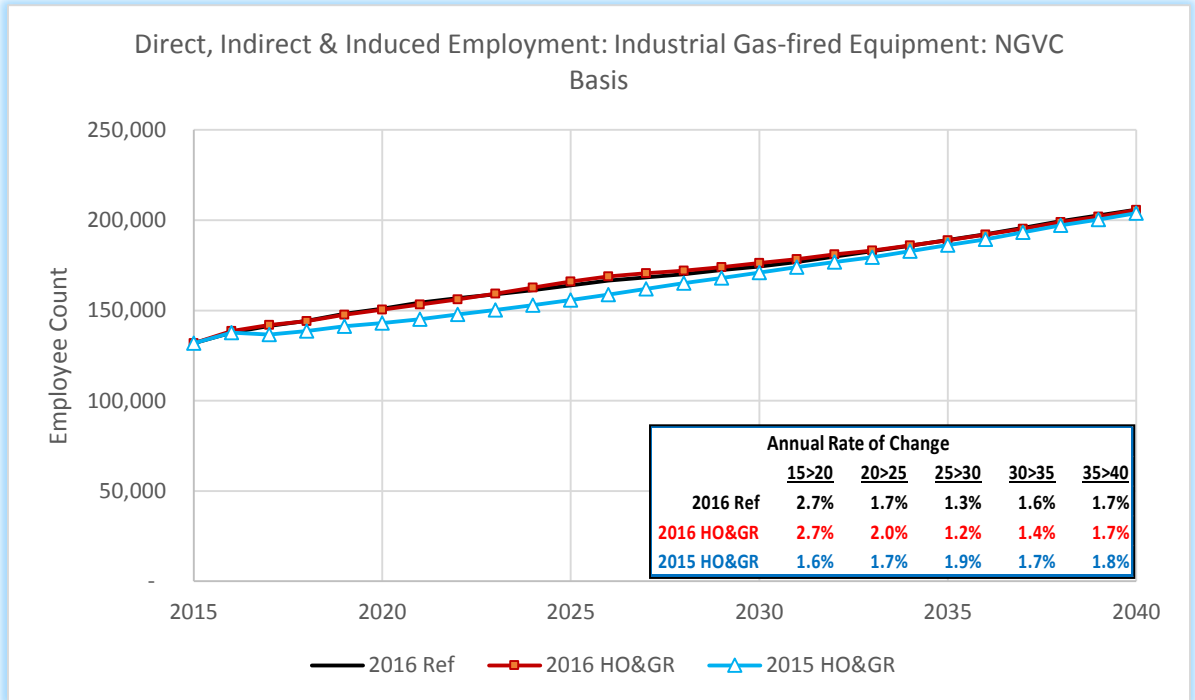


Exhibit 6-26: Forecasted Employment Related to Industrial Combustion

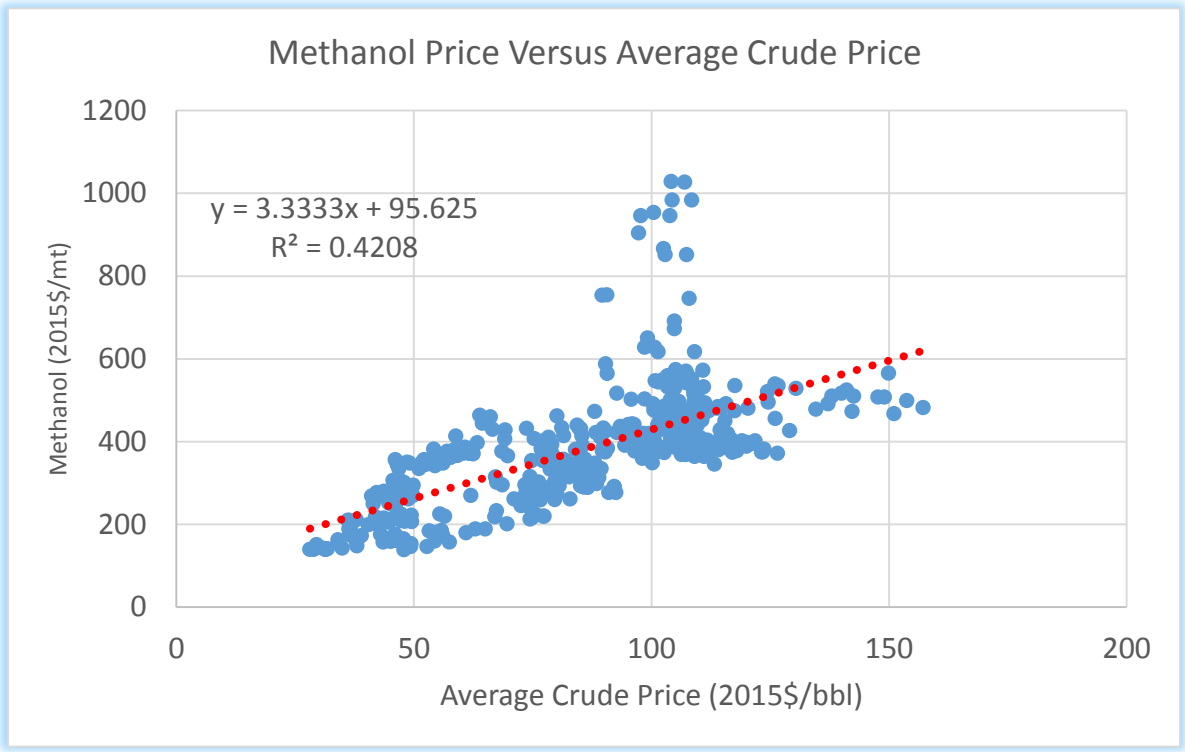


6.2.5 Forecast for Industrial Natural Gas Feedstock Consumption

Demand for natural gas will grow for feedstock uses to make ammonia, methanol and their derived products. ICF projected ammonia and methanol plant capacity increases based on published plans 2015 to 2025.[52] Projected plant capacity utilization rates were based on historical 2015 data but adjusted over time to better match EIA projections of natural gas feedstock use. Additional plant capacity was added after 2025 to track the long-term AEO projection of natural gas feedstock use. Future gas consumption to produce ammonia and methanol was based on historical yield ratios. The cost of natural gas feedstock came from the three AEO case projections.

The future prices of ammonia and methanol were based on a regression model that estimated ammonia prices as a function of crude oil prices. The projected annual average crude oil prices from the three AEO cases were put into the regression model to project future primary chemical prices. The total value of ammonia and methanol was then determined as the product of forecasted production volumes and prices. The value added was calculated by taking the total value for each year and subtracting the value of the natural gas feed required. This difference was determined for each future year to give a total value added from the primary bulk chemical ammonia and methanol production stages.

Exhibit 6-27: Example of Price Regression Model: Methanol vs Crude Oil



[52] For ammonia we used "Ammonia Plants in North America" https://ammoniaindustry.com/ammonia-plants-in-north-america. For methanol we used "U.S. Downstream Engineering, Construction & Maintenance Market Outlook 2017" by Petrochemical Update, March 2017.

The additional value added that comes from converting domestically produced ammonia and imported ammonia into the 1st to Nth derivative products was also calculated for future years. The same was done for methanol derived products of methanol. The methodology used for 1st to Nth derivative products assumes that (1) the future volumes of imports of the primary chemical would be the same as the base year, (2) the mix of chemicals derived from ammonia and methanol in the future will be the same as in the base year and (3) the average value added for each derived chemical would stay constant on a dollar per ton basis. In other words, the value added from derived chemicals varied among the three cases only based on the volume of ammonia and methanol made in the U.S. while the value added from production of the primary chemical varied based both on volume produced and the regression model prediction of ammonia and methanol prices. This means that value added by producing the primary chemical is predicted to higher per ton when the ratio of oil to gas prices is high.

6.2.6 Forecasted Industrial NGL Feedstock Consumption

A single methodology was used to forecast production volumes of ethylene, propylene and butadiene and their derivatives and the associated value added. This NGL feedstock methodology was very similar to that used for ammonia and methanol in that it started by developing estimates for near-term plant capacity changes based on compiling investment plans from various publications and press releases to project future ethylene production capacity from 2015 to 2025. The new capacity increase was assumed to be fed 90% by ethane with the remaining 10% distributed between propane, butane, and naphtha based on cracker-feed proportions in 2015. Historical capacity utilization rates and yield ratios were used to estimate plant output volumes by product and volume of feedstocks required. The same process was used for PDH plants that will make propylene out of propane. The long-term projection for crackers and PDH plants was adjusted by adding additional (unplanned) cracker and PDH capacity so that total feedstock use tracked volumes in the AEO cases.

As with ammonia and methanol, ICF developed regression models to predict olefin prices as a function of crude oil process and applied those regression models to the annual crude oil prices found in the three AEO cases. Additionally, because the AEO does not produce price projections for the relevant natural gas liquids (ethane, propane and butane) ICF also estimated gas plant liquid prices for the three AEO cases. This was done by assuming that the price depression of ethane and propane relative to crude experienced in 2015 would ease over time as ethylene cracker capacity and NGL export capacity is added in the U.S.

Exhibit 6-28: Expected NGL Component Prices - 2016 Reference Case

Component	Price ($/bbl)				Ratio to Oil Price			
	2015	2020	2030	2040	2015	2020	2030	2040
Crude WTI	$48.67	$71.12	$97.06	$129.11	1.00	1.00	1.00	1.00
Ethane	$7.72	$19.32	$35.18	$46.43	0.16	0.26	0.35	0.35
Propane	$19.03	$39.90	$63.33	$83.58	0.39	0.54	0.63	0.63
Butane	$25.26	$51.00	$80.42	$106.13	0.52	0.69	0.80	0.80
Naphtha	$57.68	$84.36	$114.84	$151.55	1.14	1.14	1.14	1.14

Exhibit 6-29: Expected NGL Component Prices - 2016 High Oil & Gas Case

Component	Price ($/bbl)				Ratio to Oil Price			
	2015	2020	2030	2040	2015	2020	2030	2040
Crude WTI	$48.67	$64.84	$77.35	$98.86	1.00	1.00	1.00	1.00
Ethane	$7.72	$17.78	$28.47	$36.49	0.16	0.26	0.35	0.35
Propane	$19.03	$36.72	$51.25	$65.69	0.39	0.54	0.63	0.63
Butane	$25.26	$46.93	$65.08	$83.41	0.52	0.69	0.80	0.80
Naphtha	$57.68	$77.64	$92.93	$119.12	1.14	1.14	1.14	1.14

Exhibit 6-30: Expected NGL Component Prices - 2015 High Oil & Gas Case

Component	Price ($/bbl)				Ratio to Oil Price			
	2015	2020	2030	2040	2015	2020	2030	2040
Crude WTI	$50.98	$66.26	$86.48	$118.61	1.00	1.00	1.00	1.00
Ethane	$7.72	$18.57	$32.31	$43.40	0.15	0.26	0.35	0.35
Propane	$19.03	$38.35	$58.16	$78.12	0.37	0.54	0.63	0.63
Butane	$25.26	$49.02	$73.85	$99.20	0.50	0.69	0.80	0.80
Naphtha	$57.68	$76.18	$99.06	$133.06	1.07	1.07	1.07	1.07

Future values of the production of the primary olefins (ethylene, propylene and butadiene) and byproducts of the cracking process were estimated by multiplying their projected production volumes times their expected prices. The cost of feedstocks was estimated by multiplying the volume of each feedstock times its expected price in each year for each of the three AEO cases. These values were then used to compute value added taking into account capital investment patterns and the foreign content in capital and intermediate goods.

ICF also computed the value added that would be expected to come from converting domestically produced olefins (imports are not significant) into the 1st to Nth derivative products, and was also calculated for future years. The same was done for methanol-derived products of methanol. This assumed that (1) the mix of chemicals derived from each olefin in the future will be the same as in the base year and (2) the average value added for each derived chemical would stay constant on a dollar per ton basis.

6.2.7 Forecasted BTX Feedstock Consumption

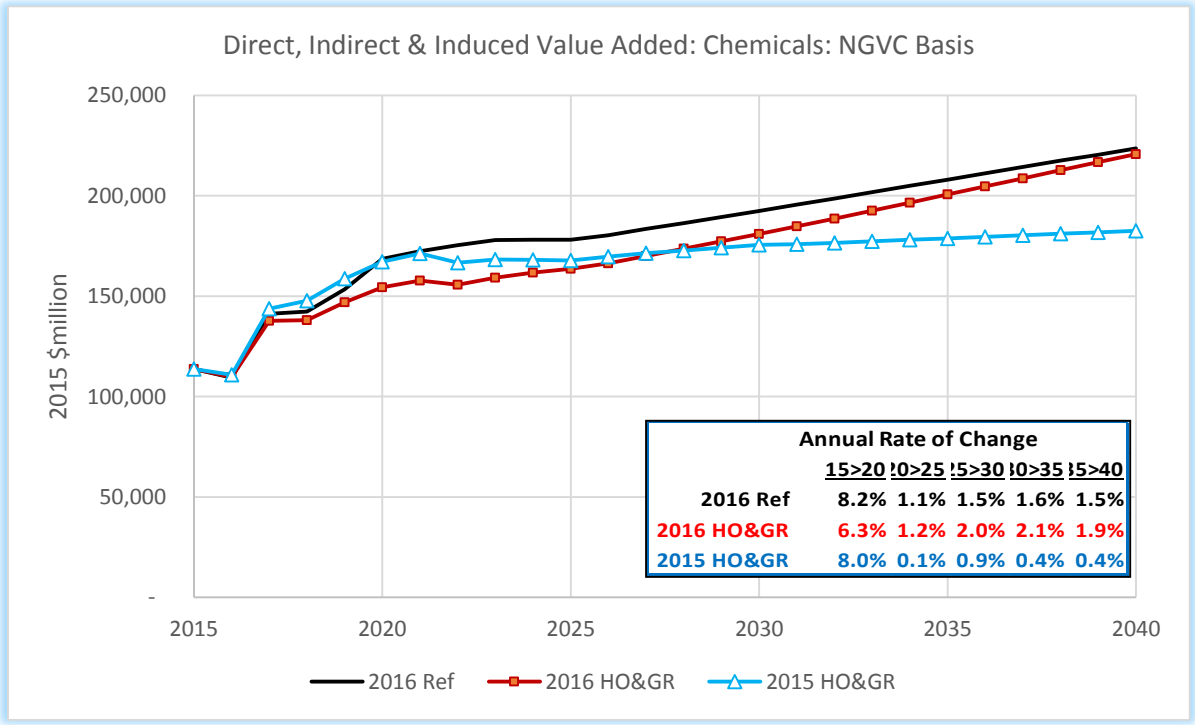
ICF estimated future BTX (benzene, toluene and xylene) production from refineries based on the AEO projections of refinery runs and an assumed fixed ratio of barrels of BTX output per barrel of feed. The portion of that BTX that was attributed to the natural gas value chain was adjusted over time to account for the increasing fraction of refinery feed expected to be made up of domestic lease condensate (relative to domestic and foreign crudes). The future value of the BTX was based on a regression model that predicts BTX prices as a function of crude price. As with the other petrochemicals, the value added for the 1st to Nth derivatives were based on assumptions that the mix of derivative from each primary chemical would not change over time and that the value added on a per-ton basis would be the same as in the base year.

6.2.8 Methodology for Estimating Natural Gas Value Chain Basis

The methodologies described above were employed first to develop estimates of future production volumes and value added on a 100% Basis that included all expected future activity in the U.S. regardless of whether natural gas or NGLs were the feedstock and regardless of whether the natural gas was domestically produced. Then that 100% Basis estimate was adjusted to remove the effects of oil-based feedstocks, imported natural gas and imported primary chemicals (chiefly imported ammonia and imported methanol).

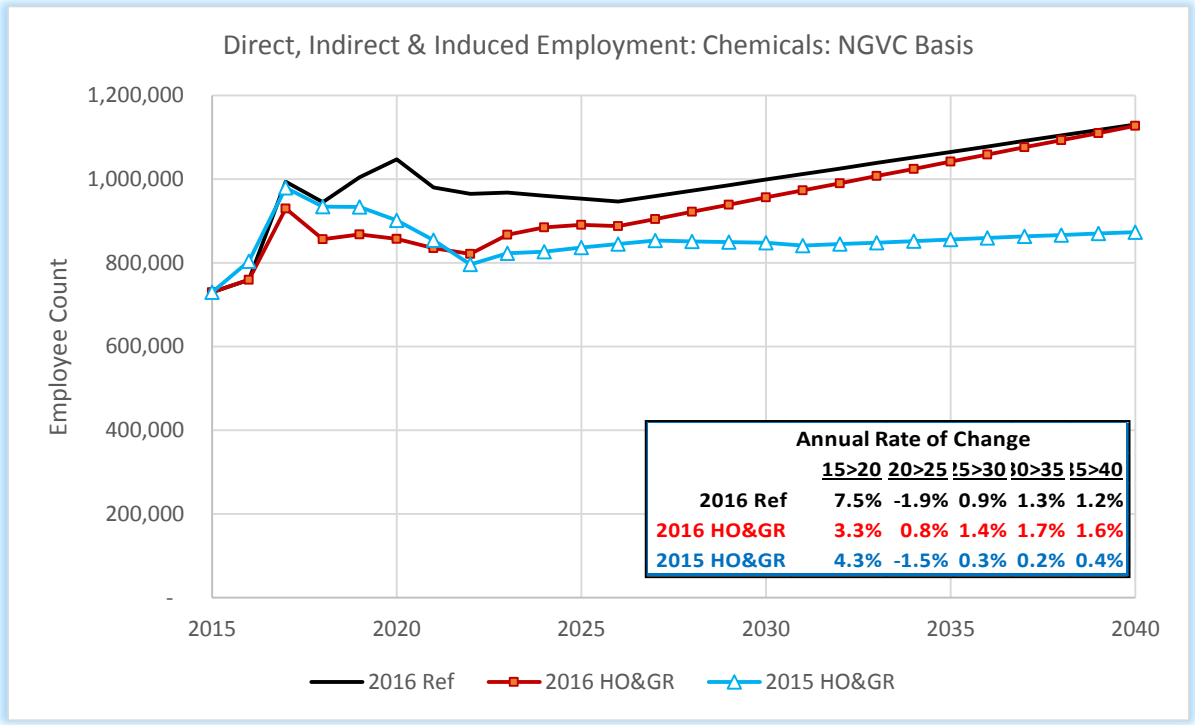
Exhibit 6-31 shows the value added results on a Natural Gas Value Chain Basis for the three AEO cases. There is a rapid growth in the near-term as planned new ethylene cracker and PDH capacity is added. After that, growth occurs steadily but at a more moderate pace. The differences between the 2016 Reference and High Oil and Gas Resource Case is due to the fact that the lower oil prices in the latter case reduces the amount petrochemicals manufactured in the U.S. The same is true in the 2015 High Oil and Gas Resource Case.

Exhibit 6-31: Forecasted Total Chemical Value Added (NGVC Basis)



The forecasted employment numbers related to chemical sector use of natural gas, natural gas liquids and gas-related BTX are shown in Exhibit 6-32. These results mirror the value added patterns in that growth is rapid in the near-terms as new plant capacity is added and then continues in the long run at a slower rate. The near-term ups and downs in the employment patterns are due to construction activity as plants are added.

Exhibit 6-32: Forecasted Total Chemical Employment (NGVC Basis)



6.2.9 LNG Export Terminals

Value added and employment related to LNG plants are shown in Exhibit 6-33 and Exhibit 6-34. The up and down patterns for employment is due to the effects of the construction of new LNG terminals. Because the High Oil and Gas Resource Cases have higher levels of LNG exports, they have longer periods of high employment and greater value added in the long term.

Exhibit 6-33: Forecasted Total Value Added Related to LNG Export Terminals (NGVC Basis)

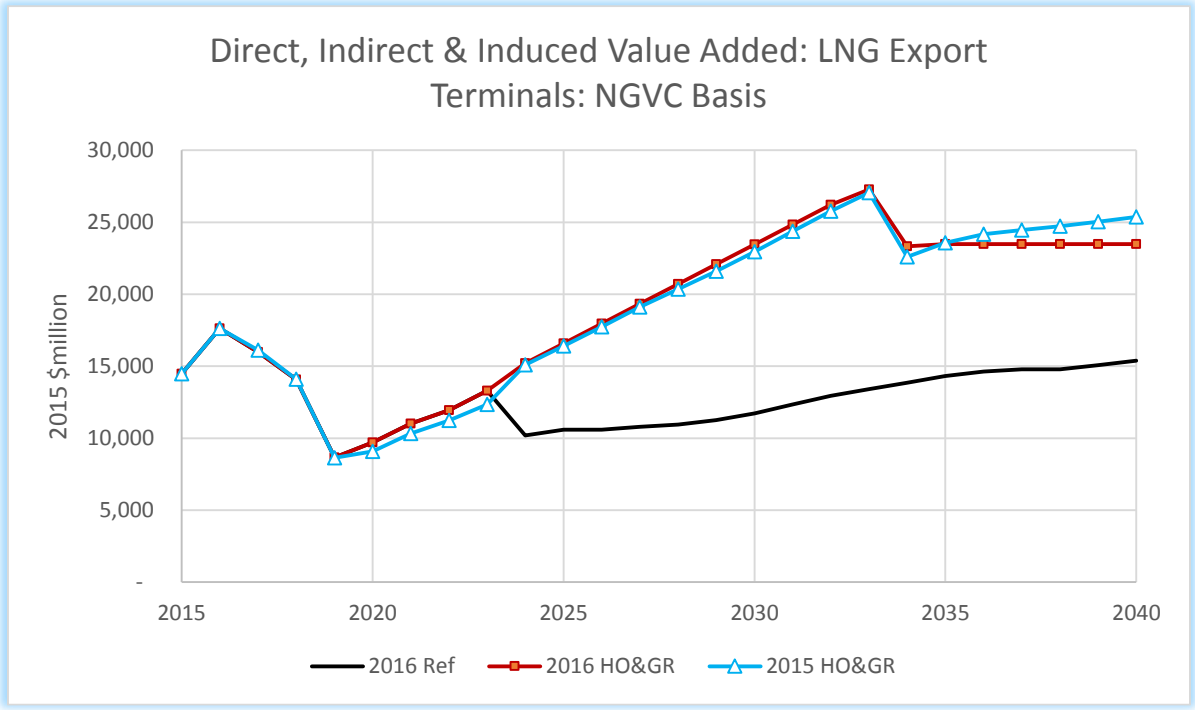
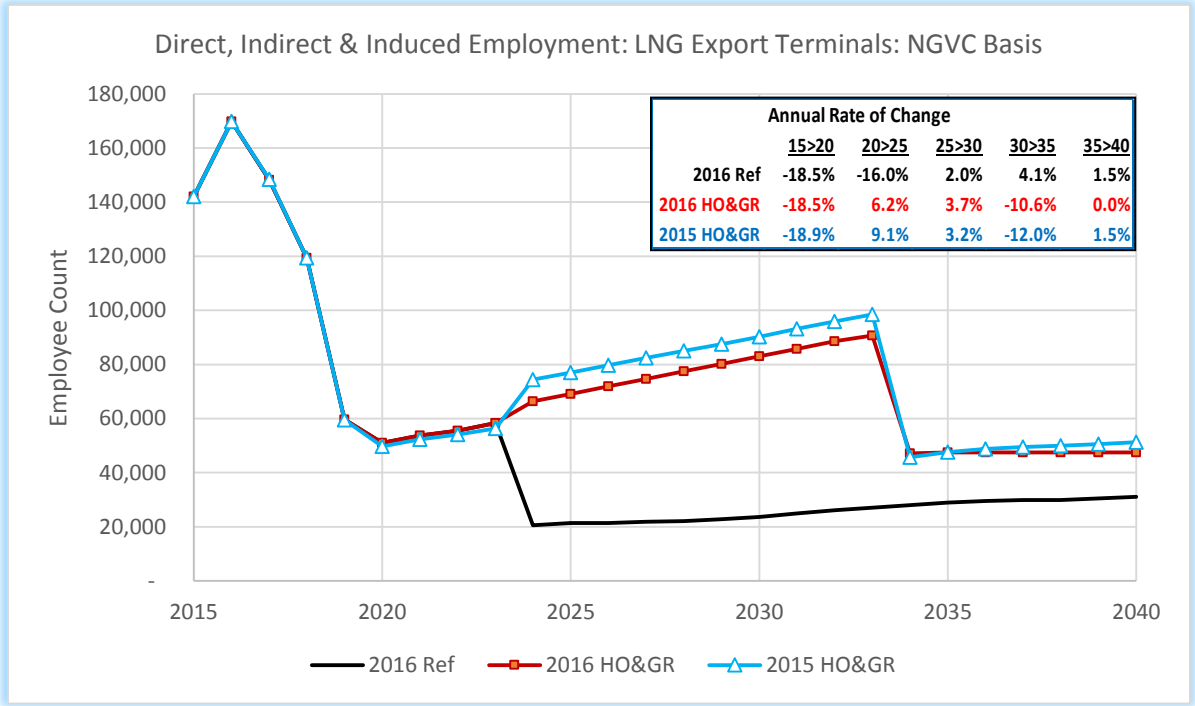


Exhibit 6-34: Forecasted Total Employment Related to LNG Export Terminals (NGVC Basis)



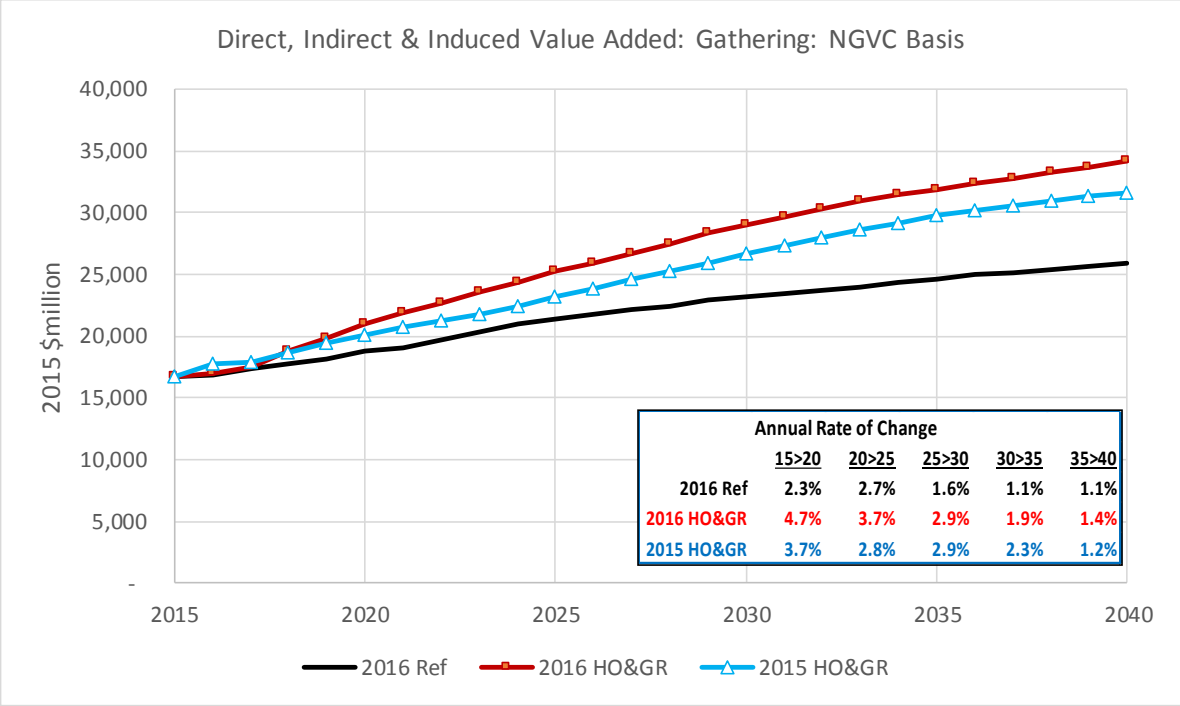
6.3 Natural Gas Infrastructure

The forecasts of the value added and employment associated with infrastructure are shown in the next several exhibits starting with gathering, then gas processing, pipelines, gas distribution, petroleum refining, and NGL/LPG distribution.

6.3.1 Gathering

The forecasted value trends for gas gathering are shown in Exhibit 6-35 and the trends for employment are shown in Exhibit 6-36. These trends follow the trend in natural gas production for each AEO case and so the high resource cases have higher value added and employment as compared to the Reference Case.

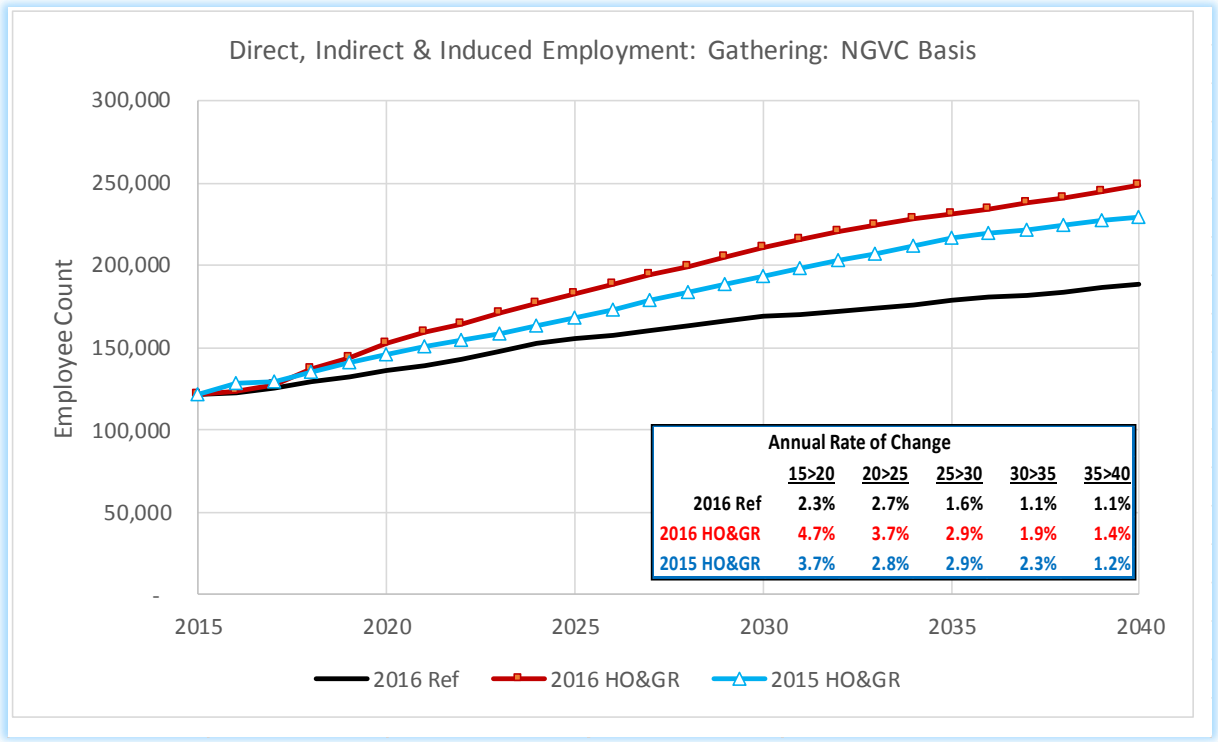
Exhibit 6-35: Forecasted Total Valued Added Associated with Gas Gathering (NGVC Basis)



Annual Rate of Change

	15>20	20>25	25>30	30>35	35>40
2016 Ref	2.3%	2.7%	1.6%	1.1%	1.1%
2016 HO&GR	4.7%	3.7%	2.9%	1.9%	1.4%
2015 HO&GR	3.7%	2.8%	2.9%	2.3%	1.2%

Exhibit 6-36: Forecasted Total Employment Associated with Gas Gathering (NGVC Basis)



Annual Rate of Change

	15>20	20>25	25>30	30>35	35>40
2016 Ref	2.3%	2.7%	1.6%	1.1%	1.1%
2016 HO&GR	4.7%	3.7%	2.9%	1.9%	1.4%
2015 HO&GR	3.7%	2.8%	2.9%	2.3%	1.2%

6.3.2 Processing

The forecast for value added associated with gas processing is shown in Exhibit 6-37 for gas processing. The corresponding chart for employment is shown in Exhibit 6-38. As with gas gathering, the economic impacts of gas processing follows the trend in natural gas production and so the high resource cases have higher valued added and employment compared to the Reference Case.

Exhibit 6-37: Forecasted Total Valued Added Associated with Gas Processing (NGVC Basis)

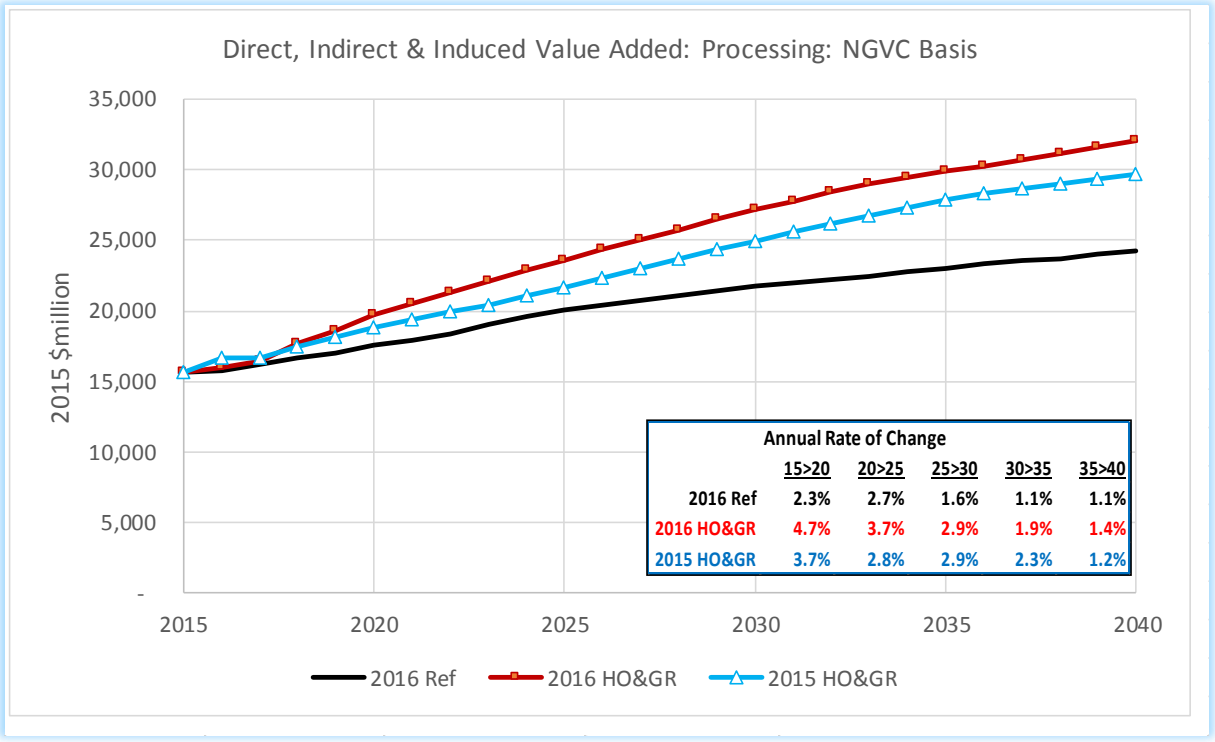
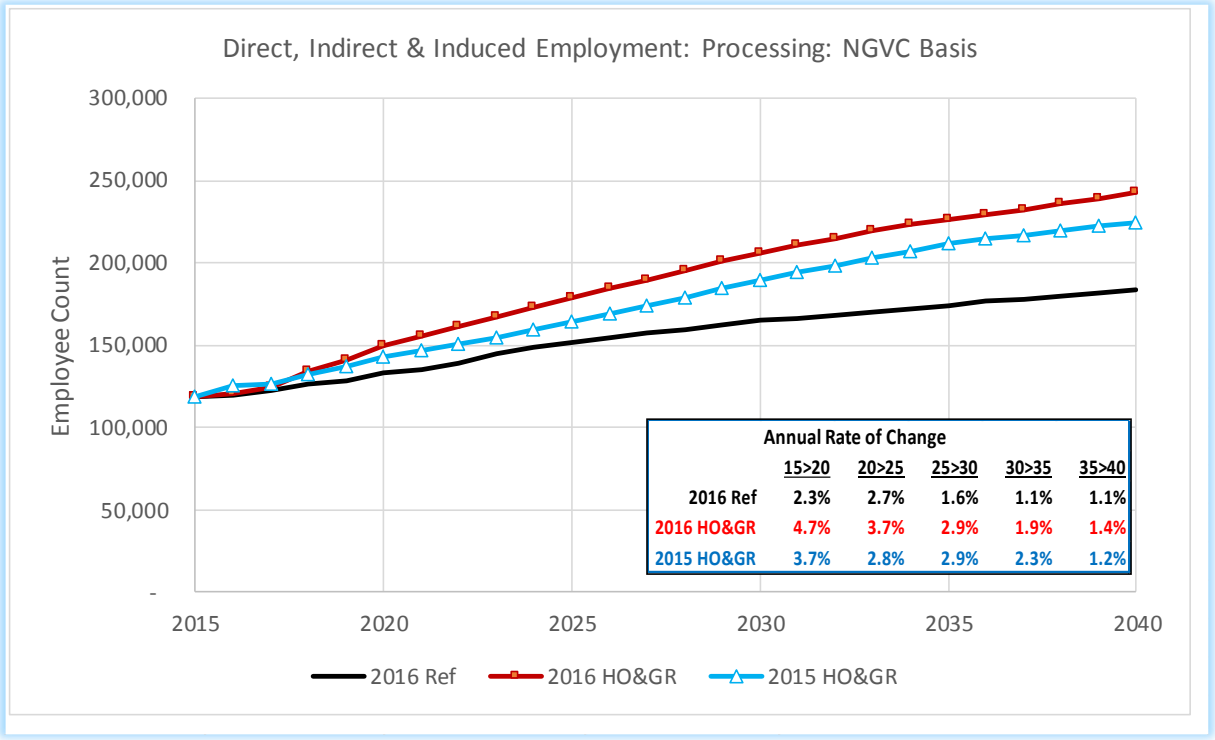


Exhibit 6-38: Forecasted Total Employment Associated with Gas Processing (NGVC Basis)



6.3.3 Pipelines

The forecasts for energy pipelines are shown in Exhibit 6-39 for value added and in Exhibit 6-40 for employment. These patterns are based on trends in production for natural gas, crude oil, NGLs and petroleum products in each AEO case. As would be expected, the higher production rates in the high resource cases leads to greater use of energy pipelines and therefore greater value added and employment.

Exhibit 6-39: Forecasted Total Valued Added Associated with Energy Pipelines (NGVC Basis)

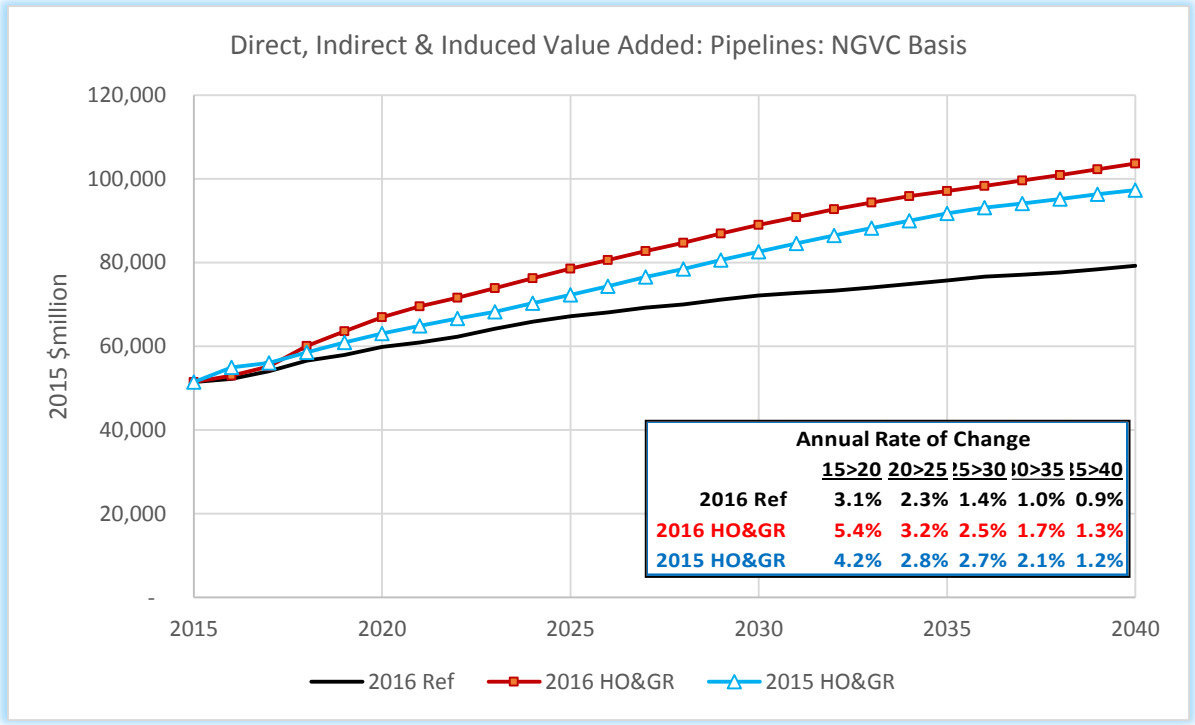
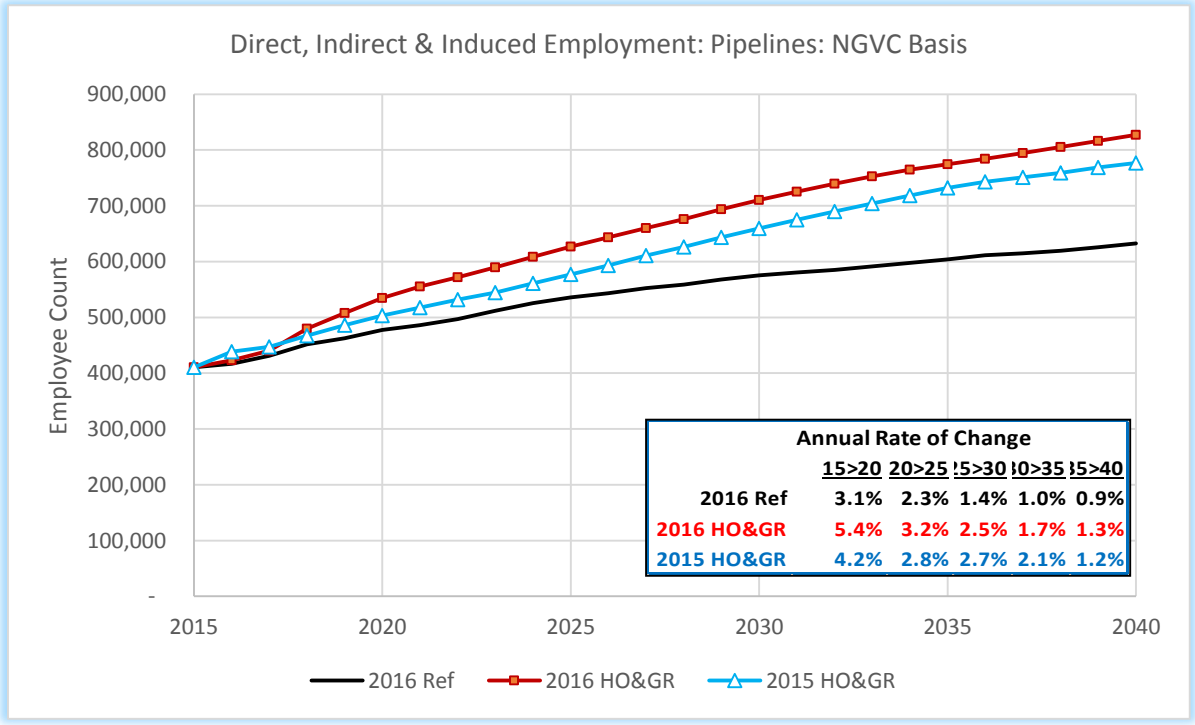


Exhibit 6-40: Forecasted Total Employment Associated with Energy Pipelines (NGVC Basis)



6.3.4 Natural Gas Distribution

The forecast for natural gas distribution value added is shown in Exhibit 6-41. The employment forecast is in Exhibit 6-42. These trends are relatively flat because gas distributors primarily provide services to residential and commercial natural gas users and their forecasted increase in consumption is much lower than power generators, LNG exporters and industrial users. Also because the long-term price elasticity of demand in the residential and commercial sectors is low, the differences among the three AEO cases are relatively small compared to the other infrastructure sectors presented above.

Exhibit 6-41: Forecasted Total Value Added Associated with Natural Gas Distribution (NGVC Basis)

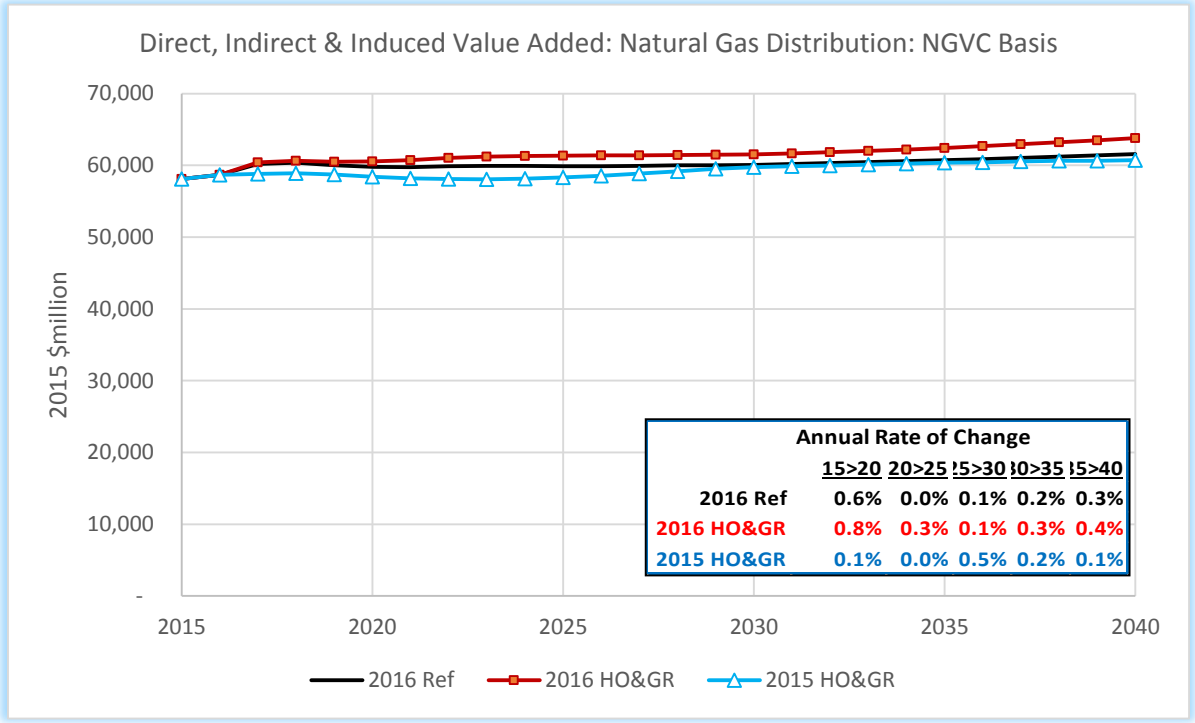
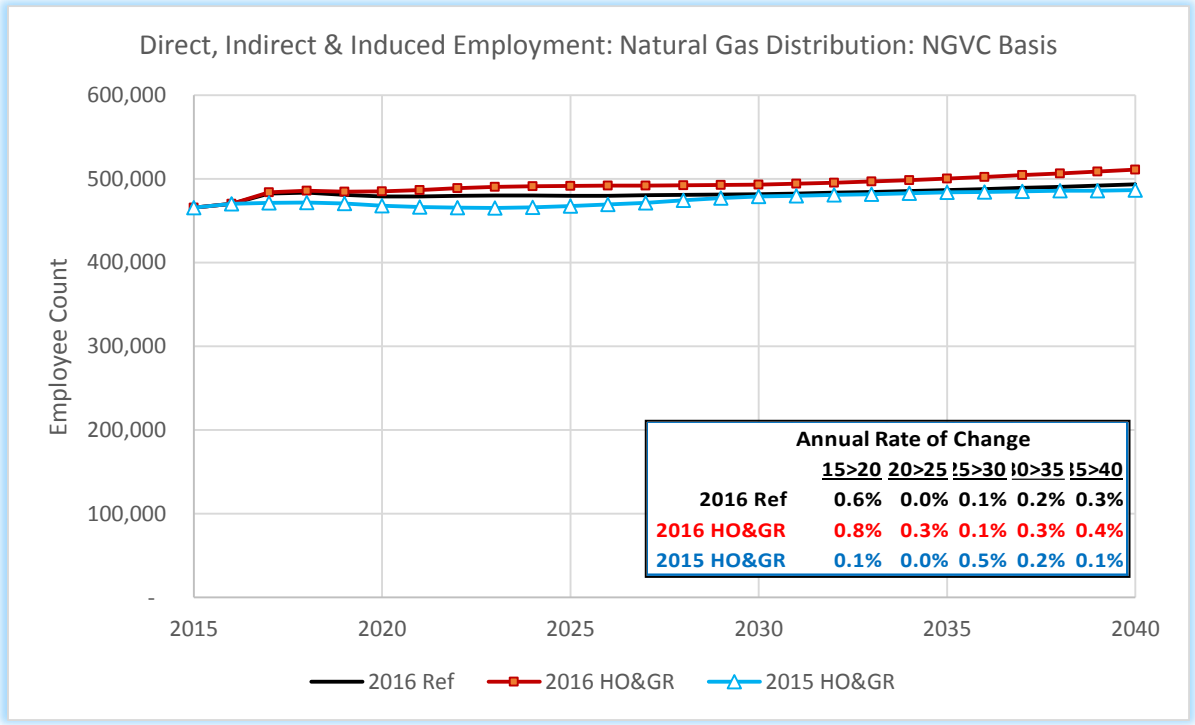


Exhibit 6-42: Forecasted Total Employment Associated with Natural Gas Distribution (NGVC Basis)



6.3.5 Petroleum Refining

The results for petroleum refining are shown in Exhibit 6-43 for value added and Exhibit 6-44 for employment. These trends are influenced primarily by the AEO forecast of refinery throughput. The Reference Case has a relatively flat forecast for refinery throughput, while the two higher resource cases show greater volumes of refinery throughput for most forecast years.

Exhibit 6-43: Forecasted Total Valued Added Associated with Petroleum Refining (NGVC Basis)

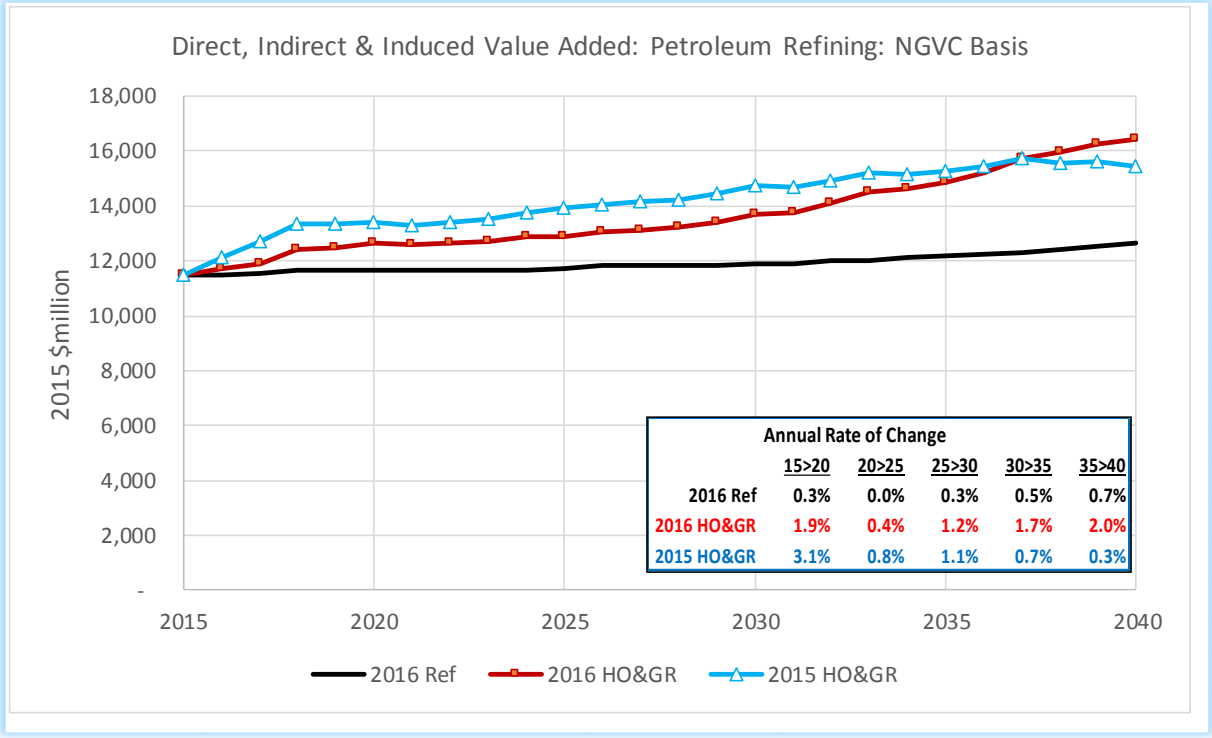
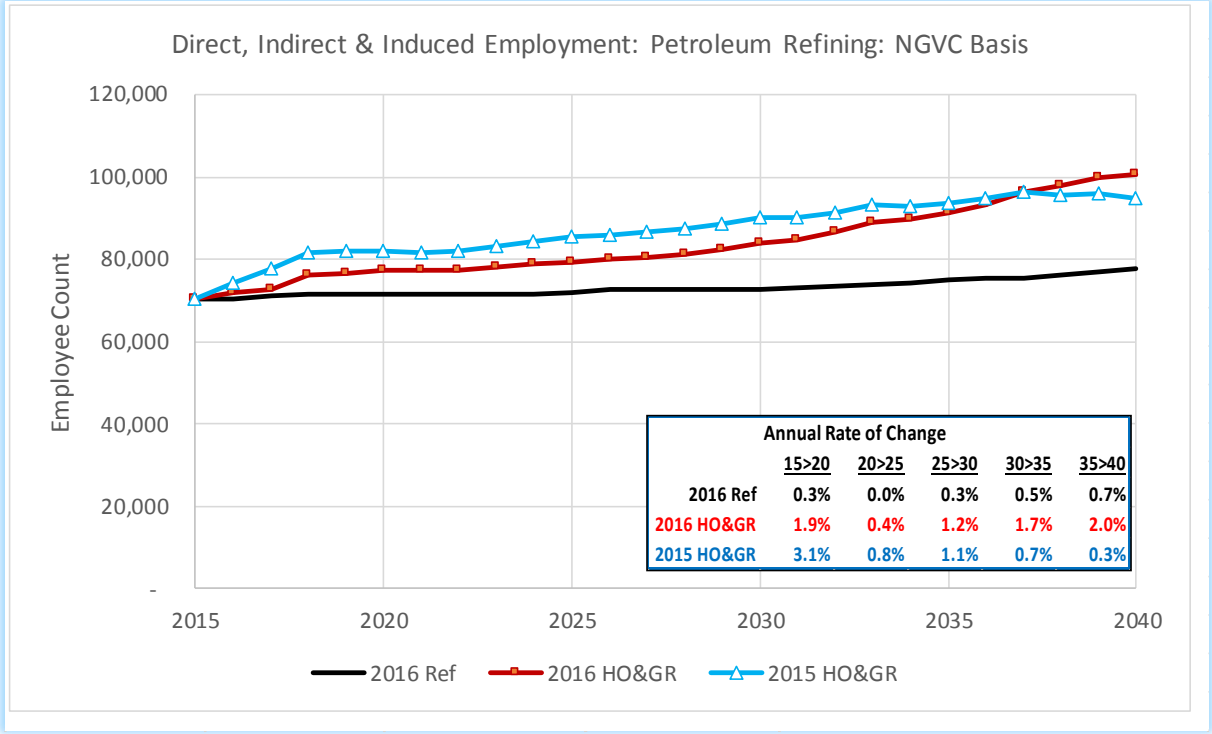


Exhibit 6-44: Forecasted Employment Associated with Petroleum Refining (NGVC Basis)



6.3.6 Propane & Other NGL/ LPG Distribution

The infrastructure for propane and other NGL/LPG distribution covers the non-pipeline portions of transporting and distributing those products primarily to residential, commercial and small industrial customers. Deliveries to large petrochemical users are mostly achieved through pipeline delivery and contribute only a small portion of the revenues in this sector. The results for value added appear in Exhibit 6-45 and those for employment are in Exhibit 6-46. For most of the Reference Case forecast, demand (other than petrochemicals) is relatively flat for propane and other NGLs and so value added and employment do not grow significantly. The high resource cases show somewhat higher growth rates for both value added and employment.

Exhibit 6-45: Forecasted Total Valued Added Associated with NGL/LPG Distribution Terminals (NGVC Basis)

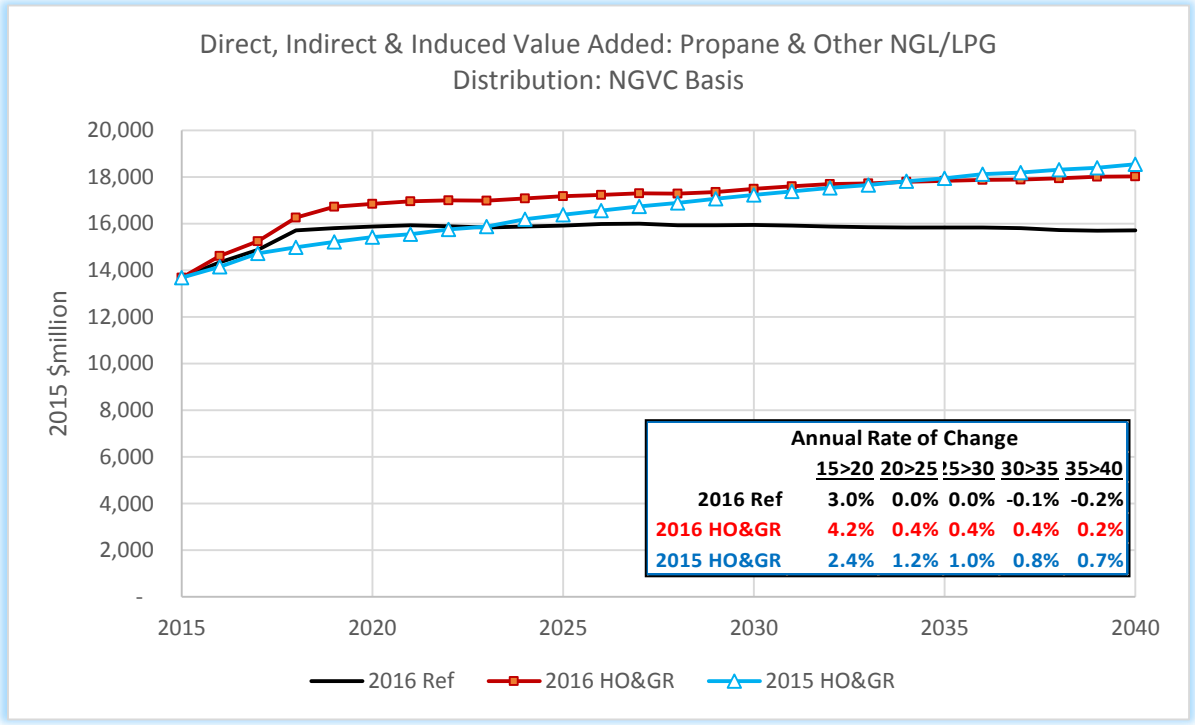
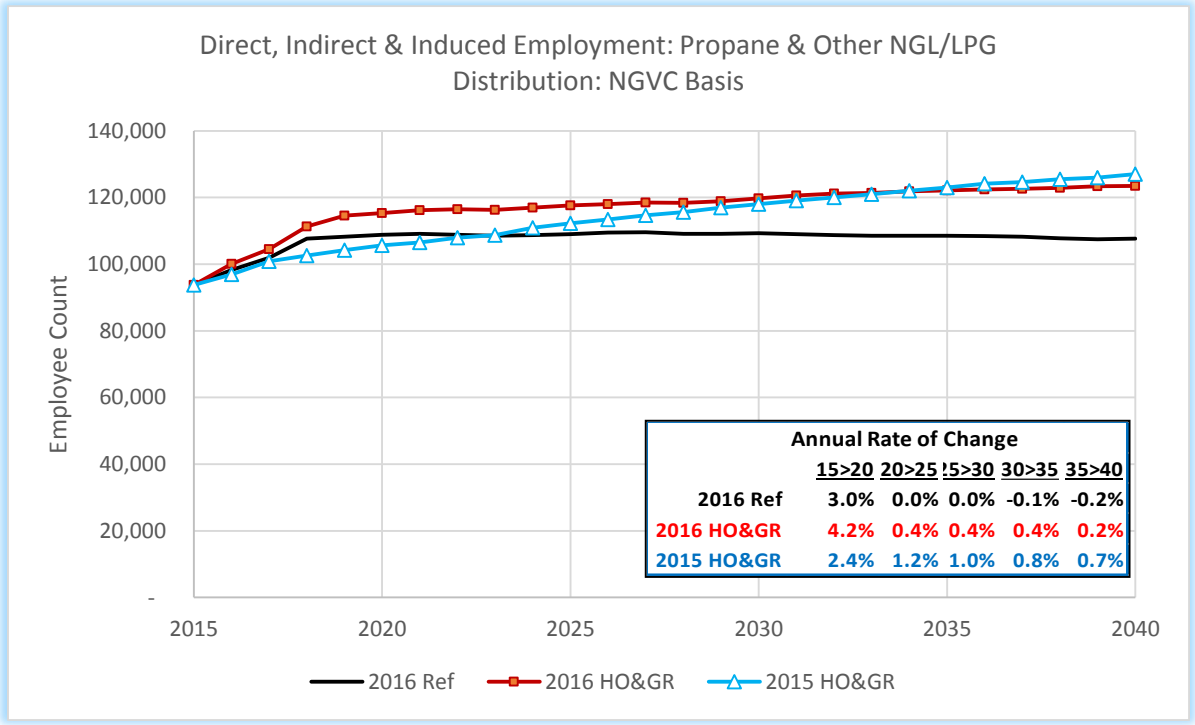


Exhibit 6-46: Forecasted Total Employment Associated with NGL/LPG Distribution (NGVC Basis)



6.4 Natural Gas Production Sector

The value added and employment forecasts for the production sector are shown in Exhibit 6-47 and in Exhibit 6-48. The value added for the 2016 High Oil and Gas Resource Case is lower in most years than the corresponding Reference Case because the lower oil and gas prices overwhelm the increased production, leading to lower value added. The same is generally true for the 2015 High Oil and Gas Resource Case when compared to the 2016 Reference Case. On the other hand, employment for the two high resource cases is greater than the Reference Case because expenditures are higher.

Exhibit 6-47: Forecasted Total Valued Added Associated with the Production Sector

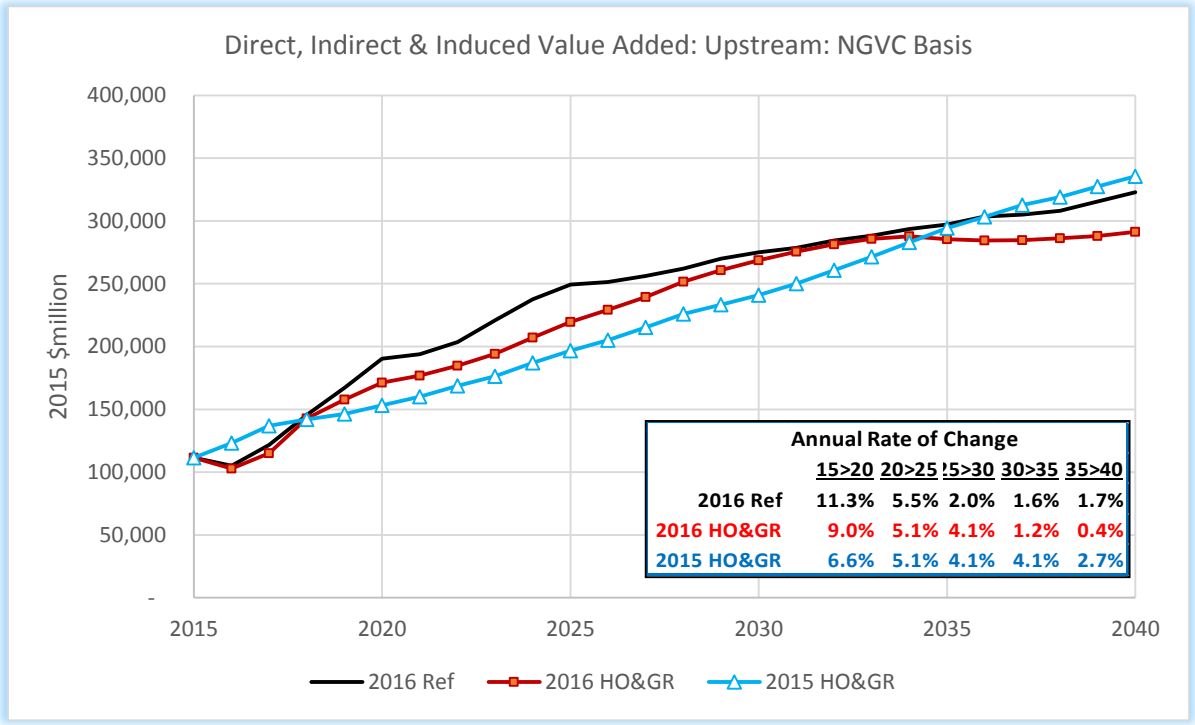
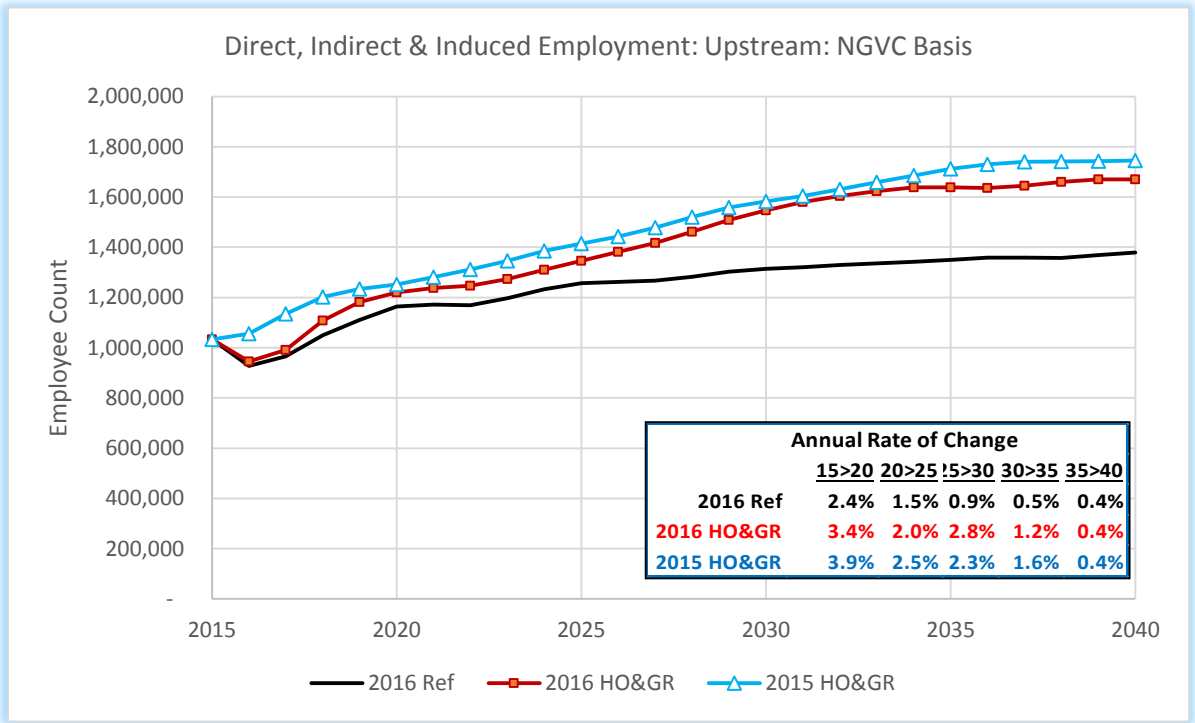


Exhibit 6-48: Forecasted Total Employment Associated with the Production Sector (NGVC Basis)



7. Appendix A: State Level Factsheets

This Appendix contains a one-page “Fact Sheet” of statistics on each state based on the 2015 Natural Gas Value Chain economic impact estimates discussed in Chapter 5 of this report. There is also a brief introduction with a few notable highlights related to how the natural gas value chain affects the economy of each state.

United States Totals

Economic Impacts of Natural Gas

As shown in Exhibit 7-1, there were 4.10 million jobs in the U.S. related to natural gas in 2015. The top three sectors with the greatest number of jobs were support activities for oil and gas operations, chemical manufacturing, and oil and gas pipeline construction. The contribution to the U.S. economy in terms of direct, indirect, and induced value added in 2015 was $551 billion, of which $272 billion was related to the end use segment, $168 billon was from the infrastructure segment, and $111 billion was from the production segment.

Natural Gas Consumers

In 2015, the U.S. consumed 25.1 Tcf of natural gas. There were a total of 73.5 million customers. The value of natural gas delivered to consumers was $130 billion.

The U.S. has 67.9 million residential customers who consumed 4.6 Tcf in 2015. Average consumption was 68 Mcf per household.

The U.S. has 5.4 million commercial customers who consumed 3.2 Tcf in 2015. Average consumption per commercial customer was 587 Mcf.

There are 189,000 industrial customers who consumed 7.5 Tcf. Average consumption per industrial customer was 40 MMcf.

Natural Gas Infrastructure

In 2015, the U.S. had 595,000 producing oil wells and 574,000 producing gas wells. There were 397.000 miles of gas gathering lines, 298,000 miles of gas pipelines, 73,000 miles of crude oil pipelines, 67,000 miles of NGL pipelines, 63,000 miles of product pipelines, and 5,000 miles of CO2 pipelines. There were 1.3 million miles of gas distribution mains and 912,000 miles of service lines. .

Natural Gas and Oil Production

In 2015, the U.S. produced 27.1 Tcf of dry natural gas, 1.2 billion barrels of gas plant liquids, 323 million barrels of lease condensate, and 3.1 billion barrels of crude.

Exhibit 7-1: US Total Factsheet

US Total			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	147,857	258,596	406,453	11,419	12,891	24,311	42,395	22,735	65,130
		Industrial	297,763	563,432	861,195	23,354	28,228	51,582	83,885	49,717	133,602
		Residential/ Commercial	163,499	211,665	375,165	10,934	10,946	21,880	38,907	19,123	58,029
		Export	81,532	60,548	142,080	5,965	3,075	9,040	9,076	5,396	14,471
		Transportation	1,751	1,564	3,315	82	81	130	284	146	430
	Infrastructure	Processing	86,951	102,342	189,293	7,211	5,296	12,508	17,856	9,327	27,183
		Pipelines	268,373	257,754	526,128	21,702	13,409	35,111	43,793	23,637	67,430
		Distribution	287,063	264,488	551,552	21,992	13,693	35,717	47,079	23,962	71,041
		Wholesalers, Marketers, Other	7,920	7,414	15,333	619	385	1,005	1,296	675	1,971
	Production	Natural Gas/ NGLs	609,382	424,129	1,033,510	56,667	21,537	78,204	73,596	37,794	111,390
	All Segments	Grand Total	1,952,091	2,151,932	4,104,023	159,946	109,541	269,486	358,167	192,510	550,677

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	134,530
	2	325	Chemical Manufacturing	114,505
	3	237120	Oil & Gas Pipeline Construction	97,220
	4	211111	Crude Petroleum & Natural Gas Extraction	90,579
	5	221210	Natural Gas Distribution	84,211
	6	811310	Industrial Equip. & Machinery Repair & Maint.	54,205
	7	236210	Industrial Construction	41,651
	8	213111	Drilling Oil & Gas Wells	33,878
	9	4841	Freight Truck	33,515
	10	45431NGL	NGL Retail	27,678

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	67,873,861	4,609,672	$46,462
	Commercial Sector	5,449,180	3,198,799	$23,802
	Industrial Sector	188,585	7,534,588	$27,559
	Transportation	1,821	39,377	$353
	Power Sector	2,410	9,671,096	$31,461
	All Sectors	73,515,857	25,053,529	$129,637

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	1,277,270	911,651	396,674	298,005	73,260	67,467	62,543	5,205

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	27,059,503
	Gas Plant Liquids (barrels)	1,202,077,000
	Lease Condensate (barrels)	323,000,000
	Crude Oil (barrels)	3,113,515,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$98,890
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$236,968

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	594,634	19,858
	Gas Wells	574,459	4,990
	All Wells	1,169,093	24,848

Annual 2015 Data for US Total Natural Gas Value Chain Basis

Alabama

Economic Impacts of Natural Gas

There were 56,600 jobs in Alabama related to natural gas. These jobs represented 3.0 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and industrial equipment and machinery repair and maintenance. The contribution to the Alabama economy in terms of direct, indirect, and induced value added in 2015 was $7.76 billion, of which $4.46 billion was related to the end use segment, $2.46 billon was from the infrastructure segment, and $0.84 billion was from the production segment.

Natural Gas Consumers

In 2015, Alabama consumed 643 Bcf of natural gas. There were a total of 840,000 customers. The value of natural gas delivered to consumers was $2.59 billion.

Alabama has 769,000 residential customers who consumed 33 Bcf in 2015. Average consumption was 42 Mcf per household. Residential demand was 65 percent for space heating, 29 percent for water heating, 3 percent for cooking, and 3 percent for other uses

Alabama has 68,000 commercial customers who consumed 25 Bcf in 2015. Average consumption per commercial customer was 368 Mcf. Commercial demand was 50 percent for space heating, 29 percent for water heating, 10 percent for cooking, and 11 percent for other uses.

There are 3,300 industrial customers who consumed 187 Bcf. Average consumption per industrial customer was 57 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Primary Metals (331), Food (311), Petroleum and Coal Products (324), and Transportation Equipment (336), representing 80 percent of industrial demand.

Alabama has 42 power plants consuming natural gas. Gas consumed was 398 Bcf, representing 37 percent of generation in the state. Average consumption per customer was 9,475 MMcf.

Natural Gas Infrastructure

In 2015, Alabama had 1,005 producing oil wells and 6,044 producing gas wells. There were 3,475 miles of gas gathering lines and 16 gas processing plants in the state with a capacity of 1,459 MMcf/d. In addition, there were 6,712 miles of gas pipelines, 395 miles of crude oil pipelines, 357 miles of NGL pipelines, 1,102 miles of product pipelines, and 11 miles of CO2 pipelines. There were 30,954 miles of gas distribution mains and 26,598 miles of service lines. There were 2 natural gas storage sites in the state with a working gas capacity of 33 Bcf.

Natural Gas and Oil Production

In 2015, Alabama produced 162 Bcf of dry natural gas, 9 million barrels of gas plant liquids, 1 million barrels of lease condensate, and 64 million barrels of crude.

Exhibit 7-2: Alabama State Factsheet

Alabama			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,416	4,755	8,170	272	242	514	1,308	418	1,726
		Industrial	4,602	8,157	12,759	325	388	713	1,154	720	1,874
		Residential/ Commercial	2,189	2,863	5,052	151	151	302	484	259	743
		Export	699	673	1,372	48	33	81	52	60	112
		Transportation	18	13	31	1	1	1	3	2	5
	Infrastructure	Processing	869	1,222	2,091	64	60	124	163	111	274
		Pipelines	3,606	3,486	7,092	275	176	451	562	320	881
		Distribution	6,252	4,718	10,970	372	212	585	849	427	1,276
		Wholesalers, Marketers, Other	148	120	267	9	6	15	21	11	32
	Production	Natural Gas/ NGLs	4,470	4,365	8,836	347	208	556	447	389	836
	All Segments	Grand Total	26,269	30,371	56,641	1,864	1,477	3,341	5,043	2,716	7,759

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	2,167
	2	325	Chemical Manufacturing	1,614
	3	811310	Industrial Equip. & Machinery Repair & Maint.	1,178
	4	237120	Oil & Gas Pipeline Construction	927
	5	221112	Gas-fired Electric Power Generation	852
	6	331210	Iron & Steel Pipe & Tube Manufacturing	802
	7	45431NGL	NGL Retail	736
	8	236210	Industrial Construction	712
	9	211111	Crude Petroleum & Natural Gas Extraction	430
	10	4841	Freight Truck	376

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	768,568	32,709	$460
	Commercial Sector	67,746	24,915	$255
	Industrial Sector	3,300	186,954	$696
	Transportation	34	421	$5
	Power Sector	42	397,961	$1,177
	All Sectors	839,690	642,961	$2,594

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	30,954	26,598	3,475	6,712	395	357	1,102	11

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	162,436
	Gas Plant Liquids (barrels)	9,041,000
	Lease Condensate (barrels)	1,000,000
	Crude Oil (barrels)	63,982,300
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$632
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$3,483

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	1,005	26
	Gas Wells	6,044	23
	All Wells	7,049	48

Annual 2015 Data for Alabama Natural Gas Value Chain Basis

Alaska

Economic Impacts of Natural Gas

There were 21,510 jobs in Alaska related to natural gas. These jobs represented 6.5 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas operations, crude petroleum and natural gas extraction, and oil and gas pipeline construction. The contribution to the Alaska economy in terms of direct, indirect, and induced value added in 2015 was $3.09 billion, of which $0.33 billion was related to the end use segment, $1.11 billon was from the infrastructure segment, and $1.66 billion was from the production segment.

Natural Gas Consumers

In 2015, Alaska consumed 70 Bcf of natural gas in all sectors. There were a total of 142,000 customers. The value of natural gas delivered to consumers was $509 million.

Alaska has 128,600 residential customers who consumed 19 Bcf in 2015. Average consumption was 144 mcf per household. Residential demand was 67 percent for space heating, 26 percent for water heating, 2 percent for cooking, 1 percent for clothes drying, and 4 percent for other uses.

Alaska has 13,500 commercial customers who consumed 18 Bcf in 2015. Average consumption per commercial customer was 1.4 MMcf. Commercial demand was 34 percent for space heating, 23 percent for water heating, 8 percent for cooking, and 35 percent for other uses.

Industrial customers in Alaska consumed 4.9 Bcf. Average consumption per customer was 1,216 MMcf. The top industries for gas consumption were Food (NAICS Code 311), Mining (21), Petroleum and Coal Products (324), Construction (23), and Fabricated Metal Products (332), representing 95 percent of industrial demand.

Alaska has 18 power plants consuming natural gas. Gas consumed was 28 Bcf. Average consumption per customer was 1,540 MMcf.

Natural Gas Infrastructure

In 2015, Alaska had 1,619 producing oil wells and 329 producing gas wells. There were 292 miles of gas gathering lines in the state. In addition, there were 973 miles of gas pipelines, 1,133 miles of crude oil pipelines, 0 miles of NGL pipelines, 119 miles of product pipelines, and no CO2 pipelines. There were 3,405 miles of gas distribution mains and 2,440 miles of service lines. There were 5 natural gas storage sites in the state with a working gas capacity of 68 Bcf.

Natural Gas and Oil Production

In 2015, Alaska produced 326 Bcf of dry natural gas, 15 million barrels of gas plant liquids, no lease condensate, and 176 million barrels of crude.

Exhibit 7-3: Alaska State Factsheet

Alaska			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	285	487	772	22	24	47	87	43	130
		Industrial	72	580	652	5	29	34	8	51	59
		Residential/ Commercial	315	398	713	20	20	41	94	36	129
		Export	23	64	86	2	3	5	2	6	7
		Transportation	0	0	1	0	0	0	0	0	0
	Infrastructure	Processing	990	590	1,580	55	22	77	429	54	483
		Pipelines	1,718	1,067	2,785	175	67	243	262	98	360
		Distribution	1,149	804	1,952	109	47	156	181	73	254
		Wholesalers, Marketers, Other	39	26	65	4	2	5	6	2	8
	Production	Natural Gas/ NGLs	9,300	3,604	12,904	1,101	227	1,328	1,336	321	1,657
	All Segments	Grand Total	13,891	7,619	21,510	1,494	441	1,935	2,405	684	3,088

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	4,420
	2	211111	Crude Petroleum & Natural Gas Extraction	1,575
	3	237120	Oil & Gas Pipeline Construction	1,247
	4	213111	Drilling Oil & Gas Wells	457
	5	811310	Industrial Equip. & Machinery Repair & Maint.	429
	6	221210	Natural Gas Distribution	287
	7	236210	Industrial Construction	138
	8	4841	Freight Truck	114
	9	221112	Gas-fired Electric Power Generation	65
	10	811412	Household Appliance Repair & Maintenance	54

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	128,605	18,574	$178
	Commercial Sector	13,549	18,472	$148
	Industrial Sector	4	4,864	$33
	Transportation	1	10	$0
	Power Sector	18	27,722	$149
	All Sectors	142,177	69,642	$509

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	3,405	2,440	292	973	1,133	0	119	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	326,066
	Gas Plant Liquids (barrels)	14,987,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	176,241,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$1,272
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$8,517

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	1,619	156
	Gas Wells	329	13
	All Wells	1,948	169

Annual 2015 Data for Alaska Natural Gas Value Chain Basis

Arizona

Economic Impacts of Natural Gas

There were 39,667 jobs in Arizona related to natural gas. These jobs represented 1.5 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and gas-fired electric generation. The contribution to the Arizona economy in terms of direct, indirect, and induced value added in 2015 was $5.04 billion, of which $2.89 billion was related to the end use segment, $1.70 billon was from the infrastructure segment, and $0.45 billion was from the production segment.

Natural Gas Consumers

In 2015, Arizona consumed 337 Bcf of natural gas in all sectors. There were a total of 1.26 million customers. The value of natural gas delivered to consumers was $1.82 billion.

Arizona has 1.20 million residential customers who consumed 35 Bcf in 2015. Average consumption was 29 Mcf per household. Residential demand was 36 percent for space heating, 47 percent for water heating, 7 percent for cooking, 2 percent for clothes drying, and 8 percent for other uses.

Arizona has 57,000 commercial customers who consumed 31 Bcf in 2015. Average consumption per commercial customer was 538 Mcf. Commercial demand was 52 percent for space heating, 16 percent for water heating, 12 percent for cooking, 5 percent for cogeneration, and 15 percent for other uses.

There are 400 industrial customers who produced 20 Bcf in 2015. Average consumption per industrial customer was 51 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Mining (21), Primary Metals (331), Food (311), and Fabricated Metal Products (332), representing 72 percent of industrial demand.

Arizona has 34 power plants consuming natural gas. Gas consumed was 249 Bcf, representing 30 percent of power generation in the state. Average consumption per customer was 7,337 MMcf.

Natural Gas Infrastructure

In 2015, Arizona had 20 producing oil wells and 6 producing gas wells. There were 16 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 6,694 miles of gas pipelines, no crude oil pipelines, no NGL pipelines, 575 miles of product pipelines, and no CO2 pipelines. There were 24,548 miles of gas distribution mains and 15,166 miles of service lines. There are no natural gas storage sites in the state.

Natural Gas and Oil Production

In 2015, Arizona produced 0.1 Bcf of dry natural gas, and 37,000 barrels of crude.

Exhibit 7-4: Arizona State Factsheet

Arizona			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,081	4,444	7,525	238	222	460	860	391	1,251
		Industrial	1,527	5,283	6,811	97	250	347	291	466	757
		Residential/ Commercial	2,020	2,740	4,760	133	140	273	531	248	779
		Export	385	553	938	27	28	54	29	49	79
		Transportation	108	91	199	5	5	8	17	8	26
	Infrastructure	Processing	545	1,046	1,591	37	50	87	41	95	136
		Pipelines	2,075	2,733	4,808	143	135	278	281	251	532
		Distribution	4,034	3,654	7,688	285	181	468	675	331	1,006
		Wholesalers, Marketers, Other	92	93	186	6	5	11	15	8	23
	Production	Natural Gas/ NGLs	1,764	3,399	5,162	134	167	301	148	303	450
	All Segments	Grand Total	15,630	24,037	39,667	1,106	1,182	2,287	2,889	2,150	5,039

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	1,372
	2	811310	Industrial Equip. & Machinery Repair & Maint.	758
	3	221112	Gas-fired Electric Power Generation	672
	4	237120	Oil & Gas Pipeline Construction	655
	5	236210	Industrial Construction	518
	6	45431NGL	NGL Retail	449
	7	325	Chemical Manufacturing	397
	8	335228	Other Major Household Appliance Manufacturing	250
	9	486210	Pipeline Transportation of Natural Gas	173
	10	4841	Freight Truck	167

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,200,783	34,507	$586
	Commercial Sector	56,793	30,528	$303
	Industrial Sector	400	20,402	$84
	Transportation	42	2,434	$28
	Power Sector	34	249,477	$823
	All Sectors	1,258,052	337,347	$1,824

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	24,548	15,166	16	6,694	0	12	575	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	95
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	37,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$2

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	20	0
	Gas Wells	6	0
	All Wells	26	0

Annual 2015 Data for Arizona Natural Gas Value Chain Basis

Arkansas

Economic Impacts of Natural Gas

There were 40,546 jobs in Arkansas related to natural gas. These jobs represented 3.4 percent of total state jobs. The top three sectors with the greatest number of jobs were freight truck, crude petroleum and natural gas extraction, and natural gas distribution. The contribution to the Arkansas economy in terms of direct, indirect, and induced value added in 2015 was $5.27 billion, of which $2.23 billion was related to the end use segment, $1.74 billon was from the infrastructure segment, and $1.30 billion was from the production segment.

Natural Gas Consumers

In 2015, Arkansas consumed 274 Bcf of natural gas in all sectors. There were a total of 620,000 customers. The value of natural gas delivered to consumers was $1.36 billion.

Arkansas has 550,000 residential customers who consumed 33 Bcf in 2015. Average consumption was 60 Mcf per household. Residential demand was 64 percent for space heating, 27 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Arkansas has 69,000 commercial customers who consumed 48 Bcf in 2015. Average consumption per commercial customer was 688 Mcf. Commercial demand was 38 percent for space heating, 21 percent for water heating, 9 percent for cooking, and 32 percent for other uses.

There are 1,023 industrial customers in Arkansas who consumed 85 Bcf in 2015. Average consumption per industrial customer was 83 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Mining (21), Primary Metals (331), Paper (322), Food (311), and Petroleum and Coal Products (324), representing 84 percent of industrial demand.

Arkansas has 26 power plants consuming natural gas. In 2015, gas consumption was 109 Bcf, representing 27 percent of power generation in the state. Average consumption per customer was 4,183 MMcf.

Natural Gas Infrastructure

In 2015, Arkansas had 7,698 producing oil wells and 9,965 producing gas wells. There were 4,874 miles of gas gathering lines and 2 gas processing plants in the state with a capacity of 37 MMcf/d. In addition, there were 7,211 miles of gas pipelines, 453 miles of crude oil pipelines, 947 miles of NGL pipelines, 406 miles of product pipelines, and no CO2 pipelines. There were 20,184 miles of gas distribution mains and 8,276 miles of service lines. There were 2 natural gas storage sites in the state with a working gas capacity of 12 Bcf.

Natural Gas and Oil Production

In 2015, Arkansas produced 1.01 Tcf of dry natural gas, 427,000 barrels of plant liquids, and 6.17 million barrels of crude. Arkansas is the location of the Fayetteville shale gas play, which is one of the top shale gas plays in the U.S.

Exhibit 7-5: Arkansas State Factsheet

Arkansas			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	1,500	2,273	3,773	116	113	229	363	200	563
		Industrial	2,498	4,452	6,951	166	205	371	642	393	1,035
		Residential/ Commercial	1,597	1,820	3,418	104	93	197	395	164	559
		Export	501	411	913	32	20	52	36	37	72
		Transportation	1	1	2	0	0	0	0	0	0
	Infrastructure	Processing	685	783	1,468	44	36	81	98	71	170
		Pipelines	3,008	2,414	5,422	218	118	336	584	221	805
		Distribution	3,563	2,652	6,215	221	122	344	507	240	747
		Wholesalers, Marketers, Other	95	72	167	6	3	10	15	7	22
	Production	Natural Gas/ NGLs	7,935	4,283	12,219	621	195	816	918	382	1,300
	All Segments	Grand Total	21,384	19,162	40,546	1,529	906	2,434	3,558	1,715	5,274

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	4841	Freight Truck	1,361
	2	211111	Crude Petroleum & Natural Gas Extraction	1,305
	3	221210	Natural Gas Distribution	1,228
	4	213112	Support Activities for Oil & Gas Operations	1,099
	5	331210	Iron & Steel Pipe & Tube Manufacturing	1,061
	6	325	Chemical Manufacturing	985
	7	237120	Oil & Gas Pipeline Construction	872
	8	811310	Industrial Equip. & Machinery Repair & Maint.	662
	9	45431NGL	NGL Retail	428
	10	236210	Industrial Construction	387

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	550,108	32,998	$381
	Commercial Sector	69,265	47,651	$352
	Industrial Sector	1,023	85,287	$313
	Transportation	18	36	$0
	Power Sector	26	108,755	$313
	All Sectors	620,440	274,727	$1,359

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	20,184	8,276	4,874	7,211	453	947	406	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1,009,723
	Gas Plant Liquids (barrels)	427,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	6,165,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$2,167
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$2,433

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	7,698	74
	Gas Wells	9,965	293
	All Wells	17,663	367

Annual 2015 Data for Arkansas Natural Gas Value Chain Basis

California

Economic Impacts of Natural Gas

There were 378,799 jobs in California related to natural gas. These jobs represented 2.3 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, oil and gas pipeline construction, and chemical manufacturing. The contribution to the California economy in terms of direct, indirect, and induced value added in 2015 was $45.6 billion, of which $23.5 billion was related to the end use segment, $15.4 billon was from the infrastructure segment, and $6.7 billion was from the production segment.

Natural Gas Consumers

In 2015, California consumed 2.25 Tcf of natural gas in all sectors. There were a total of 11.5 million customers. The value of natural gas delivered to consumers was $12.0 billion.

California has 11.0 million residential customers who consumed 401 Bcf in 2015. Average consumption was 37 Mcf per household. Residential demand was 33 percent for space heating, 43 percent for water heating, 9 percent for cooking, 3 percent for clothes drying, 1 percent for space cooling, and 11 percent for other uses.

California has 447,000 commercial customers who consumed 236 Bcf in 2015. Average consumption per commercial customer was 528 Mcf. Commercial demand was 32 percent for space heating, 21 percent for water heating, 8 percent for cooking, 7 percent for cogeneration, and 32 percent for other uses.

There are 37,000 industrial customers in California who consumed 777 Bcf in 2015. Average consumption per industrial customer was 21 MMcf. The top industries for gas consumption were Petroleum and Coal Products (NAICS Code 324), Chemicals (325), Food (311), Non-metallic Mineral Products ((327), and Primary Metals (331), representing 78 percent of industrial demand.

California has 357 power plants consuming natural gas. In 2015, gas consumed was 817 Bcf, representing 59 percent of power generation in the state. Average consumption per customer was 2,288 MMcf.

Natural Gas Infrastructure

In 2015, California had 48,856 producing oil wells and 4,209 producing gas wells. There were 3,337 miles of gas gathering lines and 23 gas processing plants in the state with a capacity of 898 MMcf/d. In addition, there were 12,458 miles of gas pipelines, 4,391 miles of crude oil pipelines, 63 miles of NGL pipelines, 3,338 miles of product pipelines, and no CO2 pipelines. There were 105,353 miles of gas distribution mains and 94,746 miles of service lines. There were 14 natural gas storage sites in the state with a working gas capacity of 375 Bcf.

Natural Gas and Oil Production

In 2015, California produced 0.22 Tcf of dry natural gas, 9.09 million barrels of plant liquids, no lease condensate, and 213 million barrels of crude.

Exhibit 7-6: California State Factsheet

California			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	15,018	30,356	45,374	1,251	1,565	2,816	4,686	2,669	7,354
		Industrial	21,364	57,396	78,760	1,443	2,744	4,187	4,538	5,067	9,605
		Residential/ Commercial	15,900	24,389	40,289	1,122	1,290	2,412	3,198	2,203	5,402
		Export	5,012	5,894	10,906	391	305	696	430	525	955
		Transportation	762	702	1,464	36	35	58	123	68	191
	Infrastructure	Processing	6,769	11,212	17,981	619	619	1,238	1,599	1,021	2,619
		Pipelines	21,455	27,507	48,962	1,593	1,389	2,981	2,271	2,522	4,794
		Distribution	31,534	31,951	63,485	2,287	1,606	3,905	4,913	2,889	7,802
		Wholesalers, Marketers, Other	781	855	1,636	57	43	100	110	78	187
	Production	Natural Gas/ NGLs	31,568	38,374	69,942	2,863	1,932	4,795	3,239	3,420	6,659
	All Segments	Grand Total	150,163	228,636	378,799	11,660	11,528	23,189	25,106	20,462	45,568

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	9,053
	2	237120	Oil & Gas Pipeline Construction	7,237
	3	325	Chemical Manufacturing	5,277
	4	811310	Industrial Equip. & Machinery Repair & Maint.	4,306
	5	213112	Support Activities for Oil & Gas Operations	3,917
	6	333611	Turbine and Turbine Generator Manufacturing	3,660
	7	211111	Crude Petroleum & Natural Gas Extraction	2,947
	8	236210	Industrial Construction	2,203
	9	45431NGL	NGL Retail	2,101
	10	221112	Gas-fired Electric Power Generation	1,966

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	10,969,597	401,172	$4,504
	Commercial Sector	446,510	235,787	$1,728
	Industrial Sector	36,854	777,104	$2,892
	Transportation	365	17,111	$150
	Power Sector	357	816,787	$2,687
	All Sectors	11,453,683	2,247,961	$11,962

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	105,353	94,746	3,337	12,458	4,391	63	3,338	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	218,590
	Gas Plant Liquids (barrels)	9,086,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	212,729,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$907
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$10,614

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	48,856	1,641
	Gas Wells	4,209	1
	All Wells	53,065	1,642

Annual 2015 Data for California Natural Gas Value Chain Basis

Colorado

Economic Impacts of Natural Gas

There were 75,210 jobs in Colorado related to natural gas. These jobs represented 3.0 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, crude petroleum and natural gas extraction, and oil and gas pipeline construction. The contribution to the Colorado economy in terms of direct, indirect, and induced value added in 2015 was $10.4 billion, of which $2.24 billion was related to the end use segment, $3.93 billon was from the infrastructure segment, and $4.22 billion was from the production segment.

Natural Gas Consumers

In 2015, Colorado consumed 348 Bcf of natural gas in all sectors. There were a total of 1.87 million customers. The value of natural gas delivered to consumers was $2.04 billion.

Colorado has 1.71 million residential customers who consumed 122 Bcf in 2015. Average consumption was 71 Mcf per household. Residential demand was 69 percent for space heating, 25 percent for water heating, 2 percent for cooking, and 4 percent for other uses.

Colorado has 150,500 commercial customers who consumed 54 Bcf in 2015. Average consumption per commercial customer was 359 Mcf. Commercial demand was 55 percent for space heating, 17 percent for water heating, 13 percent for cooking, and 15 percent for other uses.

There are 8,100 industrial customers of natural gas in Colorado who consumed 79 Bcf. Average consumption per industrial customer was 10 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Non-metallic Mineral Products (327), Fabricated Metal Products (332), and Petroleum and Coal Products (324), representing 72 percent of industrial demand.

Colorado has 44 power plants consuming natural gas. In 2015, gas consumed was 93 Bcf, representing 22 percent of power generation in the state. Average consumption per customer was 2,108 MMcf.

Natural Gas Infrastructure

In 2015, Colorado had 14,852 producing oil wells and 46,322 producing gas wells. There were 14,579 miles of gas gathering lines and 43 gas processing plants in the state with a capacity of 6,130 MMcf/d. In addition, there were 7,775 miles of gas pipelines, 888 miles of crude oil pipelines, 1,897 miles of NGL pipelines, 1,034 miles of product pipelines, and 229 miles of CO2 pipelines. There were 35,859 miles of gas distribution mains and 19,844 miles of service lines. There were 10 natural gas storage sites in the state with a working gas capacity of 64 Bcf.

Natural Gas and Oil Production

In 2015, Colorado produced 1.60 Tcf of dry natural gas, 74 million barrels of gas plant liquids, 15 million barrels of lease condensate, and 111 million barrels of crude. Drilling activity in Colorado since the start of the horizontal drilling boom has concentrated on the Niobrara gas and liquids play in northeastern Colorado. The Niobrara formation is productive across a large area and has dry gas, wet gas, and liquids areas. Colorado also has large-scale tight gas sand

resources in the northwest and coalbed resources in the southwest. In April of 2017, Colorado had 28 active rigs, most of which were targeting the Niobrara.

Exhibit 7-7: Colorado State Factsheet

Colorado			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,657	3,263	4,920	126	162	287	316	287	603
		Industrial	1,555	5,386	6,942	102	259	361	288	476	764
		Residential/ Commercial	2,146	2,874	5,020	136	145	281	525	260	785
		Export	374	564	938	26	28	55	29	50	79
		Transportation	16	15	31	1	1	1	3	1	4
	Infrastructure	Processing	2,644	2,031	4,675	313	132	445	705	186	890
		Pipelines	6,949	5,156	12,105	572	271	843	1,395	473	1,868
		Distribution	4,165	3,894	8,059	322	205	527	780	353	1,133
		Wholesalers, Marketers, Other	149	124	273	12	7	18	29	11	40
	Production	Natural Gas/ NGLs	21,796	10,451	32,247	2,409	601	3,010	3,285	931	4,217
	All Segments	Grand Total	41,452	33,758	75,210	4,019	1,810	5,828	7,355	3,028	10,382

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	6,389
	2	211111	Crude Petroleum & Natural Gas Extraction	5,372
	3	237120	Oil & Gas Pipeline Construction	3,170
	4	4841	Freight Truck	1,444
	5	486210	Pipeline Transportation of Natural Gas	1,067
	6	213111	Drilling Oil & Gas Wells	931
	7	811310	Industrial Equip. & Machinery Repair & Maint.	869
	8	221210	Natural Gas Distribution	751
	9	211112	Natural Gas Liquid Extraction	636
	10	45431NGL	NGL Retail	476

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,712,153	122,364	$1,008
	Commercial Sector	150,545	54,004	$403
	Industrial Sector	8,098	78,694	$297
	Transportation	46	365	$3
	Power Sector	44	92,757	$327
	All Sectors	1,870,886	348,183	$2,037

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	35,859	19,844	14,579	7,775	888	1,897	1,034	229

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1,600,203
	Gas Plant Liquids (barrels)	73,956,000
	Lease Condensate (barrels)	15,000,000
	Crude Oil (barrels)	111,232,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$6,113
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$10,619

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	14,852	1,158
	Gas Wells	46,322	332
	All Wells	61,174	1,489

Annual 2015 Data for Colorado Natural Gas Value Chain Basis

Connecticut

Economic Impacts of Natural Gas

There were 33,026 jobs in Connecticut related to natural gas. These jobs represented 2.0 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and industrial equipment and machinery repair and maintenance. The contribution to the Connecticut economy in terms of direct, indirect, and induced value added in 2015 was $4.35 billion, of which $2.59 billion was related to the end use segment, $1.33 billon was from the infrastructure segment, and $0.44 billion was from the production segment.

Natural Gas Consumers

In 2015, Connecticut consumed 248 Bcf of natural gas in all sectors. There were a total of 593,000 customers. The value of natural gas delivered to consumers was $1.73 billion.

Connecticut has 531,000 residential customers who consumed 51 Bcf in 2015. Average consumption was 96 Mcf per household. Residential demand was 69 percent for space heating, 22 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Connecticut has 57,400 commercial customers who consumed 52 Bcf in 2015. Average consumption per commercial customer was 914 Mcf. Commercial demand was 51 percent for space heating, 7 percent for water heating, 3 percent for cooking, 8 percent for cogeneration, and 31 percent for other uses.

There are 4,000 industrial customers in Connecticut who consumed 26 Bcf. Average consumption per industrial customer was 6.5 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Fabricated Metal Products (336), Transportation Equipment (336), Food (311), and Primary Metals (331), representing 70 percent of industrial demand.

Connecticut has 43 power plants consuming natural gas. In 2015, gas consumed was 119 Bcf, representing 46 percent of power generation in the state. Average consumption per customer was 2,775 MMcf.

Natural Gas Infrastructure

Connecticut has no oil and gas wells or production and all natural gas consumed comes from other states. In 2015, there were 591 miles of gas pipelines and 93 miles of product pipelines. There were 7,984 miles of gas distribution mains and 5,964 miles of service lines.

Exhibit 7-8: Connecticut State Factsheet

Connecticut			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,423	2,953	4,376	110	147	258	694	260	954
		Industrial	2,022	5,634	7,656	154	279	433	485	497	983
		Residential/ Commercial	1,621	2,448	4,069	110	128	238	346	221	567
		Export	404	550	955	29	28	57	32	49	81
		Transportation	1	1	2	0	0	0	0	0	0
	Infrastructure	Processing	418	919	1,337	30	46	76	33	84	117
		Pipelines	1,367	2,361	3,728	101	120	221	117	217	333
		Distribution	2,729	3,065	5,794	228	166	394	581	278	859
		Wholesalers, Marketers, Other	62	79	141	5	4	9	11	7	18
	Production	Natural Gas/ NGLs	1,668	3,300	4,968	133	163	296	146	294	440
	All Segments	Grand Total	11,714	21,312	33,026	900	1,082	1,982	2,446	1,906	4,352

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	762
	2	325	Chemical Manufacturing	553
	3	811310	Industrial Equip. & Machinery Repair & Maint.	429
	4	45431NGL	NGL Retail	346
	5	237120	Oil & Gas Pipeline Construction	318
	6	221112	Gas-fired Electric Power Generation	275
	7	236210	Industrial Construction	204
	8	811412	Household Appliance Repair & Maintenance	147
	9	333994	Industrial Process Furnace & Oven Manufacturing	131
	10	4841	Freight Truck	76

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	531,380	50,975	$628
	Commercial Sector	57,403	52,453	$428
	Industrial Sector	3,945	25,612	$126
	Transportation	22	21	$0
	Power Sector	43	119,305	$549
	All Sectors	592,793	248,366	$1,731

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	7,984	5,964	0	591	0	0	93	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Connecticut Natural Gas Value Chain Basis

Delaware

Economic Impacts of Natural Gas

There were 7,985 jobs in Delaware related to natural gas. These jobs represented 1.8 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and NGL retail. The contribution to the Delaware economy in terms of direct, indirect, and induced value added in 2015 was $1.02 billion, of which $0.57 billion was related to the end use segment, $0.37 billon was from the infrastructure segment, and $0.09 billion was from the production segment.

Natural Gas Consumers

In 2015, Delaware consumed 101 Bcf of natural gas in all sectors. There were a total of 175,000 customers. The value of natural gas delivered to consumers was $0.50 billion.

Delaware has 161,600 residential customers who consumed 11 Bcf in 2015. Average consumption was 70 Mcf per household. Residential demand was 72 percent for space heating, 20 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

Delaware has 13,400 commercial customers who consumed 12 Bcf in 2015. Average consumption per commercial customer was 873 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 144 industrial customers in Delaware who consumed 33 Bcf in 2015. Average consumption per industrial customer was 230 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Petroleum and Coal Products (324), Plastics and Rubber Products (326), and Agriculture (11), representing 87 percent of industrial demand.

Delaware has 10 power plants consuming natural gas. In 2015, gas consumption was 45 Bcf, representing 86 percent of power generation in the state. Average consumption per customer was 4,473 MMcf.

Natural Gas Infrastructure

Delaware has no oil and gas wells or production and all natural gas consumed comes from other states. The state has 336 miles of gas pipelines, and 40 miles of product pipelines. There were 3,105 miles of gas distribution mains and 2,178 miles of service lines.

Exhibit 7-9: Delaware State Factsheet

Delaware			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	507	835	1,342	40	42	82	184	73	258
		Industrial	344	1,154	1,498	24	57	81	52	102	154
		Residential/ Commercial	365	557	922	24	29	53	90	50	140
		Export	68	117	185	5	6	11	5	10	16
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	72	198	270	5	10	15	6	18	24
		Pipelines	304	536	840	21	27	48	26	49	75
		Distribution	978	880	1,858	71	45	116	181	80	261
		Wholesalers, Marketers, Other	20	21	41	1	1	3	3	2	5
	Production	Natural Gas/ NGLs	301	728	1,029	24	36	61	27	65	92
	All Segments	Grand Total	2,960	5,025	7,985	215	253	468	574	450	1,024

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	326
	2	811310	Industrial Equip. & Machinery Repair & Maint.	212
	3	45431NGL	NGL Retail	189
	4	221112	Gas-fired Electric Power Generation	118
	5	237120	Oil & Gas Pipeline Construction	117
	6	236210	Industrial Construction	109
	7	811412	Household Appliance Repair & Maintenance	33
	8	325	Chemical Manufacturing	26
	9	333415	Air-Conditioning and Warm Air Heating Equipment	24
	10	4841	Freight Truck	24

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	161,607	11,260	$142
	Commercial Sector	13,430	11,731	$100
	Industrial Sector	144	33,126	$120
	Transportation	1	0	$0
	Power Sector	10	44,725	$133
	All Sectors	175,192	100,842	$495

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	3,105	2,178	0	336	0	1	40	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Delaware Natural Gas Value Chain Basis

District of Columbia

Economic Impacts of Natural Gas

There were 5,154 jobs in the District of Columbia related to natural gas. These jobs represented 0.7 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment, and household appliance repair and maintenance. The contribution to the District of Columbia economy in terms of direct, indirect, and induced value added in 2015 was $0.58 billion, of which $0.27 billion was related to the end use segment, $0.25 billon was from the infrastructure segment, and $0.07 billion was from the production segment.

Natural Gas Consumers

In 2015, the District of Columbia consumed 31 Bcf of natural gas in all sectors. There were a total of 158,000 customers. The value of natural gas delivered to consumers was $0.29 billion.

The District of Columbia has 148,000 residential customers who consumed 13 Bcf in 2015. Average consumption was 91 Mcf per household. Residential demand was 72 percent for space heating, 20 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

The District of Columbia has 10,000 commercial customers who consumed 17 Bcf in 2015. Average consumption per commercial customer was 1.7 MMcf. Commercial demand was 41 percent for space heating, 25 percent for water heating, 10 percent for cooking, 4 percent for cogeneration, and 20 percent for other uses.

The District of Columbia has 2 power plants consuming natural gas. Gas consumption was less than 1 Bcf.

Natural Gas Infrastructure

The District of Columbia has no oil and gas wells or production and all natural gas consumed comes from other states. The District has 1,214 miles of gas distribution mains and 1,129 miles of service lines.

Exhibit 7-10: District of Columbia Factsheet

District of Columbia			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	5	453	458	0	23	23	0	40	40
		Industrial	22	1,000	1,022	1	50	51	1	88	90
		Residential/ Commercial	213	506	719	14	26	40	71	46	116
		Export	4	107	111	0	5	6	0	10	10
		Transportation	40	41	80	2	2	3	6	3	10
	Infrastructure	Processing	4	180	185	0	9	10	0	16	17
		Pipelines	10	453	463	1	24	24	1	42	42
		Distribution	619	720	1,339	47	36	84	119	66	185
		Wholesalers, Marketers, Other	11	17	28	1	1	2	2	2	4
	Production	Natural Gas/ NGLs	25	724	749	1	37	38	2	65	66
	All Segments	Grand Total	953	4,201	5,154	68	212	280	203	376	579

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	332
	2	811310	Industrial Equip. & Machinery Repair & Maint.	50
	3	811412	Household Appliance Repair & Maintenance	39
	4	45431CNG	CNG Stations	34
	5	237120	Oil & Gas Pipeline Construction	19
	6	4841	Freight Truck	14
	7	45431NGL	NGL Retail	10
	8			
	9			
	10			

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	147,895	13,494	$151
	Commercial Sector	9,975	17,113	$129
	Industrial Sector	-	0	$0
	Transportation	2	896	$11
	Power Sector	2	0	$0
	All Sectors	157,874	31,502	$291

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	1,214	1,129	0	0	0	0	0	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for District of Columbia
Natural Gas Value Chain Basis

Florida

Economic Impacts of Natural Gas

There were 91,189 jobs in Florida related to natural gas. These jobs represented 1.1 percent of total state jobs. The top three sectors with the greatest number of jobs were gas fired electric power generation, industrial equipment and machinery repair and maintenance, and industrial construction. The contribution to the Florida economy in terms of direct, indirect, and induced value added in 2015 was $12.57 billion, of which $8.81 billion was related to the end use segment, $2.73 billon was from the infrastructure segment, and $1.03 billion was from the production segment.

Natural Gas Consumers

In 2015, Florida consumed 1.33 Tcf of natural gas in all sectors. There were a total of 768,000 customers. The value of natural gas delivered to consumers was $6.15 billion.

Florida has 702,000 residential customers who consumed 15 Bcf in 2015. Average consumption was 21 Mcf per household. Residential demand was 7 percent for space heating, 58 percent for water heating, 14 percent for cooking, 2 percent for clothes drying, 2 percent for space cooling, and 17 percent for other uses.

Florida has 65,000 commercial customers who consumed 63 Bcf in 2015. Average consumption per commercial customer was 961 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 479 industrial customers in Florida who consumed 96 Bcf in 2015. Average consumption per industrial customer was 201 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Petroleum and Coal Products (324), Paper (322), and Non-metallic Mineral Products (327), representing 78 percent of industrial demand.

Florida has 90 power plants consuming natural gas. Gas consumption was 1.16 Tcf, representing 66 percent of power generation in the state. Average consumption per customer was 12,890 MMcf.

Natural Gas Infrastructure

In 2015, Florida had 58 producing oil wells and 44 producing gas wells. There were 35 miles of gas gathering lines and 1 gas processing plant in the state with a capacity of 90 MMcf/d. In addition, there were 5,091 miles of gas pipelines, 44 miles of crude oil pipelines, 93 miles of NGL pipelines, 346 miles of product pipelines, and no CO2 pipelines. There were 20,184 miles of gas distribution mains and 8,276 miles of service lines. There are no natural gas storage sites in the state.

Natural Gas and Oil Production

In 2015, Florida produced 0.3 Bcf of dry natural gas, 173,000 barrels of plant liquids, no lease condensate, and 2.21 million barrels of crude.

Exhibit 7-11: Florida State Factsheet

Florida			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	10,192	13,454	23,646	799	677	1,476	4,062	1,183	5,245
		Industrial	4,768	14,454	19,221	296	675	971	1,078	1,275	2,353
		Residential/ Commercial	2,608	5,406	8,014	177	281	458	529	488	1,017
		Export	867	1,385	2,252	61	70	130	67	123	190
		Transportation	15	19	34	1	1	1	2	2	5
	Infrastructure	Processing	1,061	2,448	3,510	70	120	189	82	223	305
		Pipelines	2,953	5,953	8,906	201	298	500	268	546	814
		Distribution	5,938	7,664	13,602	353	370	723	877	694	1,572
		Wholesalers, Marketers, Other	135	198	333	8	10	18	18	18	36
	Production	Natural Gas/ NGLs	3,297	8,375	11,672	257	416	672	283	746	1,029
	All Segments	Grand Total	31,833	59,356	91,189	2,222	2,916	5,138	7,265	5,300	12,565

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221112	Gas-fired Electric Power Generation	2,543
	2	811310	Industrial Equip. & Machinery Repair & Maint.	2,365
	3	236210	Industrial Construction	1,664
	4	325	Chemical Manufacturing	1,557
	5	221210	Natural Gas Distribution	1,401
	6	45431NGL	NGL Retail	1,304
	7	333611	Turbine and Turbine Generator Manufacturing	711
	8	237120	Oil & Gas Pipeline Construction	700
	9	4841	Freight Truck	343
	10	331210	Iron & Steel Pipe & Tube Manufacturing	245

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	701,981	15,044	$289
	Commercial Sector	65,313	62,754	$495
	Industrial Sector	479	96,124	$356
	Transportation	60	324	$4
	Power Sector	90	1,160,140	$5,000
	All Sectors	767,923	1,334,385	$6,145

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	28,003	13,671	35	5,091	44	93	346	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	264
	Gas Plant Liquids (barrels)	173,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	2,208,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$4
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$102

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	58	0
	Gas Wells	44	0
	All Wells	102	0

Annual 2015 Data for Florida Natural Gas Value Chain Basis

Georgia

Economic Impacts of Natural Gas

There were 85,300 jobs in Georgia related to natural gas. These jobs represented 2.1 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and industrial equipment and machinery repair and maintenance. The contribution to the Georgia economy in terms of direct, indirect, and induced value added in 2015 was $11.36 billion, of which $7.50 billion was related to the end use segment, $2.95 billon was from the infrastructure segment, and $0.91 billion was from the production segment.

Natural Gas Consumers

In 2015, Georgia consumed 0.68 Tcf of natural gas in all sectors. There were a total of 1.90 million customers. The value of natural gas delivered to consumers was $3.27 billion.

Georgia has 1.78 million residential customers who consumed 118 Bcf in 2015. Average consumption was 66 Mcf per household. Residential demand was 52 percent for space heating, 34 percent for water heating, 5 percent for cooking and 9 percent for other uses.

Georgia has 123,000 commercial customers who consumed 54 Bcf in 2015. Average consumption per commercial customer was 436 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 2,548 industrial customers who consumed 158 Bcf in 2015. Average consumption per industrial customer was 619 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Paper (322), Non-metallic Mineral Products (327), Food (311), and Primary Metals (331), representing 86 percent of industrial demand.

Georgia has 50 power plants consuming natural gas. In 2015, gas consumption was 354 Bcf, representing 39 percent of power generation in the state. Average consumption per customer was 7,081 MMcf.

Natural Gas Infrastructure

Georgia has no oil and gas wells or production and all natural gas consumed comes from other states. In 2015, there were 4,556 miles of gas pipelines, no crude oil pipelines, 362 miles of NGL pipelines, 1,763 miles of product pipelines, and no CO2 pipelines. There were 44,493 miles of gas distribution mains and 39,983 miles of service lines.

Exhibit 7-12: Georgia State Factsheet

Georgia			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	5,101	7,885	12,985	384	388	772	1,314	693	2,008
		Industrial	8,073	15,192	23,265	535	698	1,232	2,200	1,340	3,540
		Residential/ Commercial	4,857	5,947	10,804	317	304	621	1,225	537	1,762
		Export	942	1,152	2,094	65	58	123	72	103	175
		Transportation	54	52	107	3	3	4	9	5	14
	Infrastructure	Processing	1,252	2,164	3,416	79	101	180	87	197	284
		Pipelines	3,365	5,027	8,392	243	252	495	426	461	887
		Distribution	6,794	6,803	13,598	543	359	903	1,123	617	1,739
		Wholesalers, Marketers, Other	154	173	327	12	9	21	24	16	40
	Production	Natural Gas/ NGLs	3,595	6,700	10,295	286	331	617	315	597	912
	All Segments	Grand Total	34,188	51,095	85,282	2,468	2,501	4,969	6,795	4,565	11,360

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	3,350
	2	221210	Natural Gas Distribution	1,784
	3	811310	Industrial Equip. & Machinery Repair & Maint.	1,461
	4	45431NGL	NGL Retail	1,173
	5	221112	Gas-fired Electric Power Generation	957
	6	236210	Industrial Construction	940
	7	237120	Oil & Gas Pipeline Construction	727
	8	33241	Power Boiler & Heat Exchanger Manufacturing	617
	9	333415	Air-Conditioning and Warm Air Heating Equipment	458
	10	335221	Household Ovens Manufacturing	395

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,777,558	118,025	$1,157
	Commercial Sector	123,307	53,712	$377
	Industrial Sector	2,548	157,936	$598
	Transportation	52	1,208	$11
	Power Sector	50	354,090	$1,122
	All Sectors	1,903,515	684,971	$3,265

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	44,493	39,983	0	4,556	0	362	1,763	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Georgia Natural Gas Value Chain Basis

Hawaii

Economic Impacts of Natural Gas

There were 4,100 jobs in Hawaii related to natural gas. These jobs represented 0.6 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, NGL retail, and oil and gas pipeline construction. The contribution to the Hawaii economy in terms of direct, indirect, and induced value added in 2015 was $417 million, of which $191 million was related to the end use segment, $165 million was from the infrastructure segment, and $60 million was from the production segment.

Natural Gas Consumers

In 2015, Hawaii consumed 2.9 Bcf of natural gas in all sectors. There were a total of 32,000 customers. The value of natural gas delivered to consumers was $91 million.

Hawaii has 29,000 residential customers who consumed 0.6 Bcf in 2015. Average consumption was 20 Mcf per household. Residential demand was 67 percent for space heating, 26 percent for water heating, 2 percent for cooking, and 5 percent for other uses.

Hawaii has 2,800 commercial customers who consumed 1.9 Bcf in 2015. Average consumption per commercial customer was 678 Mcf. Commercial demand was 34 percent for space heating, 23 percent for water heating, 8 percent for cooking, and 35 percent for other uses.

There are 25 industrial customers in Hawaii who consumed 0.4 Bcf in 2015. Average consumption per industrial customer was 18 MMcf. The top industries for gas consumption were Food (NAICS Code 311), Agriculture (11), Mining (21), Petroleum and Coal Products (324), and Transportation Equipment (336), representing 78 percent of industrial demand.

Natural Gas Infrastructure

Hawaii has no oil or gas production. In 2015 there were 96 miles of product pipelines, 610 miles of gas distribution mains, and 425 miles of service lines.

Exhibit 7-13: Hawaii State Factsheet

Hawaii			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	28	364	392	2	18	20	2	32	34
		Industrial	115	851	966	7	41	48	19	75	94
		Residential/ Commercial	99	342	441	7	18	25	22	31	53
		Export	23	88	112	2	4	6	2	8	10
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	44	166	210	3	8	11	3	15	18
		Pipelines	112	393	505	8	20	28	9	36	45
		Distribution	296	508	803	21	26	47	54	46	100
		Wholesalers, Marketers, Other	6	13	19	0	1	1	1	1	2
	Production	Natural Gas/ NGLs	104	577	681	8	29	37	9	51	60
	All Segments	Grand Total	827	3,302	4,129	58	166	224	121	296	417

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	78
	2	45431NGL	NGL Retail	68
	3	237120	Oil & Gas Pipeline Construction	45
	4	325	Chemical Manufacturing	25
	5	4841	Freight Truck	24
	6	811310	Industrial Equip. & Machinery Repair & Maint.	14
	7	333414	Heating Boilers & Fireplace Manufacturing	11
	8			
	9			
	10			

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	28,952	572	$23
	Commercial Sector	2,815	1,908	$60
	Industrial Sector	25	442	$8
	Transportation	1	0	$0
	Power Sector	-	0	$0
	All Sectors	31,793	2,922	$91

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	610	425	0	0	0	0	96	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Hawaii Natural Gas Value Chain Basis

Idaho

Economic Impacts of Natural Gas

There were 10,400 jobs in Idaho related to natural gas. These jobs represented 1.6 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and oil and gas pipeline construction. The contribution to the Idaho economy in terms of direct, indirect, and induced value added in 2015 was $1,207 million, of which $631 million was related to the end use segment, $446 million was from the infrastructure segment, and $130 million was from the production segment.

Natural Gas Consumers

In 2015, Idaho consumed 100 Bcf of natural gas in all sectors. There were a total of 416,000 customers. The value of natural gas delivered to consumers was $522 million.

Idaho has 375,000 residential customers who consumed 23 Bcf in 2015. Average consumption was 63 Mcf per household. Residential demand was 68 percent for space heating, 27 percent for water heating, 2 percent for cooking, and 3 percent for other uses.

Idaho has 41,000 commercial customers who consumed 17 Bcf in 2015. Average consumption per commercial customer was 410 Mcf. Commercial demand was 55 percent for space heating, 17 percent for water heating, 12 percent for cooking, and 16 percent for other uses.

There are 187 industrial customers in Idaho who consumed 32 Bcf in 2015. Average consumption per industrial customer was 169 MMcf. The top industries for gas consumption were Food (NAICS Code 311), Chemicals (325), Agriculture (11), Fabricated Metal Products (332), and Computer and Electronic Products (334), representing 84 percent of industrial demand.

Idaho has 11 power plants consuming natural gas. In 2015, gas consumed was 28 Bcf, representing 24 percent of power generation in the state. Average consumption per customer was 2,526 MMcf.

Natural Gas Infrastructure

Idaho has no oil and gas wells or production and all natural gas consumed comes from other states. In 2015, there were 1,503 miles of gas transmission lines, 11 miles of crude oil pipelines, no NGL lines, and 646 miles of oil product lines. There were 8,257 miles of gas distribution mains and 7,010 miles of service lines.

Exhibit 7-14: Idaho State Factsheet

Idaho			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	370	780	1,150	28	39	67	90	69	159
		Industrial	503	1,449	1,952	32	69	100	83	128	211
		Residential/ Commercial	671	808	1,478	43	41	84	165	73	238
		Export	105	146	251	8	7	15	8	13	21
		Transportation	7	6	13	0	0	1	1	1	2
	Infrastructure	Processing	143	275	418	9	13	22	10	25	35
		Pipelines	526	710	1,236	34	34	68	51	65	116
		Distribution	1,276	1,070	2,346	83	51	134	192	97	289
		Wholesalers, Marketers, Other	28	26	54	2	1	3	4	2	6
	Production	Natural Gas/ NGLs	588	931	1,519	43	45	88	47	83	130
	All Segments	Grand Total	4,217	6,200	10,417	282	300	582	652	555	1,207

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	356
	2	811310	Industrial Equip. & Machinery Repair & Maint.	187
	3	237120	Oil & Gas Pipeline Construction	165
	4	45431NGL	NGL Retail	156
	5	326122	Plastics Pipe & Fittings manufacturing	123
	6	236210	Industrial Construction	80
	7	325	Chemical Manufacturing	74
	8	811412	Household Appliance Repair & Maintenance	68
	9	221112	Gas-fired Electric Power Generation	68
	10	4841	Freight Truck	67

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	374,557	23,482	$201
	Commercial Sector	40,744	16,708	$123
	Industrial Sector	187	31,664	$116
	Transportation	13	166	$1
	Power Sector	11	27,790	$80
	All Sectors	415,512	99,811	$522

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	8,257	7,010	0	1,503	11	0	646	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	1
	All Wells	0	1

Annual 2015 Data for Idaho Natural Gas Value Chain Basis

Illinois

Economic Impacts of Natural Gas

There were 149,611 jobs in Illinois related to natural gas. These jobs represented 2.6 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and oil and gas pipeline construction. The contribution to the Illinois economy in terms of direct, indirect, and induced value added in 2015 was $18.86 billion, of which $10.9 billion was related to the end use segment, $6.18 billon was from the infrastructure segment, and $1.78 billion was from the production segment.

Natural Gas Consumers

In 2015, Illinois consumed 966 Bcf of natural gas in all sectors. There were a total of 4.20 million customers. The value of natural gas delivered to consumers was $5.97 billion.

Illinois has 3.87 million residential customers who consumed 401 Bcf in 2015. Average consumption was 103 Mcf per household. Residential demand was 65 percent for space heating, 22 percent for water heating, 5 percent for cooking, 2 percent for clothes drying, and 6 percent for other uses.

Illinois has 296,000 commercial customers who consumed 215 Bcf in 2015. Average consumption per commercial customer was 727 Mcf. Commercial demand was 73 percent for space heating, 12 percent for water heating, 3 percent for cooking, and 12 percent for other uses.

There are 23,000 industrial customers in Illinois who consumed 266 Bcf in 2015. Average consumption per industrial customer was 12 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Petroleum and Coal Products (324), Primary Metals (331), and Non-metallic Mineral Products (327), representing 80 percent of industrial demand.

Illinois has 108 power plants consuming natural gas. In 2015, gas consumption was 84 Bcf, representing 6 percent of power generation in the state. Average consumption per customer was 774 MMcf.

Natural Gas Infrastructure

In 2015, Illinois had 14,820 producing oil wells and 35 producing gas wells. There were 2 gas processing plants in the state with a capacity of 2,102 MMcf/d. In addition, there were 9,293 miles of gas pipelines, 2,818 miles of crude oil pipelines, 1,385 miles of NGL pipelines, and 3,793 miles of product pipelines. There were 61,629 miles of gas distribution mains and 53,144 miles of service lines. There were 28 natural gas storage sites in the state with a working gas capacity of 304 Bcf.

Natural Gas and Oil Production

In 2015, Illinois produced 2 Bcf of dry natural gas, 1.4 million barrels of plant liquids, no lease condensate, and 9.5 million barrels of crude.

Exhibit 7-15: Illinois State Factsheet

Illinois			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	4,825	9,987	14,812	355	488	842	512	878	1,390
		Industrial	13,605	25,488	39,094	1,001	1,235	2,237	3,702	2,249	5,951
		Residential/ Commercial	9,261	10,715	19,976	608	549	1,157	2,240	968	3,208
		Export	2,016	2,099	4,115	143	105	249	158	187	345
		Transportation	21	18	38	1	1	2	3	2	5
	Infrastructure	Processing	2,953	4,273	7,226	212	209	421	499	389	888
		Pipelines	8,975	10,042	19,017	747	529	1,276	1,162	921	2,083
		Distribution	12,253	11,585	23,838	935	597	1,532	2,085	1,049	3,134
		Wholesalers, Marketers, Other	310	311	621	24	16	41	49	28	77
	Production	Natural Gas/ NGLs	8,680	12,194	20,874	627	585	1,212	693	1,087	1,780
	All Segments	Grand Total	62,899	86,712	149,611	4,654	4,313	8,967	11,104	7,757	18,861

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	5,156
	2	221210	Natural Gas Distribution	3,899
	3	237120	Oil & Gas Pipeline Construction	2,480
	4	811310	Industrial Equip. & Machinery Repair & Maint.	2,160
	5	331210	Iron & Steel Pipe & Tube Manufacturing	1,529
	6	811412	Household Appliance Repair & Maintenance	1,159
	7	236210	Industrial Construction	1,049
	8	4841	Freight Truck	658
	9	45431NGL	NGL Retail	615
	10	333994	Industrial Process Furnace & Oven Manufacturing	567

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	3,876,362	400,876	$3,244
	Commercial Sector	295,869	215,218	$1,474
	Industrial Sector	23,049	265,900	$991
	Transportation	50	454	$4
	Power Sector	108	83,570	$254
	All Sectors	4,195,438	966,018	$5,966

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	61,629	53,144	0	9,293	2,818	1,385	3,793	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	2,038
	Gas Plant Liquids (barrels)	1,431,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	9,522,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$37
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$456

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	14,820	189
	Gas Wells	35	0
	All Wells	14,855	189

Annual 2015 Data for Illinois Natural Gas Value Chain Basis

Indiana

Economic Impacts of Natural Gas

There were 105,660 jobs in Indiana related to natural gas. These jobs represented 3.6 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and industrial equipment repair and maintenance. The contribution to the Indiana economy in terms of direct, indirect, and induced value added in 2015 was $12.18 billion, of which $6.95 billion was related to the end use segment, $3.74 billon was from the infrastructure segment, and $1.49 billion was from the production segment.

Natural Gas Consumers

In 2015, Indiana consumed 711 Bcf of natural gas in all sectors. There were a total of 1.87 million customers. The value of natural gas delivered to consumers was $3.49 billion.

Indiana has 1.70 million residential customers who consumed 133 Bcf in 2015. Average consumption was 78 Mcf per household. Residential demand was 70 percent for space heating, 21 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Indiana has 160,000 commercial customers who consumed 78 Bcf in 2015. Average consumption per commercial customer was 484 MMcf. Commercial demand was 73 percent for space heating, 12 percent for water heating, 3 percent for cooking, and 12 percent for other uses.

There are 5,100 industrial customers in Indiana who consumed 373 Bcf in 2015. Average consumption per industrial customer was 73 MMcf. The top industries for gas consumption were Primary Metals (NAICS Code 331), Chemicals (325), Food (311), Non-metallic Mineral Products (327), and Transportation Equipment, representing 83 percent of industrial demand.

Indiana has 46 power plants consuming natural gas. In 2015, gas consumed was 127 Bcf, representing 16 percent of power generation in the state. Average consumption per customer was 2,769 MMcf.

Natural Gas Infrastructure

In 2015, Indiana had 4,647 producing oil wells and 899 producing gas wells. There were 5,332 miles of gas pipelines, 532 miles of crude oil pipelines, 931 miles of NGL pipelines, and 2,654 miles of product pipelines. There were 40,598 miles of gas distribution mains and 35,200 miles of service lines. There were 21 natural gas storage sites in the state with a working gas capacity of 34 Bcf.

Natural Gas and Oil Production

In 2015, Indiana produced 7 Bcf of dry natural gas, no plant liquids, no lease condensate, and 2.2 million barrels of crude.

Exhibit 7-16: Indiana State Factsheet

Indiana			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,217	7,032	10,249	237	344	582	692	618	1,311
		Industrial	9,254	17,779	27,032	687	873	1,559	2,164	1,570	3,734
		Residential/ Commercial	5,292	6,878	12,170	369	363	733	985	621	1,607
		Export	1,904	1,695	3,599	132	84	216	145	151	296
		Transportation	4	4	9	0	0	0	1	0	1
	Infrastructure	Processing	2,020	2,866	4,887	140	137	277	154	261	415
		Pipelines	6,692	7,418	14,110	489	370	859	758	680	1,438
		Distribution	7,837	8,075	15,913	540	402	942	1,110	732	1,841
		Wholesalers, Marketers, Other	209	221	430	15	11	26	28	20	48
	Production	Natural Gas/ NGLs	7,828	9,433	17,261	585	451	1,037	646	841	1,486
	All Segments	Grand Total	44,259	61,401	105,660	3,194	3,037	6,231	6,681	5,495	12,176

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	2,649
	2	221210	Natural Gas Distribution	1,521
	3	811310	Industrial Equip. & Machinery Repair & Maint.	1,509
	4	237120	Oil & Gas Pipeline Construction	1,096
	5	331210	Iron & Steel Pipe & Tube Manufacturing	896
	6	331110	Iron and Steel Mills	808
	7	45431NGL	NGL Retail	770
	8	236210	Industrial Construction	702
	9	4841	Freight Truck	409
	10	811412	Household Appliance Repair & Maintenance	385

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,704,243	133,045	$1,183
	Commercial Sector	160,051	77,526	$566
	Industrial Sector	5,095	372,537	$1,366
	Transportation	37	92	$1
	Power Sector	46	127,365	$375
	All Sectors	1,869,472	710,564	$3,490

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	40,598	35,200	0	5,332	532	931	2,654	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	7,250
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	2,219,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$17
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$116

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	4,647	25
	Gas Wells	899	7
	All Wells	5,546	32

Annual 2015 Data for Indiana Natural Gas Value Chain Basis

Iowa

Economic Impacts of Natural Gas

There were 47,056 jobs in Iowa related to natural gas. These jobs represented 3.1 percent of total state jobs. The top three sectors with the greatest number of jobs were oil and gas pipeline construction, turbine and turbine generator manufacturing, and chemical manufacturing. The contribution to the Iowa economy in terms of direct, indirect, and induced value added in 2015 was $5.60 billion, of which $3.21 billion was related to the end use segment, $1.91 billon was from the infrastructure segment, and $0.48 billion was from the production segment.

Natural Gas Consumers

In 2015, Iowa consumed 308 Bcf of natural gas in all sectors. There were a total of 1.01 million customers. The value of natural gas delivered to consumers was $1.57 billion.

Iowa has 908,000 residential customers who consumed 63 Bcf in 2015. Average consumption was 69 Mcf per household. Residential demand was 70 percent for space heating, 23 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

Iowa has 100,000 commercial customers who consumed 49 Bcf in 2015. Average consumption per commercial customer was 494 Mcf. Commercial demand was 73 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 9 percent for other uses.

There are 1,570 industrial customers in Iowa who consumed 179 Bcf in 2015. Average consumption per commercial customer was 114 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Primary Metals (331), Agriculture (11), and Machinery (333), representing 92 percent of industrial demand.

Iowa has 78 power plants consuming natural gas. In 2015, gas consumed was 18 Bcf, representing 4 percent of power generation in the state. Average consumption per customer was 224 MMcf.

Natural Gas Infrastructure

Iowa has no oil and gas wells or production and all natural gas consumed comes from other states.

In 2015, Iowa had 8,340 miles of gas pipelines, 422 miles of crude oil pipelines, 2,200 miles of NGL pipelines, and 1,813 miles of product pipelines. There were 18,150 miles of gas distribution mains and 14,900 miles of service lines. There were 4 natural gas storage sites in the state with a working gas capacity of 90 Bcf.

Exhibit 7-17: Iowa State Factsheet

Iowa			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	2,609	3,890	6,499	158	169	328	274	342	616
		Industrial	4,311	7,519	11,830	308	361	669	1,047	664	1,711
		Residential/ Commercial	2,410	2,876	5,287	158	147	305	508	260	768
		Export	828	684	1,512	52	32	84	57	61	118
		Transportation	1	1	2	0	0	0	0	0	0
	Infrastructure	Processing	794	1,085	1,879	48	50	98	55	99	154
		Pipelines	4,389	3,701	8,090	352	192	544	614	339	953
		Distribution	3,165	3,179	6,344	235	163	399	490	288	778
		Wholesalers, Marketers, Other	103	96	199	8	5	13	15	9	24
	Production	Natural Gas/ NGLs	2,119	3,295	5,414	165	161	326	181	294	475
	All Segments	Grand Total	20,730	26,326	47,056	1,484	1,281	2,765	3,240	2,356	5,595

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	237120	Oil & Gas Pipeline Construction	1,725
	2	333611	Turbine and Turbine Generator Manufacturing	1,438
	3	325	Chemical Manufacturing	1,317
	4	811310	Industrial Equip. & Machinery Repair & Maint.	794
	5	221210	Natural Gas Distribution	519
	6	236210	Industrial Construction	366
	7	45431NGL	NGL Retail	311
	8	486210	Pipeline Transportation of Natural Gas	242
	9	33241	Power Boiler & Heat Exchanger Manufacturing	194
	10	811412	Household Appliance Repair & Maintenance	181

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	908,058	62,739	$532
	Commercial Sector	99,662	49,269	$323
	Industrial Sector	1,572	178,772	$657
	Transportation	9	26	$0
	Power Sector	78	17,518	$54
	All Sectors	1,009,379	308,324	$1,565

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	18,152	14,905	0	8,340	422	2,200	1,813	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Iowa Natural Gas Value Chain Basis

Kansas

Economic Impacts of Natural Gas

There were 43,160 jobs in Kansas related to natural gas. These jobs represented 3.2 percent of total state jobs. The top three sectors with the greatest number of jobs were oil and gas pipeline construction, support activities for oil and gas operations, and natural gas distribution. The contribution to the Kansas economy in terms of direct, indirect, and induced value added in 2015 was $5.34 billion, of which $1.75 billion was related to the end use segment, $2.60 billon was from the infrastructure segment, and $0.99 billion was from the production segment.

Natural Gas Consumers

In 2015, Kansas consumed 216 Bcf of natural gas in all sectors. There were a total of 955,000 customers. The value of natural gas delivered to consumers was $1.30 billion.

Kansas has 861,000 residential customers who consumed 57 Bcf in 2015. Average consumption was 67 Mcf per household. Residential demand was 60 percent for space heating, 33 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

Kansas has 86,000 commercial customers who consumed 31 Bcf in 2015. Average consumption per commercial customer was 360 Mcf. Commercial demand was 74 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 8 percent for other uses.

There are 7,200 industrial customers in Kansas who consumed 111 Bcf in 2015. Average consumption per industrial customer was 15 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Petroleum and Coal Products (324), Food (311), Non-metallic Mineral Products (327), and Transportation Equipment (336), representing 86 percent of industrial demand.

Kansas has 87 power plants consuming natural gas. Gas consumed was 17 Bcf, representing 3 percent of power generation in the state. Average consumption per customer was 191 MMcf.

Natural Gas Infrastructure

In 2015, Kansas had 55,025 producing oil wells and 24,450 producing gas wells. There were 17,500 miles of gas gathering lines and 8 gas processing plants in the state with a capacity of 1,664 MMcf/d. In addition, there were 13,760 miles of gas pipelines, 3,480 miles of crude oil pipelines, 4,640 miles of NGL pipelines, 3,556 miles of product pipelines, and 29 miles of CO2 pipelines. There were 22,456 miles of gas distribution mains and 10,250 miles of service lines. There were 17 natural gas storage sites in the state with a working gas capacity of 123 Bcf.

Natural Gas and Oil Production

In 2015, Kansas produced 270 Bcf of dry natural gas, 10.9 million barrels of plant liquids, 2.0 million barrels of lease condensate, and 43.5 million barrels of crude.

Exhibit 7-18: Kansas State Factsheet

Kansas			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	975	2,016	2,992	70	98	168	104	177	281
		Industrial	1,968	4,283	6,251	124	201	325	449	379	827
		Residential/ Commercial	1,667	2,032	3,699	108	103	211	398	184	582
		Export	304	385	689	21	19	41	24	34	58
		Transportation	1	0	1	0	0	0	0	0	0
	Infrastructure	Processing	1,364	1,263	2,627	103	62	166	287	115	402
		Pipelines	4,273	3,193	7,466	322	159	480	858	293	1,150
		Distribution	4,863	3,460	8,323	332	171	503	702	314	1,015
		Wholesalers, Marketers, Other	131	95	226	9	5	14	22	9	30
	Production	Natural Gas/ NGLs	6,706	4,179	10,886	462	181	643	617	372	989
	All Segments	Grand Total	22,253	20,906	43,160	1,552	999	2,551	3,459	1,876	5,335

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	237120	Oil & Gas Pipeline Construction	1,776
	2	213112	Support Activities for Oil & Gas Operations	1,607
	3	221210	Natural Gas Distribution	1,587
	4	211111	Crude Petroleum & Natural Gas Extraction	1,327
	5	486210	Pipeline Transportation of Natural Gas	618
	6	213111	Drilling Oil & Gas Wells	583
	7	811310	Industrial Equip. & Machinery Repair & Maint.	568
	8	4247NGL	NGL Wholesale	415
	9	325	Chemical Manufacturing	393
	10	4841	Freight Truck	295

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	861,419	57,408	$582
	Commercial Sector	86,034	30,959	$245
	Industrial Sector	7,218	111,016	$407
	Transportation	21	17	$0
	Power Sector	87	16,614	$63
	All Sectors	954,779	216,014	$1,297

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	22,456	10,252	17,553	13,762	3,480	4,641	3,556	29

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	270,180
	Gas Plant Liquids (barrels)	10,894,000
	Lease Condensate (barrels)	2,000,000
	Crude Oil (barrels)	43,481,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$1,042
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$2,918

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	55,025	1,730
	Gas Wells	24,451	84
	All Wells	79,476	1,814

Annual 2015 Data for Kansas Natural Gas Value Chain Basis

Kentucky

Economic Impacts of Natural Gas

There were 56,450 jobs in Kentucky related to natural gas. These jobs represented 3.1 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and industrial equipment repair and maintenance. The contribution to the Kentucky economy in terms of direct, indirect, and induced value added in 2015 was $7.76 billion, of which $4.85 billion was related to the end use segment, $2.16 billon was from the infrastructure segment, and $0.75 billion was from the production segment.

Natural Gas Consumers

In 2015, Kentucky consumed 253 Bcf of natural gas in all sectors. There were a total of 853,000 customers. The value of natural gas delivered to consumers was $1.44 billion.

Kentucky has 765,000 residential customers who consumed 49 Bcf in 2015. Average consumption was 65 Mcf per household. Residential demand was 65 percent for space heating, 29 percent for water heating, 3 percent for cooking, and 3 percent for other uses.

Kentucky has 86,000 commercial customers who consumed 35 Bcf in 2015. Average consumption per commercial customer was 412 Mcf. Commercial demand was 50 percent for space heating, 29 percent for water heating, 10 percent for cooking, and 11 percent for other uses.

There are 2,000 industrial customers in Kentucky who consumed 116 Bcf. Average consumption per industrial customer was 57 MMcf. The top industries for gas consumption were Primary Metals (NAICS Code 331), Chemicals (325), Food (311), Paper (322), and Mining (21), representing 83 percent of industrial demand.

Kentucky has 17 power plants consuming natural gas. Gas consumed was 52 Bcf, representing 7 percent of power generation in the state. Average consumption per customer was 3,059 MMcf.

Natural Gas Infrastructure

In 2015, Kentucky had 18,229 producing oil wells and 18,000 producing gas wells. There were 9,800 miles of gas gathering lines and 3 gas processing plants in the state with a capacity of 255 MMcf/d. In addition, there were 6,760 miles of gas pipelines, 550 miles of crude oil pipelines, 91 miles of NGL pipelines, 274 miles of product pipelines, and no CO2 pipelines. There were 18,700 miles of gas distribution mains and 10,900 miles of service lines. There were 23 natural gas storage sites in the state with a working gas capacity of 108 Bcf.

Natural Gas and Oil Production

In 2015, Kentucky produced 80 Bcf of dry natural gas, 3.4 million barrels of plant liquids, 0 barrels of lease condensate, and 2.9 million barrels of crude.

Exhibit 7-19: Kentucky State Factsheet

Kentucky			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	1,936	3,529	5,465	144	173	317	313	310	623
		Industrial	6,627	10,399	17,026	475	489	964	1,966	917	2,883
		Residential/ Commercial	3,152	3,543	6,695	205	180	386	905	320	1,225
		Export	718	697	1,415	49	34	83	53	62	116
		Transportation	2	2	3	0	0	0	0	0	0
	Infrastructure	Processing	839	1,201	2,040	62	59	120	81	110	191
		Pipelines	3,870	3,669	7,539	296	185	481	696	336	1,032
		Distribution	3,727	3,683	7,410	235	177	412	576	334	910
		Wholesalers, Marketers, Other	107	104	211	7	5	12	18	9	27
	Production	Natural Gas/ NGLs	4,246	4,397	8,643	305	206	511	362	392	754
	All Segments	Grand Total	25,224	31,223	56,447	1,778	1,509	3,287	4,970	2,790	7,760

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	3,164
	2	221210	Natural Gas Distribution	828
	3	811310	Industrial Equip. & Machinery Repair & Maint.	755
	4	237120	Oil & Gas Pipeline Construction	722
	5	486210	Pipeline Transportation of Natural Gas	715
	6	4841	Freight Truck	530
	7	236210	Industrial Construction	464
	8	45431NGL	NGL Retail	452
	9	331210	Iron & Steel Pipe & Tube Manufacturing	337
	10	211111	Crude Petroleum & Natural Gas Extraction	314

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	764,946	49,426	$532
	Commercial Sector	85,961	35,435	$295
	Industrial Sector	2,041	115,956	$435
	Transportation	12	46	$0
	Power Sector	17	52,015	$180
	All Sectors	852,977	252,877	$1,442

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	18,696	10,860	9,833	6,757	550	91	274	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	79,699
	Gas Plant Liquids (barrels)	3,352,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	2,862,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$263
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$393

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	18,229	121
	Gas Wells	18,000	67
	All Wells	36,229	188

Annual 2015 Data for Kentucky Natural Gas Value Chain Basis

Louisiana

Economic Impacts of Natural Gas

There were 201,319 jobs in Louisiana related to natural gas. These jobs represented 10.5 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, oil and gas pipeline construction, and industrial construction. The contribution to the Louisiana economy in terms of direct, indirect, and induced value added in 2015 was $28.6 billion, of which $13.9 billion was related to the end use segment, $7.99 billon was from the infrastructure segment, and $6.72 billion was from the production segment.

Natural Gas Consumers

In 2015, Louisiana consumed 1.36 Tcf of natural gas in all sectors. There were a total of 947,000 customers. The value of natural gas delivered to consumers was $5.03 billion.

Louisiana has 888,000 residential customers who consumed 36 Bcf in 2015. Average consumption was 41 Mcf per household. Residential demand was 64 percent for space heating, 27 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Louisiana has 57,900 commercial customers who consumed 30 Bcf in 2015. Average consumption per commercial customer was 515 Mcf. Commercial demand was 36 percent for space heating, 20 percent for water heating, 9 percent for cooking, and 35 percent for other uses.

There are 845 industrial customers who consumed 949 Bcf in 2015. Average consumption per industrial customer was 1,122 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Petroleum and Coal Products (324), Paper (322), Food (311), and Primary Metals (331), representing 97 percent of industrial demand.

Louisiana has 75 power plants consuming natural gas. In 2015, gas consumed was 343 Bcf, representing 61 percent of power generation in the state. Average consumption per customer was 4,570 MMcf.

Natural Gas Infrastructure

In 2015, Louisiana had 21,388 producing oil wells and 19,196 producing gas wells. There were 13,640 miles of gas gathering lines and 50 gas processing plants in the state with a capacity of 10,870 MMcf/d. In addition, there were 26,750 miles of gas pipelines, 6,785 miles of crude oil pipelines, 7,419 miles of NGL pipelines, 1,618 miles of product pipelines, and 322 miles of CO2 pipelines. There were 27,098 miles of gas distribution mains and 13,394 miles of service lines. There were 19 natural gas storage sites in the state with a working gas capacity of 454 Bcf.

Natural Gas and Oil Production

In 2015, Louisiana produced 2.69 Tcf of dry natural gas, 61 million barrels of gas plant liquids, 24 million barrels of lease condensate, and 400 million barrels of crude. Louisiana has abundant conventional and unconventional oil and gas resources, and has the advantages of good access to gas pipeline and processing capacity and of proximity to LNG export facilities. The largest horizontal play in the state is the Haynesville gas play. The Haynesville has some of the highest gas well ultimate recoveries in the U.S. and is currently experiencing a

resurgence in activity due in part to proximity to LNG export markets. Louisiana is the location of large-scale current and planned LNG liquefaction infrastructure. Gulf of Mexico oil and gas production is piped to facilities along the Louisiana coast and the state accounts for a large fraction of jobs supporting offshore development and production. In April of 2017, Louisiana accounted for about 38 onshore and 20 offshore active rigs.

Exhibit 7-20: Louisiana State Factsheet

Louisiana			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	3,891	5,827	9,717	306	294	600	1,451	512	1,963
		Industrial	17,408	21,455	38,864	1,580	1,217	2,797	5,387	1,895	7,282
		Residential/ Commercial	2,217	3,419	5,636	154	180	334	348	309	657
		Export	22,326	8,857	31,183	1,643	452	2,095	3,198	789	3,988
		Transportation	2	2	4	0	0	0	0	0	1
	Infrastructure	Processing	4,746	3,926	8,672	397	213	610	1,543	357	1,901
		Pipelines	19,812	11,911	31,723	1,534	600	2,134	3,286	1,092	4,378
		Distribution	8,702	6,482	15,184	612	319	931	1,043	587	1,630
		Wholesalers, Marketers, Other	370	244	614	28	12	40	54	22	77
	Production	Natural Gas/ NGLs	41,473	18,249	59,722	3,733	900	4,633	5,091	1,626	6,718
	All Segments	Grand Total	120,947	80,371	201,319	9,987	4,187	14,174	21,403	7,191	28,594

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	14,557
	2	237120	Oil & Gas Pipeline Construction	10,455
	3	236210	Industrial Construction	8,904
	4	325	Chemical Manufacturing	7,451
	5	211111	Crude Petroleum & Natural Gas Extraction	6,223
	6	811310	Industrial Equip. & Machinery Repair & Maint.	4,406
	7	336611	Ship Building and Repairing	2,545
	8	213111	Drilling Oil & Gas Wells	2,236
	9	486210	Pipeline Transportation of Natural Gas	2,079
	10	221210	Natural Gas Distribution	1,335

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	888,023	36,046	$392
	Commercial Sector	57,873	29,805	$232
	Industrial Sector	845	948,918	$3,420
	Transportation	24	61	$1
	Power Sector	75	342,742	$990
	All Sectors	946,840	1,357,572	$5,034

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	27,098	13,394	13,640	26,750	6,785	7,419	1,618	322

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	2,693,969
	Gas Plant Liquids (barrels)	61,440,000
	Lease Condensate (barrels)	24,000,000
	Crude Oil (barrels)	399,756,400
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$9,084
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$28,444

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	21,388	355
	Gas Wells	19,196	195
	All Wells	40,584	550

Annual 2015 Data for Louisiana Natural Gas Value Chain Basis

Maine

Economic Impacts of Natural Gas

There were 7,200 jobs in Maine related to natural gas. These jobs represented 1.2 percent of total state jobs. The top three sectors with the greatest number of jobs were industrial equipment and machinery repair and maintenance, NGL retail, and natural gas distribution. The contribution to the Maine economy in terms of direct, indirect, and induced value added in 2015 was $793 million, of which $414 million was related to the end use segment, $288 million was from the infrastructure segment, and $93 million was from the production segment.

Natural Gas Consumers

In 2015, Maine consumed 51 Bcf of natural gas in all sectors. There were a total of 43,000 customers. The value of natural gas delivered to consumers was $311 million.

Maine has 31,000 residential customers who consumed 2.7 Bcf in 2015. Average consumption was 87 Mcf per household. Residential demand was 69 percent for space heating, 22 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Maine has 12,000 commercial customers who consumed 10 Bcf in 2015. Average consumption per commercial customer was 847 Mcf. Commercial demand was 54 percent for space heating, 7 percent for water heating, 3 percent for cooking, 4 percent for cogeneration, and 32 percent for other uses.

There are 136 industrial customers in Maine who consumed 21 Bcf in 2015. Average consumption per industrial customer was154 MMcf. The top industries for gas consumption were Paper (NAICS Code 322), Food (311), Chemicals (325), Transportation Equipment (336), and Fabricated Metal Products (332), representing 80 percent of industrial demand.

Maine has 13 power plants consuming natural gas. In 2015, gas consumed was 17 Bcf, representing 25 percent of power generation in the state. Average consumption per customer was 1,342 MMcf.

Natural Gas Infrastructure

Maine has no oil and gas wells or production and all natural gas consumed comes from other states.

Maine has 510 miles of gas pipelines, 144 miles of crude oil pipelines, no NGL pipelines, 125 miles of product pipelines, and no CO2 pipelines. There were 1,070 miles of gas distribution mains and 494 miles of service lines.

Exhibit 7-21: Maine State Factsheet

Maine			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	430	749	1,179	33	37	70	92	66	158
		Industrial	279	1,061	1,340	19	52	70	31	94	125
		Residential/ Commercial	312	507	819	22	27	48	68	46	114
		Export	79	116	195	6	6	12	6	10	17
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	101	213	314	7	10	17	7	19	27
		Pipelines	311	521	832	22	26	48	29	48	77
		Distribution	684	730	1,414	43	35	79	113	66	180
		Wholesalers, Marketers, Other	15	18	34	1	1	2	2	2	4
	Production	Natural Gas/ NGLs	341	712	1,053	27	35	62	29	63	93
	All Segments	Grand Total	2,553	4,627	7,179	178	229	407	378	414	793

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	811310	Industrial Equip. & Machinery Repair & Maint.	167
	2	45431NGL	NGL Retail	160
	3	221210	Natural Gas Distribution	157
	4	236210	Industrial Construction	89
	5	237120	Oil & Gas Pipeline Construction	88
	6	221112	Gas-fired Electric Power Generation	78
	7	4841	Freight Truck	29
	8	4247NGL	NGL Wholesale	25
	9	333414	Heating Boilers & Fireplace Manufacturing	23
	10	333415	Air-Conditioning and Warm Air Heating Equipment	12

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	31,011	2,700	$45
	Commercial Sector	11,888	10,072	$107
	Industrial Sector	136	20,972	$82
	Transportation	2	0	$0
	Power Sector	13	17,447	$77
	All Sectors	43,050	51,191	$311

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	1,171	494	0	510	144	0	125	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Maine Natural Gas Value Chain Basis

Maryland

Economic Impacts of Natural Gas

There were 38,300 jobs in Maryland related to natural gas. These jobs represented 1.5 percent of total state jobs. The top three sectors with the greatest number of jobs were industrial construction, industrial equipment and machinery repair and maintenance, and oil and gas pipeline construction. The contribution to the Maryland economy in terms of direct, indirect, and induced value added in 2015 was $4.90 billion, of which $3.11 billion was related to the end use segment, $1.36 billion was from the infrastructure segment, and $433 million was from the production segment.

Natural Gas Consumers

In 2015, Maryland consumed 208 Bcf of natural gas in all sectors. There were a total of 1.19 million customers. The value of natural gas delivered to consumers was $1.67 billion.

Maryland has 1.11 million residential customers who consumed 83 Bcf in 2015. Average consumption was 74 Mcf per household. Residential demand was 72 percent for space heating, 20 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

Maryland has 78,000 commercial customers who consumed 70 Bcf in 2015. Average consumption per customer was 989 Mcf. Commercial demand was 38 percent for space heating, 24 percent for water heating, 10 percent for cooking, 9 percent for cogeneration, and 19 percent for other uses.

There are 1,170 industrial customers in Maryland who consumed 15 Bcf in 2015. Average consumption per industrial customer was 13 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Agriculture (11), Petroleum and Coal Products (324), and Non-metallic Mineral Products (327), representing 72 percent of industrial demand.

Maryland has 24 power plants consuming natural gas. In 2015, gas consumed was 40 Bcf, representing 13 percent of power generation in the state. Average consumption per customer was 1,651 MMcf.

Natural Gas Infrastructure

Maryland has no oil and gas wells or production and all natural gas consumed comes from other states.

Maryland has 974 miles of gas pipelines and 311 miles of product pipelines. There were 14,800 miles of gas distribution mains and 13,400 miles of service lines. There was 1 natural gas storage site in the state with a working gas capacity of 18 Bcf.

Exhibit 7-22: Maryland State Factsheet

Maryland			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,037	2,821	3,858	77	139	217	440	248	688
		Industrial	1,637	5,758	7,394	104	272	376	367	508	874
		Residential/ Commercial	1,871	2,778	4,649	124	143	267	486	251	737
		Export	4,383	2,075	6,458	323	106	429	623	185	808
		Transportation	12	16	27	1	1	1	2	1	3
	Infrastructure	Processing	379	1,005	1,384	26	49	75	50	92	141
		Pipelines	1,531	2,641	4,172	103	131	234	143	242	385
		Distribution	2,192	3,053	5,245	153	156	309	538	277	816
		Wholesalers, Marketers, Other	55	82	137	4	4	8	11	7	18
	Production	Natural Gas/ NGLs	1,404	3,534	4,939	107	175	282	118	315	433
	All Segments	Grand Total	14,501	23,762	38,263	1,022	1,176	2,198	2,776	2,126	4,902

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	236210	Industrial Construction	1,574
	2	811310	Industrial Equip. & Machinery Repair & Maint.	661
	3	237120	Oil & Gas Pipeline Construction	580
	4	325	Chemical Manufacturing	560
	5	221210	Natural Gas Distribution	490
	6	45431NGL	NGL Retail	363
	7	811412	Household Appliance Repair & Maintenance	240
	8	221112	Gas-fired Electric Power Generation	153
	9	4841	Freight Truck	134
	10	213111	Drilling Oil & Gas Wells	81

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,113,342	82,858	$927
	Commercial Sector	78,138	70,199	$525
	Industrial Sector	1,169	14,765	$60
	Transportation	17	263	$3
	Power Sector	24	39,632	$154
	All Sectors	1,192,690	207,716	$1,669

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	14,806	13,389	6	974	0	0	311	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	27
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	7	0
	All Wells	7	0

Annual 2015 Data for Maryland Natural Gas Value Chain Basis

Massachusetts

Economic Impacts of Natural Gas

There were 63,500 jobs in Massachusetts related to natural gas. These jobs represented 1.8 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and NGL retail. The contribution to the Massachusetts economy in terms of direct, indirect, and induced value added in 2015 was $7.98 billion, of which $3.02 billion was related to the end use segment, $2.79 billion was from the infrastructure segment, and $0.81 billion was from the production segment.

Natural Gas Consumers

In 2015, Massachusetts consumed 434 Bcf of natural gas in all sectors. There were a total of 1.63 million customers. The value of natural gas delivered to consumers was $3.4 billion.

Massachusetts has 1.48 million residential customers who consumed 127 Bcf in 2015. Average consumption was 86 Mcf per household. Residential demand was 66 percent for space heating, 23 percent for water heating, 4 percent for cooking, and 7 percent for other uses.

Massachusetts has 141,000 commercial customers who consumed 105 Bcf in 2015. Average consumption per commercial customer was 750 Mcf. Commercial demand was 53 percent for space heating, 7 percent for water heating, 3 percent for cooking, 4 percent for cogeneration, and 33 percent for other uses.

There are 11,000 industrial customers in Massachusetts who consumed 45 Bcf in 2015. Average consumption per industrial customer was 4 MMcf. The top industries for gas consumption were Paper (NAICS Code 322), Chemicals (325), Food (311), Fabricated Metal Products (332), and Non-metallic Mineral Products (327), representing 72 percent of industrial demand.

Massachusetts has 48 power plants consuming natural gas. Gas consumed was 156 Bcf, representing 65 percent of power generation in the state. Average consumption per customer was 3,260 MMcf.

Natural Gas Infrastructure

Massachusetts has no oil and gas wells or production and all natural gas consumed comes from other states. There are 1,133 miles of gas pipelines, no crude oil pipelines, no NGL pipelines, 93 miles of product pipelines, and no CO2 pipelines. There were 21,600 miles of gas distribution mains and 15,100 miles of service lines.

Exhibit 7-23: Massachusetts State Factsheet

Massachusetts			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	2,748	5,580	8,328	213	279	492	878	491	1,369
		Industrial	3,025	9,711	12,736	209	472	681	641	857	1,499
		Residential/ Commercial	3,708	5,001	8,709	257	263	520	900	452	1,352
		Export	828	1,052	1,880	61	53	114	67	94	160
		Transportation	35	31	66	2	2	3	6	2	8
	Infrastructure	Processing	848	1,748	2,597	61	87	148	67	159	227
		Pipelines	2,334	4,294	6,628	174	219	393	201	394	595
		Distribution	6,723	6,359	13,082	596	351	948	1,351	576	1,928
		Wholesalers, Marketers, Other	142	157	299	12	8	21	25	14	40
	Production	Natural Gas/ NGLs	3,053	6,118	9,171	238	302	540	262	545	807
	All Segments	Grand Total	23,443	40,052	63,495	1,822	2,036	3,858	4,398	3,585	7,983

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	2,453
	2	811310	Industrial Equip. & Machinery Repair & Maint.	737
	3	45431NGL	NGL Retail	536
	4	325	Chemical Manufacturing	469
	5	237120	Oil & Gas Pipeline Construction	437
	6	221112	Gas-fired Electric Power Generation	373
	7	811412	Household Appliance Repair & Maintenance	366
	8	33241	Power Boiler & Heat Exchanger Manufacturing	355
	9	333611	Turbine and Turbine Generator Manufacturing	314
	10	333994	Industrial Process Furnace & Oven Manufacturing	313

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,478,072	126,662	$1,640
	Commercial Sector	140,533	105,397	$898
	Industrial Sector	11,266	44,554	$227
	Transportation	17	802	$9
	Power Sector	48	156,492	$659
	All Sectors	1,629,936	433,907	$3,433

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	21,576	15,138	0	1,133	0	0	93	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Massachusetts Natural Gas Value Chain Basis

Michigan

Economic Impacts of Natural Gas

There were 17,400 jobs in the state related to natural gas. These jobs represented 2.9 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and industrial equipment repair and maintenance. The contribution to the Michigan economy in terms of direct, indirect, and induced value added in 2015 was $16.75 billion, of which $10.7 billion was related to the end use segment, $4.53 billon was from the infrastructure segment, and $1.57 billion was from the production segment.

Natural Gas Consumers

In 2015, Michigan consumed 827 Bcf of natural gas in all sectors. There were a total of 3.48 million customers. The value of natural gas delivered to consumers was $5.15 billion.

Michigan has 3.21 million residential customers who consumed 312 Bcf in 2015. Average consumption per was 97 Mcf per household. Residential demand was 69 percent for space heating, 21 percent for water heating, 3 percent for cooking, 1 percent for clothes drying and 6 percent for other uses.

Michigan has 254,000 commercial customers who consumed 168 Bcf in 2015. Average consumption per customer was 6.6 MMcf. Commercial demand was 72 percent for space heating, 12 percent for water heating, 3 percent for cooking, and 13 percent for other uses.

There are 7,900 industrial customers who consumed 171 Bcf in 2015. Average consumption per industrial customer was 22 MMcf. The top industries for gas consumption were Chemicals (325), Transportation Equipment (336), Primary Metals (331), Food (311), and Fabricated Metal Products (332), representing 82 percent of industrial demand.

Michigan has 94 power plants consuming natural gas. Gas consumed was 175 Bcf, representing 18 percent of power generation in the state. Average consumption per customer was 1,859 MMcf.

Natural Gas Infrastructure

In 2015, Michigan had 3,900 producing oil wells and 9,900 producing gas wells. There were 2,500 miles of gas gathering lines and 13 gas processing plants in the state with a capacity of 126 MMcf/d. In addition, there were 8,700 miles of gas pipelines, 1,550 miles of crude oil pipelines, 580 miles of NGL pipelines, 1,390 miles of product pipelines, and no CO2 pipelines. There were 57,900 miles of gas distribution mains and 54,200 miles of service lines. There were 44 natural gas storage sites in the state with a working gas capacity of 686 Bcf.

Natural Gas and Oil Production

In 2015, Michigan produced 106 Bcf of dry natural gas, 1.6 million barrels of plant liquids, no lease condensate, and 6.4 million barrels of crude.

Exhibit 7-24: Michigan State Factsheet

Michigan			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,372	7,371	10,744	251	362	614	736	648	1,384
		Industrial	14,422	23,426	37,848	1,209	1,216	2,424	4,505	2,066	6,571
		Residential/ Commercial	7,084	8,205	15,289	469	422	891	1,690	741	2,431
		Export	1,475	1,583	3,058	111	81	192	122	141	263
		Transportation	22	20	42	1	1	2	4	2	5
	Infrastructure	Processing	1,840	2,907	4,746	125	138	263	143	265	408
		Pipelines	6,671	7,591	14,262	524	390	914	969	696	1,666
		Distribution	8,716	8,667	17,383	669	449	1,118	1,611	785	2,397
		Wholesalers, Marketers, Other	224	233	457	17	12	29	38	21	60
	Production	Natural Gas/ NGLs	7,710	9,716	17,426	606	472	1,078	702	866	1,568
	All Segments	Grand Total	51,535	69,720	121,255	3,982	3,543	7,526	10,520	6,232	16,752

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	6,302
	2	221210	Natural Gas Distribution	2,207
	3	811310	Industrial Equip. & Machinery Repair & Maint.	1,493
	4	237120	Oil & Gas Pipeline Construction	1,258
	5	45431NGL	NGL Retail	936
	6	811412	Household Appliance Repair & Maintenance	903
	7	333994	Industrial Process Furnace & Oven Manufacturing	857
	8	236210	Industrial Construction	747
	9	486210	Pipeline Transportation of Natural Gas	746
	10	213112	Support Activities for Oil & Gas Operations	622

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	3,213,910	312,098	$2,745
	Commercial Sector	254,484	168,360	$1,199
	Industrial Sector	7,931	171,196	$654
	Transportation	24	493	$4
	Power Sector	94	174,770	$545
	All Sectors	3,476,443	826,917	$5,147

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	57,867	54,232	2,491	8,698	1,554	582	1,390	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	105,841
	Gas Plant Liquids (barrels)	1,565,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	6,424,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$333
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$624

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	3,930	29
	Gas Wells	9,929	1
	All Wells	13,859	30

Annual 2015 Data for Michigan Natural Gas Value Chain Basis

Minnesota

Economic Impacts of Natural Gas

There were 61,100 jobs in Minnesota related to natural gas. These jobs represented 2.2 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and NGL retail. The contribution to the Minnesota economy in terms of direct, indirect, and induced value added in 2015 was $7.19 billion, of which $3.64 billion was related to the end use segment, $2.80 billion was from the infrastructure segment, and $0.74 billion was from the production segment.

Natural Gas Consumers

In 2015, Minnesota consumed 422 Bcf of natural gas in all sectors. There were a total of 1.64 million customers. The value of natural gas delivered to consumers was $2.5 billion.

Minnesota has 1.50 million residential customers who consumed 118 Bcf in 2015. Average consumption per was 79 Mcf per household. Residential demand was 70 percent for space heating, 23 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

Minnesota has 139,000 commercial customers who consumed 93 Bcf in 2015. Average consumption per commercial customer was 670 Mcf. Commercial demand was 73 percent for space heating, 13 percent for water heating, 4 percent for cooking, and 10 percent for other uses.

There are 1,900 industrial customers in Minnesota who consumed 157 Bcf in 2015. Average consumption per customer was 84 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Petroleum and Coal Products (324), Food (311), Agriculture (11), and Fabricated Metal Products (332), representing 79 percent of industrial demand.

Minnesota has 75 power plants consuming natural gas. Gas consumed was 54 Bcf, representing 13 percent of power generation in the state. Average consumption per customer was 721 MMcf.

Natural Gas Infrastructure

Minnesota has no oil and gas wells or production and all natural gas consumed comes from other states.

Minnesota had 5,500 miles of gas pipelines, 2,660 miles of crude oil pipelines, 573 miles of NGL pipelines, 1,722 miles of product pipelines, and no CO2 pipelines. There were 31,900 miles of gas distribution mains and 25,100 miles of service lines. There was 1 natural gas storage site in the state with a working gas capacity of 2 Bcf.

Exhibit 7-25: Minnesota State Factsheet

Minnesota			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,863	4,250	6,113	138	209	347	263	374	637
		Industrial	3,134	8,581	11,715	217	416	633	551	758	1,308
		Residential/ Commercial	4,426	5,010	9,436	297	260	557	1,109	453	1,561
		Export	753	893	1,646	53	45	98	59	80	138
		Transportation	3	3	7	0	0	0	1	0	1
	Infrastructure	Processing	1,568	2,192	3,760	107	102	210	267	199	466
		Pipelines	4,160	4,601	8,761	320	234	555	486	422	908
		Distribution	5,609	5,369	10,978	405	270	675	907	487	1,394
		Wholesalers, Marketers, Other	143	143	286	11	7	18	21	13	34
	Production	Natural Gas/ NGLs	3,130	5,259	8,388	246	258	504	270	469	739
	All Segments	Grand Total	24,789	36,301	61,090	1,795	1,802	3,597	3,933	3,253	7,186

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	1,412
	2	237120	Oil & Gas Pipeline Construction	1,350
	3	811310	Industrial Equip. & Machinery Repair & Maint.	956
	4	45431NGL	NGL Retail	640
	5	325	Chemical Manufacturing	520
	6	236210	Industrial Construction	399
	7	4841	Freight Truck	394
	8	333414	Heating Boilers & Fireplace Manufacturing	376
	9	811412	Household Appliance Repair & Maintenance	340
	10	335228	Other Major Household Appliance Manufacturing	250

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,496,790	117,586	$1,029
	Commercial Sector	138,871	93,004	$672
	Industrial Sector	1,868	157,400	$599
	Transportation	25	69	$1
	Power Sector	75	54,054	$194
	All Sectors	1,637,629	422,112	$2,496

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	31,891	25,133	0	5,466	2,660	573	1,722	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Minnesota Natural Gas Value Chain Basis

Mississippi

Economic Impacts of Natural Gas

There were 35,400 jobs in Mississippi related to natural gas. These jobs represented 3.2 percent of total state jobs. The top three sectors with the greatest number of jobs were oil and gas pipeline construction, support activities for oil and gas operations, and chemical manufacturing. The contribution to the Mississippi economy in terms of direct, indirect, and induced value added in 2015 was $5.50 billion, of which $2.97 billion was related to the end use segment, $1.85 billon was from the infrastructure segment, and $0.68 billion was from the production segment.

Natural Gas Consumers

In 2015, Mississippi consumed 496 Bcf of natural gas. There were a total of 490 thousand customers. The value of natural gas delivered to consumers was $1.78 billion.

Mississippi has 439,000 residential customers who consumed 23 Bcf in 2015. Average consumption was 53 Mcf per household. Residential demand was 65 percent for space heating, 29 percent for water heating, 3 percent for cooking, and 3 percent for other uses.

Mississippi has 49,800 commercial customers who consumed 20 Bcf in 2015. Average consumption per commercial customer was 395 Mcf. Commercial demand was 50 percent for space heating, 29 percent for water heating, 10 percent for cooking, and 11 percent for other uses.

There are 930 industrial customers in Mississippi who consumed 122 Bcf in 2015. Average consumption per customer was 131 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Petroleum and Coal Products (324), Food (311), Primary Metals (331), and Transportation Equipment (336), representing 86 percent of industrial demand.

Mississippi has 37 power plants consuming natural gas. Gas consumed was 331 Bcf, representing 70 percent of power generation in the state. Average consumption per customer was 8,959 MMcf.

Natural Gas Infrastructure

In 2015, Mississippi had 2,300 producing oil wells and 1,560 producing gas wells. There were 1,630 miles of gas gathering lines and 4 gas processing plants in the state with a capacity of 1,873 MMcf/d. In addition, there were 10,400 miles of gas pipelines, 1,470 miles of crude oil pipelines, 275 miles of NGL pipelines, 1,540 miles of product pipelines, and 524 miles of CO2 pipelines. There were 16,800 miles of gas distribution mains and 11,200 miles of service lines. There were 12 natural gas storage sites in the state with a working gas capacity of 204 Bcf.

Natural Gas and Oil Production

In 2015, Mississippi produced 58 Bcf of dry natural gas, 9.2 million barrels of plant liquids, 2.0 million barrels of lease condensate, and 78.2 million barrels of crude.

Exhibit 7-26: Mississippi State Factsheet

Mississippi			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	2,310	2,890	5,200	187	149	336	1,051	254	1,305
		Industrial	2,268	3,998	6,266	149	184	332	565	353	918
		Residential/ Commercial	1,839	1,902	3,741	115	94	210	530	172	702
		Export	237	292	529	17	15	32	19	26	45
		Transportation	4	3	7	0	0	0	1	0	1
	Infrastructure	Processing	925	921	1,846	91	53	144	294	84	378
		Pipelines	3,146	2,349	5,495	228	114	341	620	215	835
		Distribution	2,687	2,245	4,932	158	104	262	409	204	612
		Wholesalers, Marketers, Other	81	65	146	5	3	8	14	6	20
	Production	Natural Gas/ NGLs	4,365	2,899	7,263	347	136	482	423	258	681
	All Segments	Grand Total	17,861	17,562	35,423	1,296	852	2,148	3,925	1,572	5,497

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	237120	Oil & Gas Pipeline Construction	1,156
	2	213112	Support Activities for Oil & Gas Operations	1,108
	3	325	Chemical Manufacturing	813
	4	811310	Industrial Equip. & Machinery Repair & Maint.	799
	5	221112	Gas-fired Electric Power Generation	648
	6	45431NGL	NGL Retail	605
	7	213111	Drilling Oil & Gas Wells	584
	8	221210	Natural Gas Distribution	580
	9	486210	Pipeline Transportation of Natural Gas	493
	10	236210	Industrial Construction	479

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	439,359	23,248	$225
	Commercial Sector	49,821	19,697	$152
	Industrial Sector	930	121,866	$453
	Transportation	9	81	$1
	Power Sector	37	331,496	$947
	All Sectors	490,156	496,388	$1,778

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	16,794	11,201	1,628	10,445	1,468	275	1,538	524

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	57,859
	Gas Plant Liquids (barrels)	9,210,000
	Lease Condensate (barrels)	2,000,000
	Crude Oil (barrels)	78,204,300
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$406
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$4,067

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	2,309	61
	Gas Wells	1,560	4
	All Wells	3,869	65

Annual 2015 Data for Mississippi Natural Gas Value Chain Basis

Missouri

Economic Impacts of Natural Gas

There were 58,200 jobs in Missouri related to natural gas. These jobs represented 2.1 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and oil and gas pipeline construction. The contribution to the Missouri economy in terms of direct, indirect, and induced value added in 2015 was $7.36 billion, of which $4.14 billion was related to the end use segment, $2.60 billon was from the infrastructure segment, and $0.62 billion was from the production segment.

Natural Gas Consumers

In 2015, Missouri consumed 263 Bcf of natural gas. There were a total of 1.51 million customers. The value of natural gas delivered to consumers was $2.03 billion.

Missouri has 1.37 million residential customers who consumed 96 Bcf in 2015. Average consumption was 70 Mcf per household. Residential demand was 63 percent for space heating, 29 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

Missouri had 141,000 commercial customers who consumed 61 Bcf in 2015. Average consumption per customer was 435 Mcf. Commercial demand was 73 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 9 percent for other uses.

There are 3,200 industrial customers in Missouri who consumed 66 Bcf in 2015. Average consumption per industrial customer was 20 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Primary Metals (331), Agriculture (11), and Fabricated Metal Products (332), representing 76 percent of industrial demand.

Missouri has 54 power plants consuming natural gas. In 2015, gas consumed was 40 Bcf, representing 6 percent of power generation in the state. Average consumption per customer was 743 MMcf.

Natural Gas Infrastructure

In 2015, Missouri had 425 producing oil wells and 6 producing gas wells. There were no gas gathering lines and no gas processing plants in the state. There were 4,608 miles of gas pipelines, 1,850 miles of crude oil pipelines, 1,370 miles of NGL pipelines, 1,913 miles of product pipelines, and no CO2 pipelines. There were 27,300 miles of gas distribution mains and 18,800 miles of service lines. There was 1 natural gas storage site in the state with a working gas capacity of 6 Bcf.

Natural Gas and Oil Production

In 2015, Missouri produced 1 MMcf of dry natural gas, no plant liquids, no lease condensate, and 149,000 barrels of crude.

Exhibit 7-27: Missouri State Factsheet

Missouri			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	1,995	3,963	5,958	145	193	338	218	348	567
		Industrial	5,006	9,625	14,631	321	437	757	1,373	849	2,222
		Residential/ Commercial	3,428	4,035	7,463	212	200	413	870	365	1,235
		Export	621	750	1,371	43	37	80	47	67	114
		Transportation	5	4	10	0	0	0	1	0	1
	Infrastructure	Processing	908	1,453	2,361	65	70	134	74	132	206
		Pipelines	2,906	3,597	6,503	207	178	385	382	330	712
		Distribution	6,929	5,543	12,472	506	284	790	1,147	502	1,649
		Wholesalers, Marketers, Other	151	135	287	11	7	18	24	12	36
	Production	Natural Gas/ NGLs	2,654	4,454	7,108	201	217	418	221	397	618
	All Segments	Grand Total	24,602	33,561	58,163	1,711	1,623	3,334	4,356	3,003	7,359

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	2,434
	2	325	Chemical Manufacturing	2,040
	3	237120	Oil & Gas Pipeline Construction	841
	4	45431NGL	NGL Retail	807
	5	811310	Industrial Equip. & Machinery Repair & Maint.	719
	6	333415	Air-Conditioning and Warm Air Heating Equipment	439
	7	236210	Industrial Construction	401
	8	811412	Household Appliance Repair & Maintenance	276
	9	221112	Gas-fired Electric Power Generation	244
	10	331210	Iron & Steel Pipe & Tube Manufacturing	224

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,369,204	95,503	$1,103
	Commercial Sector	141,216	61,388	$518
	Industrial Sector	3,232	65,691	$270
	Transportation	23	122	$1
	Power Sector	54	40,109	$133
	All Sectors	1,513,729	262,812	$2,026

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	27,348	18,789	0	4,608	1,847	1,372	1,913	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	149,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$7

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	425	0
	Gas Wells	6	0
	All Wells	431	0

Annual 2015 Data for Missouri Natural Gas Value Chain Basis

Montana

Economic Impacts of Natural Gas

There were 11,500 jobs in Montana related to natural gas. These jobs represented 2.6 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and oil and gas pipeline construction. The contribution to the Montana economy in terms of direct, indirect, and induced value added in 2015 was $1.48 billion, of which $0.30 billion was related to the end use segment, $0.88 billon was from the infrastructure segment, and $0.31 billion was from the production segment.

Natural Gas Consumers

In 2015, Montana consumed 67 Bcf of natural gas in all sectors. There were a total of 306,000 customers. The value of natural gas delivered to consumers was $393 million.

Montana has 270,000 residential customers who consumed 19 Bcf in 2015. Average consumption was 70 Mcf per household. Residential demand was 68 percent for space heating, 27 percent for water heating, 2 percent for cooking, and 3 percent for other uses.

Montana has 36,000 commercial customers who consumed 19 Bcf in 2015. Average consumption per commercial customer was 541 Mcf. Commercial demand was 55 percent for space heating, 17 percent for water heating, 13 percent for cooking, and 15 percent for other uses.

There are 366 industrial customers in Montana who consumed 21 Bcf in 2015. Average consumption per customer was 58 MMcf. The top industries for gas consumption were Petroleum and Coal Products (NAICS Code 324), Mining (21), Food (311), Agriculture (11), and Chemicals (325), representing 89 percent of industrial demand.

Montana has 11 power plants consuming natural gas. In 2015, gas consumed was 7.8 Bcf, representing 2 percent of power generation in the state. Average consumption per customer was 713 MMcf.

Natural Gas Infrastructure

In 2015, Montana had 4,938 producing oil wells and 5,655 producing gas wells. There were 7,000 miles of gas gathering lines and 5 gas processing plants in the state with a capacity of 146 MMcf/d. In addition, there were 3,890 miles of gas pipelines, 2,660 miles of crude oil pipelines, 280 miles of NGL pipelines, 871 miles of product pipelines, and 9 miles of CO2 pipelines. There were 7,150 miles of gas distribution mains and 4,411 miles of service lines. There were 5 natural gas storage sites in the state with a working gas capacity of 198 Bcf.

Natural Gas and Oil Production

In 2015, Montana produced 56 Bcf of dry natural gas, 1.0 million barrels of plant liquids, no lease condensate, and 29 million barrels of crude.

Exhibit 7-28: Montana State Factsheet

Montana			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	131	369	499	10	18	28	18	32	51
		Industrial	202	728	931	13	35	49	28	64	93
		Residential/ Commercial	376	451	827	25	23	48	105	41	145
		Export	43	75	118	3	4	7	3	7	10
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	651	631	1,282	41	26	67	151	57	209
		Pipelines	1,518	971	2,490	107	46	152	278	89	367
		Distribution	1,258	876	2,134	83	42	125	211	79	291
		Wholesalers, Marketers, Other	39	26	64	3	1	4	7	2	9
	Production	Natural Gas/ NGLs	2,026	1,107	3,133	175	53	228	208	99	307
	All Segments	Grand Total	6,243	5,235	11,478	458	249	707	1,011	471	1,482

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	863
	2	237120	Oil & Gas Pipeline Construction	749
	3	221210	Natural Gas Distribution	344
	4	45431NGL	NGL Retail	273
	5	211111	Crude Petroleum & Natural Gas Extraction	258
	6	486210	Pipeline Transportation of Natural Gas	233
	7	4841	Freight Truck	222
	8	811310	Industrial Equip. & Machinery Repair & Maint.	136
	9	4821	Freight Rail	97
	10	324110	Petroleum Refineries	94

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	269,766	18,796	$155
	Commercial Sector	35,777	19,364	$144
	Industrial Sector	366	21,152	$77
	Transportation	1	1	$0
	Power Sector	11	7,847	$18
	All Sectors	305,921	67,159	$393

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	7,147	4,411	6,985	3,893	2,661	280	871	9

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	55,691
	Gas Plant Liquids (barrels)	1,028,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	28,561,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$155
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$1,308

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	4,938	54
	Gas Wells	5,655	3
	All Wells	10,593	57

Annual 2015 Data for Montana Natural Gas Value Chain Basis

Nebraska

Economic Impacts of Natural Gas

There were 21,100 jobs in Nebraska related to natural gas. These jobs represented 2.2 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, freight rail, and chemical manufacturing. The contribution to the Nebraska economy in terms of direct, indirect, and induced value added in 2015 was $2.43 billion, of which $1.31 billion was related to the end use segment, $0.88 billon was from the infrastructure segment, and $0.25 billion was from the production segment.

Natural Gas Consumers

In 2015, Nebraska consumed 154 Bcf of natural gas in all sectors. There were a total of 592,000 customers. The value of natural gas delivered to consumers was $831 million.

Nebraska has 525,000 residential customers who consumed 35 Bcf in 2015. Average consumption was 66 Mcf per household. Residential demand was 60 percent for space heating, 33 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

Nebraska has 58,000 commercial customers who consumed 29 Bcf in 2015. Average consumption per commercial customer was 512 MMcf. Commercial demand was 74 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 8 percent for other uses.

There are 8,868 industrial customers in Nebraska who consumed 86 Bcf in 2015. Average consumption per industrial customer was 10 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Agriculture (11), Fabricated Metal Products (332), and Plastics and Rubber Products (326), representing 96 percent of industrial demand.

Nebraska has 50 power plants consuming natural gas. Gas consumed was 4.6 Bcf, representing 1 percent of power generation in the state. Average consumption per customer was 93 MMcf.

Natural Gas Infrastructure

In 2015, Nebraska had 1,824 producing oil wells and 140 producing gas wells. There were 501 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 5,813 miles of gas pipelines, 756 miles of crude oil pipelines, 680 miles of NGL pipelines, 1,489 miles of product pipelines, and no CO2 pipelines. There were 12,780 miles of gas distribution mains and 7,290 miles of service lines. There was 1 natural gas storage site in the state with a working gas capacity of 13 Bcf.

Natural Gas and Oil Production

In 2015, Nebraska produced 0.5 Bcf of dry natural gas, no plant liquids, no lease condensate, and 3 million barrels of crude.

Exhibit 7-29: Nebraska State Factsheet

Nebraska			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	589	1,346	1,935	43	66	109	53	118	171
		Industrial	2,262	3,948	6,211	157	186	343	418	348	767
		Residential/ Commercial	956	1,299	2,255	64	67	131	212	117	329
		Export	201	269	471	14	14	28	16	24	40
		Transportation	2	2	4	0	0	0	0	0	0
	Infrastructure	Processing	284	517	800	19	24	43	21	47	68
		Pipelines	988	1,300	2,288	70	65	135	140	119	259
		Distribution	2,209	1,876	4,085	197	104	301	370	170	540
		Wholesalers, Marketers, Other	49	47	96	4	3	7	8	4	12
	Production	Natural Gas/ NGLs	1,190	1,736	2,926	85	83	168	93	155	248
	All Segments	Grand Total	8,731	12,339	21,071	654	611	1,265	1,331	1,103	2,434

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	769
	2	4821	Freight Rail	516
	3	325	Chemical Manufacturing	484
	4	811310	Industrial Equip. & Machinery Repair & Maint.	411
	5	237120	Oil & Gas Pipeline Construction	311
	6	236210	Industrial Construction	184
	7	45431NGL	NGL Retail	147
	8	4841	Freight Truck	124
	9	811412	Household Appliance Repair & Maintenance	100
	10	326122	Plastics Pipe & Fittings manufacturing	98

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	525,165	34,663	$307
	Commercial Sector	57,521	29,464	$191
	Industrial Sector	8,868	85,604	$315
	Transportation	13	55	$0
	Power Sector	50	4,634	$17
	All Sectors	591,617	154,420	$831

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	12,777	7,292	501	5,813	756	680	1,489	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	477
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	2,896,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$1
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$117

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	1,824	67
	Gas Wells	140	0
	All Wells	1,964	67

Annual 2015 Data for Nebraska Natural Gas Value Chain Basis

Nevada

Economic Impacts of Natural Gas

There were 16,200 jobs in Nevada related to natural gas. These jobs represented 1.3 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and gas fired electric power generation. The contribution to the Nevada economy in terms of direct, indirect, and induced value added in 2015 was $2.33 billion, of which $1.41 billion was related to the end use segment, $0.77 billon was from the infrastructure segment, and $0.15 billion was from the production segment.

Natural Gas Consumers

In 2015, Nevada consumed 293 Bcf of natural gas in all sectors. There were a total of 867,000 customers. The value of natural gas delivered to consumers was $1.42 billion.

Nevada has 824,000 residential customers who consumed 37 Bcf in 2015. Average consumption was 45 Mcf per household. Residential demand was 51 percent for space heating, 30 percent for water heating, 8 percent for cooking, and 11 percent for other uses.

Nevada has 43,000 commercial customers who consumed 30 Bcf in 2015. Average consumption per commercial customer was 697 Mcf. Commercial demand was 54 percent for space heating, 17 percent for water heating, 12 percent for cooking, 2 percent for cogeneration, and 15 percent for other uses.

There were 215 industrial customers in Nevada who consumed 18 Bcf in 2015. Average consumption per customer was 82 MMcf. The top industries for gas consumption were Mining (NAICS Code 21), Food (311), Chemicals (325), Primary Metals (331), and Fabricated Metal Products (332), representing 71 percent of industrial demand.

Nevada has 21 power plants consuming natural gas. Gas consumed was 207 Bcf, representing 74 percent of power generation in the state. Average consumption per customer was 9,864 MMcf.

Natural Gas Infrastructure

Nevada has 2,018 miles of gas pipelines, no crude oil pipelines, no NGL pipelines, 276 miles of product pipelines, and no CO2 pipelines. There were 9,905 miles of gas distribution mains and 8,584 miles of service lines.

Natural Gas and Oil Production

In 2015, Nevada produced 3 MMcf of dry natural gas and 0.3 million barrels of crude.

Exhibit 7-30: Nevada State Factsheet

Nevada			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,668	2,151	3,819	134	110	244	665	189	854
		Industrial	345	1,818	2,163	22	89	111	45	161	206
		Residential/ Commercial	796	1,082	1,878	51	55	105	218	98	316
		Export	89	195	284	6	10	16	7	17	24
		Transportation	49	36	84	2	2	3	8	3	11
	Infrastructure	Processing	127	358	485	8	18	26	14	33	47
		Pipelines	781	1,063	1,843	47	50	97	70	97	167
		Distribution	2,159	1,693	3,852	155	84	240	388	154	541
		Wholesalers, Marketers, Other	46	41	87	3	2	5	7	4	11
	Production	Natural Gas/ NGLs	465	1,263	1,727	36	63	98	39	113	152
	All Segments	Grand Total	6,524	9,699	16,223	465	482	947	1,461	868	2,329

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	880
	2	811310	Industrial Equip. & Machinery Repair & Maint.	467
	3	221112	Gas-fired Electric Power Generation	462
	4	237120	Oil & Gas Pipeline Construction	462
	5	236210	Industrial Construction	284
	6	45431NGL	NGL Retail	227
	7	811412	Household Appliance Repair & Maintenance	107
	8	4841	Freight Truck	53
	9	45431CNG	CNG Stations	41
	10	213112	Support Activities for Oil & Gas Operations	34

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	824,039	37,029	$436
	Commercial Sector	42,860	29,873	$233
	Industrial Sector	215	17,724	$74
	Transportation	7	1,089	$10
	Power Sector	21	207,145	$663
	All Sectors	867,142	292,860	$1,416

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	9,905	8,584	1	2,018	0	0	276	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	3
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	281,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$12

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	102	0
	Gas Wells	1	0
	All Wells	103	0

Annual 2015 Data for Nevada Natural Gas Value Chain Basis

New Hampshire

Economic Impacts of Natural Gas

There were 10,100 jobs in New Hampshire related to natural gas. These jobs represented 1.6 percent of total state jobs. The top three sectors with the greatest number of jobs were NGL retail, natural gas distribution, and industrial equipment and machinery repair and maintenance. The contribution to the New Hampshire economy in terms of direct, indirect, and induced value added in 2015 was $1.32 billion, of which $0.73 billion was related to the end use sector, $0.45 billion was from the infrastructure segment, and $131 million was from the production segment.

Natural Gas Consumers

In 2015, New Hampshire consumed 69 Bcf of natural gas in all sectors. There were a total of 121,000 customers. The value of natural gas delivered to consumers was $456 million.

New Hampshire has 103,000 residential customers who consumed 7.8 Bcf in 2015. Average consumption was 76 Mcf per household. Residential demand was 69 percent for space heating, 22 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

New Hampshire has 18,000 commercial customers who consumed 10 Bcf in 2015. Average consumption per commercial customer was 529 Mcf. Commercial demand was 54 percent for space heating, 7 percent for water heating, 3 percent for cooking, 3 percent for cogeneration, and 33 percent for other uses.

There are 193 industrial customers in New Hampshire who consumed 8.4 Bcf in 2015. Average consumption per customer was 43 MMcf. The top industries for gas consumption were Paper (NAICS Code 322), Chemicals (325), Fabricated Metal Products (332), Primary Metals (331), and Plastics and Rubber Products (326), representing 62 percent of industrial demand.

New Hampshire has 6 power plants consuming natural gas. Gas consumed was 43 Bcf, representing 30 percent of power generation in the state. Average consumption per customer was 7,112 MMcf.

Natural Gas Infrastructure

New Hampshire has no oil and gas wells or production and all natural gas consumed comes from other states.

The state has 248 miles of gas pipelines and 71 miles of crude oil pipelines. There were 1,070 miles of gas distribution mains and 494 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-31: New Hampshire State Factsheet

New Hampshire

Summary

Segment	Category	Employment (# of Workers) Direct & Indirect	Employment (# of Workers) Induced	Employment (# of Workers) Total	Labor Income ($ million) Direct & Indirect	Labor Income ($ million) Induced	Labor Income ($ million) Total	Value Added ($ million) Direct & Indirect	Value Added ($ million) Induced	Value Added ($ million) Total
End-Use	Power Generation	436	884	1,320	34	44	78	195	78	272
	Industrial	546	1,602	2,148	37	77	114	121	141	263
	Residential/ Commercial	494	731	1,225	33	38	71	108	66	174
	Export	112	159	271	8	8	16	9	14	23
	Transportation	4	4	8	0	0	0	1	0	1
Infrastructure	Processing	125	274	399	9	14	23	10	25	35
	Pipelines	336	662	998	25	34	58	29	61	90
	Distribution	1,064	1,080	2,144	81	59	141	223	98	321
	Wholesalers, Marketers, Other	22	26	48	2	1	3	4	2	7
Production	Natural Gas/ NGLs	543	989	1,532	39	48	87	43	88	131
All Segments	Grand Total	3,683	6,412	10,094	268	323	591	743	574	1,317

Jobs by Top Industries

Rank	NAICS	Industry Sector	Direct and Indirect Jobs
1	45431NGL	NGL Retail	410
2	221210	Natural Gas Distribution	185
3	811310	Industrial Equip. & Machinery Repair & Maint.	116
4	325	Chemical Manufacturing	112
5	221112	Gas-fired Electric Power Generation	92
6	236210	Industrial Construction	64
7	333994	Industrial Process Furnace & Oven Manufacturing	60
8	333414	Heating Boilers & Fireplace Manufacturing	46
9	213112	Support Activities for Oil & Gas Operations	34
10	4247NGL	NGL Wholesale	33

Customers

Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
Residential Sector	102,567	7,842	$126
Commercial Sector	18,185	9,630	$103
Industrial Sector	193	8,386	$36
Transportation	3	77	$1
Power Sector	6	42,673	$189
All Sectors	120,954	68,609	$456

Infrastructure

Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
1,920	1,211	0	248	71	0	0	0

Production

Product	Annual Production
Dry Natural Gas (mmcf)	0
Gas Plant Liquids (barrels)	0
Lease Condensate (barrels)	0
Crude Oil (barrels)	0
Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells

Well Type	Operating Wells	New Wells Drilled
Oil Wells	0	0
Gas Wells	0	0
All Wells	0	0

Annual 2015 Data for New Hampshire Natural Gas Value Chain Basis

New Jersey

Economic Impacts of Natural Gas

There were 79,800 jobs in the state related to natural gas. These jobs represented 2.0 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and industrial equipment and machinery repair and maintenance. The contribution to the New Jersey economy in terms of direct, indirect, and induced value added in 2015 was $11.6 billion, of which $7.22 billion was related to the end use segment, $3.56 billion was from the infrastructure segment, and $831 million was from the production segment.

Natural Gas Consumers

In 2015, New Jersey consumed 747 Bcf of natural gas in all sectors. There were a total of 2.98 million customers. The value of natural gas delivered to consumers was $4.24 billion.

New Jersey has 2.73 million residential customers who consumed 237 Bcf in 2015. Average consumption was 87 Mcf per household. Residential demand was 55 percent for space heating, 28 percent for water heating, 6 percent for cooking, 3 percent for clothes drying, and 8 percent for other uses.

New Jersey has 241,000 commercial customers who consumed 163 Bcf in 2015. Average consumption per commercial customer was 676 Mcf. Commercial demand was 54 percent for space heating, 16 percent for water heating, 5 percent for cooking, and 25 percent for other uses.

There are 7,000 industrial customers in New Jersey who consumed 55 Bcf. Average consumption per industrial customer was 8 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Non-metallic Mineral Products (327), Food (311), Petroleum and Coal Products (324), and Primary Metals (331), representing 85 percent of industrial demand.

New Jersey has 57 power plants consuming natural gas. In 2015, gas consumed was 291 Bcf, representing 50 percent of power generation in the state. Average consumption per customer was 5,102 MMcf.

Natural Gas Infrastructure

New Jersey has no oil and gas wells or production and all natural gas consumed comes from other states. The state has 1,569 miles of gas pipelines, no crude oil pipelines, 11 miles of NGL pipelines, 614 miles of product pipelines, and no CO2 pipelines. There were 34,792 miles of gas distribution mains and 32,966 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-32: New Jersey State Factsheet

New Jersey			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,407	6,368	9,775	263	318	581	1,371	560	1,931
		Industrial	6,932	14,009	20,941	617	744	1,361	2,194	1,236	3,429
		Residential/ Commercial	4,591	5,746	10,337	302	294	596	1,186	519	1,706
		Export	757	1,074	1,831	54	54	108	60	96	155
		Transportation	11	8	19	1	0	1	2	1	2
	Infrastructure	Processing	801	1,815	2,616	57	90	147	62	165	228
		Pipelines	3,192	4,908	8,100	250	253	503	428	450	878
		Distribution	8,859	7,501	16,360	843	432	1,275	1,719	679	2,398
		Wholesalers, Marketers, Other	188	184	371	17	10	28	34	17	51
	Production	Natural Gas/ NGLs	2,991	6,434	9,425	235	318	553	258	573	831
	All Segments	Grand Total	31,730	48,047	79,776	2,638	2,515	5,153	7,313	4,296	11,609

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	3,734
	2	325	Chemical Manufacturing	2,900
	3	811310	Industrial Equip. & Machinery Repair & Maint.	1,223
	4	237120	Oil & Gas Pipeline Construction	1,045
	5	811412	Household Appliance Repair & Maintenance	686
	6	221112	Gas-fired Electric Power Generation	657
	7	236210	Industrial Construction	590
	8	333994	Industrial Process Furnace & Oven Manufacturing	466
	9	33241	Power Boiler & Heat Exchanger Manufacturing	301
	10	45431NGL	NGL Retail	272

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	2,728,340	237,104	$1,977
	Commercial Sector	241,417	163,223	$1,207
	Industrial Sector	7,019	55,368	$217
	Transportation	28	239	$2
	Power Sector	57	290,843	$835
	All Sectors	2,976,861	746,777	$4,238

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	34,792	32,966	0	1,569	0	11	614	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for New Jersey Natural Gas Value Chain Basis

New Mexico

Economic Impacts of Natural Gas

There were 39,925 jobs in the New Mexico related to natural gas. These jobs represented 5.0 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, crude petroleum and natural gas extraction, and oil and gas pipeline construction. The contribution to the New Mexico economy in terms of direct, indirect, and induced value added in 2015 was $5.06 billion, of which $0.72 billion was related to the end use segment, $1.94 billon was from the infrastructure segment, and $2.40 billion was from the production segment.

Natural Gas Consumers

In 2015, New Mexico consumed 154 Bcf of natural gas in all sectors. There were a total of 630,000 customers. The value of natural gas delivered to consumers was $753 million.

New Mexico has 579,000 residential customers who consumed 33 Bcf in 2015. Average consumption was 57 Mcf per household. Residential demand was 51 percent for space heating, 30 percent for water heating, 8 percent for cooking, 1 percent for space cooling, and 10 percent for other uses.

New Mexico has 51,000 commercial customers who consumed 25 Bcf in 2015. Average consumption per commercial customer was 495 Mcf. Commercial demand was 52 percent for space heating, 16 percent for water heating, 12 percent for cooking, 5 percent for cogeneration, and 15 percent for other uses.

There are 116 industrial customers in New Mexico who consumed 18 Bcf in 2015. Average consumption per industrial customer was 155 MMcf. The top industries for gas consumption were Food (NAICS Code 311), Chemicals (325), Petroleum and Coal Products (324), Mining (21), and Non-metallic Mineral Products (327) representing 75 percent of industrial demand.

New Mexico has 26 power plants consuming natural gas. In 2015, gas consumed was 78 Bcf representing 29 percent of power generation in the state. Average consumption per customer was 2,998 MMcf.

Natural Gas Infrastructure

In 2015, New Mexico had 24,326 producing oil wells and 40,596 producing gas wells. There were 20,699 miles of gas gathering lines and 26 gas processing plants in the state with a capacity of 3,268 MMcf/d. In addition, there were 6,580 miles of gas pipelines, 1,730 miles of crude oil pipelines, 2,021 miles of NGL pipelines, 2,140 miles of product pipelines, and 1,039 miles of CO2 pipelines. There were 13,882 miles of gas distribution mains and 6,072 miles of service lines. There were 2 natural gas storage sites in the state with a working gas capacity of 60 Bcf.

Natural Gas and Oil Production

In 2015, New Mexico produced 1.15 Tcf of dry natural gas, 62 million barrels of gas plant liquids, 10 million barrels of lease condensate, and 137 million barrels of crude. New Mexico has accounted for a large volume of historic gas production, especially from the San Juan Basin

coalbed methane play and several tight gas sand plays in the northwestern part of the state. With the decline of activity in those plays, operators have focused on oil-drilling in the southeastern New Mexico part of the Permian Basin. Some success has also been achieved with San Juan Basin horizontal plays. Rig activity in New Mexico in April, 2017 was 58 active rigs.

Exhibit 7-33: New Mexico State Factsheet

New Mexico			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	637	1,020	1,657	50	51	102	214	90	304
		Industrial	327	1,309	1,636	20	63	83	64	116	180
		Residential/ Commercial	552	736	1,288	35	37	73	150	67	217
		Export	60	131	191	4	7	11	5	12	16
		Transportation	7	4	12	0	0	0	1	1	2
	Infrastructure	Processing	1,984	1,192	3,176	145	54	199	370	109	479
		Pipelines	3,114	1,979	5,092	209	91	300	653	181	834
		Distribution	3,106	1,951	5,057	178	84	262	434	177	611
		Wholesalers, Marketers, Other	88	56	144	5	2	8	15	5	20
	Production	Natural Gas/ NGLs	15,541	6,130	21,671	1,268	276	1,544	1,852	546	2,398
	All Segments	Grand Total	25,418	14,508	39,925	1,916	667	2,583	3,758	1,302	5,060

Jobs by Top Industries				
	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	6,447
	2	211111	Crude Petroleum & Natural Gas Extraction	3,167
	3	237120	Oil & Gas Pipeline Construction	1,870
	4	221210	Natural Gas Distribution	1,023
	5	213111	Drilling Oil & Gas Wells	975
	6	211112	Natural Gas Liquid Extraction	599
	7	45431NGL	NGL Retail	461
	8	811310	Industrial Equip. & Machinery Repair & Maint.	340
	9	4841	Freight Truck	276
	10	486210	Pipeline Transportation of Natural Gas	273

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	578,769	33,130	$285
	Commercial Sector	50,584	25,038	$162
	Industrial Sector	116	17,937	$66
	Transportation	15	172	$1
	Power Sector	26	77,947	$239
	All Sectors	629,510	154,224	$753

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	13,882	6,072	20,699	6,580	1,730	2,021	2,140	1,039

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1,151,159
	Gas Plant Liquids (barrels)	62,130,000
	Lease Condensate (barrels)	10,000,000
	Crude Oil (barrels)	136,746,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$4,392
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$10,464

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	24,326	873
	Gas Wells	40,596	20
	All Wells	64,922	894

Annual 2015 Data for New Mexico Natural Gas Value Chain Basis

New York

Economic Impacts of Natural Gas

There were 152,300 jobs in New York related to natural gas. These jobs represented 1.7 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, turbine and turbine generator manufacturing, and chemical manufacturing. The contribution to the New York economy in terms of direct, indirect, and induced value added in 2015 was $20.19 billion, of which $11.50 billion was related to the end use segment, $6.94 billion was from the infrastructure segment, and $99 million was from the production segment.

Natural Gas Consumers

In 2015, New York consumed 1.33 Tcf of natural gas in all sectors. There were a total of 4.82 million customers. The value of natural gas delivered to consumers was $8.82 billion.

New York has 4.44 million residential customers who consumed 452 Bcf in 2015. Average consumption was 102 Mcf per household. Residential demand was 69 percent for space heating, 20 percent for water heating, 5 percent for cooking, and 6 percent for other uses.

New York has 398,000 commercial customers who consumed 311 Bcf in 2015. Average consumption per commercial customer was 783 Mcf. Commercial demand was 53 percent for space heating, 16 percent for water heating, 5 percent for cooking, 2 percent for cogeneration, and 24 percent for other uses.

There are 6,000 industrial customers in New York who consumed 83 Bcf in 2015. Average consumption per customer was 14 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Paper (322), Food (311), Non-metallic Mineral Products (327), and Primary Metals (331), representing 73 percent of industrial demand.

New York has 106 power plants consuming natural gas. Gas consumed was 476 Bcf, representing 41 percent of power generation in the state. Average consumption per customer was 4,487 MMcf.

Natural Gas Infrastructure

New York has 3,900 oil wells and 7,600 gas wells. There were 5,500 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 4,550 miles of gas pipelines, 94 miles of crude oil pipelines, 200 miles of NGL pipelines, 859 miles of product pipelines, and no CO2 pipelines. There were 48,684 miles of gas distribution mains and 37,653 miles of service lines. There were 26 natural gas storage sites in the state with a working gas capacity of 127 Bcf.

Natural Gas and Oil Production

In 2015, New York produced 18 Bcf of dry gas, no gas plant liquids or lease condensate, and 0.28 million barrels of oil.

Exhibit 7-34: New York State Factsheet

New York			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	8,379	14,692	23,072	692	758	1,450	2,369	1,292	3,661
		Industrial	7,704	23,289	30,993	590	1,159	1,749	2,055	2,055	4,110
		Residential/ Commercial	8,481	11,518	19,998	573	598	1,171	2,187	1,041	3,227
		Export	2,522	2,661	5,183	200	139	339	220	237	457
		Transportation	182	157	340	8	9	13	29	11	40
	Infrastructure	Processing	2,426	4,249	6,675	177	211	388	197	387	584
		Pipelines	6,060	10,282	16,342	503	540	1,043	749	943	1,692
		Distribution	15,603	14,723	30,326	1,402	817	2,223	3,330	1,337	4,667
		Wholesalers, Marketers, Other	336	367	703	30	20	50	66	33	99
	Production	Natural Gas/ NGLs	5,171	13,520	18,692	399	671	1,070	445	1,205	1,650
	All Segments	Grand Total	56,865	95,458	152,324	4,574	4,922	9,496	11,647	8,541	20,187

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	6,395
	2	333611	Turbine and Turbine Generator Manufacturing	2,824
	3	325	Chemical Manufacturing	2,190
	4	811310	Industrial Equip. & Machinery Repair & Maint.	1,829
	5	33241	Power Boiler & Heat Exchanger Manufacturing	1,804
	6	237120	Oil & Gas Pipeline Construction	1,549
	7	811412	Household Appliance Repair & Maintenance	1,308
	8	45431NGL	NGL Retail	1,088
	9	221112	Gas-fired Electric Power Generation	903
	10	333912	Air & Gas Compressor Manufacturing	738

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	4,439,101	452,148	$4,770
	Commercial Sector	397,656	311,203	$2,082
	Industrial Sector	6,030	83,055	$316
	Transportation	96	4,104	$31
	Power Sector	106	475,658	$1,622
	All Sectors	4,842,989	1,326,168	$8,820

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	48,684	37,653	5,495	4,557	94	200	859	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	17,829
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	279,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$54
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$67

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	3,922	34
	Gas Wells	7,605	3
	All Wells	11,527	37

Annual 2015 Data for New York Natural Gas Value Chain Basis

North Carolina

Economic Impacts of Natural Gas

There were 112,800 jobs in North Carolina related to natural gas. These jobs represented 2.7 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and NGL retail. The contribution to the North Carolina economy in terms of direct, indirect, and induced value added in 2015 was $13.60 billion, of which $8.34 billion was related to the end use segment, $3.87 billon was from the infrastructure segment, and $1.40 billion was from the production segment.

Natural Gas Consumers

In 2015, North Carolina consumed 493 Bcf of natural gas in all sectors. There were a total of 1.33 million customers. The value of natural gas delivered to consumers was $2.80 billion.

North Carolina has 1.21 million residential customers who consumed 64 Bcf in 2015. Average consumption was 53 Mcf per household. Residential demand was 70 percent for space heating, 27 percent for water heating, 1 percent for cooking, and 2 percent for other uses.

North Carolina has 122,000 commercial customers who consumed 55 Bcf in 2015. Average consumption per customer was 452 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 2,600 industrial customers in North Carolina who consumed 105 Bcf in 2015. Average consumption per customer was 40 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Paper (322), Food (311), Primary Metals (331), and Non-metallic Mineral Products (327), representing 72 percent of industrial demand.

North Carolina has 29 power plants consuming natural gas. Gas consumed was 269 Bcf, representing 28 percent of power generation in the state. Average consumption per customer was 9,273 MMcf.

Natural Gas Infrastructure

North Carolina has no oil and gas wells or production and all natural gas consumed comes from other states. There are no gas gathering lines and no gas processing plants in the state. The state has 4,185 miles of gas pipelines, no crude oil pipelines, 89 miles of NGL pipelines, 1,062 miles of product pipelines, and no CO2 pipelines. There are 30,355 miles of gas distribution mains and 25,330 miles of service lines.

Exhibit 7-35: North Carolina State Factsheet

North Carolina			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	4,449	8,601	13,050	326	419	745	936	756	1,692
		Industrial	10,524	20,450	30,974	712	947	1,659	2,773	1,803	4,576
		Residential/ Commercial	5,241	7,248	12,489	354	377	731	1,113	655	1,768
		Export	1,776	1,762	3,538	129	89	218	142	157	299
		Transportation	6	6	12	0	0	0	1	1	2
	Infrastructure	Processing	1,879	2,976	4,854	129	143	272	142	271	413
		Pipelines	5,603	7,401	13,004	397	368	765	550	679	1,229
		Distribution	9,151	9,293	18,444	586	449	1,036	1,336	842	2,178
		Wholesalers, Marketers, Other	220	242	462	14	12	26	29	22	51
	Production	Natural Gas/ NGLs	6,256	9,670	15,926	485	472	957	533	862	1,395
	All Segments	Grand Total	45,105	67,648	112,753	3,134	3,277	6,410	7,555	6,047	13,603

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	4,274
	2	221210	Natural Gas Distribution	1,881
	3	45431NGL	NGL Retail	1,577
	4	811310	Industrial Equip. & Machinery Repair & Maint.	1,078
	5	237120	Oil & Gas Pipeline Construction	1,024
	6	236210	Industrial Construction	702
	7	221112	Gas-fired Electric Power Generation	658
	8	335228	Other Major Household Appliance Manufacturing	499
	9	33241	Power Boiler & Heat Exchanger Manufacturing	445
	10	333912	Air & Gas Compressor Manufacturing	412

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,206,870	64,523	$744
	Commercial Sector	121,842	55,114	$442
	Industrial Sector	2,624	105,103	$411
	Transportation	42	135	$1
	Power Sector	29	268,925	$1,198
	All Sectors	1,331,407	493,801	$2,796

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	30,355	25,334	0	4,185	0	89	1,062	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for North Carolina
Natural Gas Value Chain Basis

North Dakota

Economic Impacts of Natural Gas

There were 32,300 jobs in North Dakota related to natural gas. These jobs represented 7.5 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, oil and gas pipeline construction, and drilling oil and gas wells. The contribution to the North Dakota economy in terms of direct, indirect, and induced value added in 2015 was $3.84 billion, of which $0.32 billion was related to the end use segment, $1.10 billon was from the infrastructure segment, and $2.43 billion was from the production segment.

Natural Gas Consumers

In 2015, North Dakota consumed 58 Bcf of natural gas in all sectors. There were a total of 163,000 customers. The value of natural gas delivered to consumers was $307 million.

North Dakota has 141,000 residential customers who consumed 11 Bcf in 2015. Average consumption was 75 Mcf per household. Residential demand was 70 percent for space heating, 23 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

North Dakota has 21,000 commercial customers who consumed 12 Bcf in 2015. Average consumption per commercial customer was 577 Mcf. Commercial demand was 74 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 8 percent for other uses.

There are 286 industrial customers in North Dakota who consumed 32 Bcf in 2015. Average consumption per industrial customer was 111 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Agriculture (11), Food (311), Mining (21), and Machinery (333), representing 98 percent of industrial demand.

North Dakota has 7 power plants consuming natural gas. In 2015, Gas consumed was 3.7 Bcf, representing 2 percent of power generation in the state. Average consumption per customer was 524 MMcf.

Natural Gas Infrastructure

In 2015, North Dakota had 13,420 producing oil wells and 462 producing gas wells. There were 7,536 miles of gas gathering lines and 14 gas processing plants in the state with a capacity of 950 MMcf/d. In addition, there were 2,479 miles of gas pipelines, 3,058 miles of crude oil pipelines, 266 miles of NGL pipelines, 774 miles of product pipelines, and 167 miles of CO2 pipelines. There were 3,591 miles of gas distribution mains and 2,492 miles of service lines. There are no natural gas storage sites in the state.

Natural Gas and Oil Production

In 2015, North Dakota produced 0.38 Tcf of dry natural gas, 62 million barrels of gas plant liquids, 1 million barrels of lease condensate, and 428 million barrels of crude. North Dakota is the location of most of the drilling activity in the Bakken oil play. Activity in the play has generated a surge of oil production since 2011, and current basin production is in the range of one million b/d. A large effort has been underway to improve transportation out of the basin, and to better accommodate the increase in associated gas production. Rail transportation of crude has been important. In April of 2017, North Dakota drilling activity was about 43 rigs.

Exhibit 7-36: North Dakota State Factsheet

Summary

North Dakota			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	144	447	591	11	22	33	31	39	70
		Industrial	258	917	1,175	17	45	63	34	81	115
		Residential/ Commercial	332	478	810	22	25	47	82	43	125
		Export	57	96	153	4	5	9	4	9	13
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	445	374	818	26	15	42	219	34	254
		Pipelines	3,007	1,771	4,778	232	89	322	383	162	545
		Distribution	1,489	1,033	2,522	112	55	167	192	94	286
		Wholesalers, Marketers, Other	59	37	96	5	2	6	8	3	11
	Production	Natural Gas/ NGLs	15,503	5,891	21,394	1,532	315	1,847	1,900	525	2,425
	All Segments	Grand Total	21,292	11,046	32,338	1,961	573	2,534	2,853	991	3,843

Jobs by Top Industries

Rank	NAICS	Industry Sector	Direct and Indirect Jobs
1	213112	Support Activities for Oil & Gas Operations	6,909
2	237120	Oil & Gas Pipeline Construction	2,098
3	213111	Drilling Oil & Gas Wells	1,851
4	211111	Crude Petroleum & Natural Gas Extraction	1,762
5	811310	Industrial Equip. & Machinery Repair & Maint.	207
6	4821	Freight Rail	164
7	4247NGL	NGL Wholesale	146
8	221210	Natural Gas Distribution	145
9	236210	Industrial Construction	129
10	327310	Cement Manufacturing	95

Customers

Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
Residential Sector	141,465	10,552	$86
Commercial Sector	21,345	12,317	$82
Industrial Sector	286	31,660	$108
Transportation	1	0	$0
Power Sector	7	3,671	$31
All Sectors	163,104	58,201	$307

Infrastructure

Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
3,591	2,492	7,536	2,479	3,058	266	774	167

Production

Product	Annual Production
Dry Natural Gas (mmcf)	381,653
Gas Plant Liquids (barrels)	62,009,000
Lease Condensate (barrels)	1,000,000
Crude Oil (barrels)	428,447,000
Annual Value Counted Toward Natural Gas Value Chain ($million)	$2,315
Annual Value of All Produced Oil, Gas, NGLs ($million)	$20,061

Wells

Well Type	Operating Wells	New Wells Drilled
Oil Wells	13,420	1,710
Gas Wells	462	4
All Wells	13,882	1,714

Annual 2015 Data for North Dakota Natural Gas Value Chain Basis

Ohio

Economic Impacts of Natural Gas

There were 188,500 jobs in Ohio related to natural gas. These jobs represented 3.6 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and oil and gas pipeline construction. The contribution to the Ohio economy in terms of direct, indirect, and induced value added in 2015 was $26.7 billion, of which $16.4 billion was related to the end use segment, $7.21 billon was from the infrastructure segment, and $3.13 billion was from the production segment.

Natural Gas Consumers

In 2015, Ohio consumed 939 Bcf of natural gas in all sectors. There were a total of 3.57 million customers. The value of natural gas delivered to consumers was $5.19 billion.

Ohio has 3.29 million residential customers who consumed 285 Bcf in 2015. Average consumption was 87 Mcf per household. Residential demand was 70 percent for space heating, 21 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Ohio has 270,000 commercial customers who consumed 166 Bcf in 2015. Average consumption per commercial customer was 617 Mcf. Commercial demand was 73 percent for space heating, 12 percent for water heating, 3 percent for cooking, and 12 percent for other uses.

There are 6,502 industrial customers in Ohio who consumed 276 Bcf in 2015. Average consumption per industrial customer was 42 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Primary Metals (331), Transportation Equipment (336), Petroleum and Coal Products (324), and Non-metallic Mineral Products (327), representing 82 percent of industrial demand.

Ohio has 58 power plants consuming natural gas. Gas consumed was 210 Bcf, representing 23 percent of power generation in the state. Average consumption per customer was 3,629 MMcf.

Natural Gas Infrastructure

In 2015, Ohio had 28,172 producing oil wells and 26,599 producing gas wells. There were 24,066 miles of gas gathering lines and 6 gas processing plants in the state with a capacity of 2,125 MMcf/d. In addition, there were 9,796 miles of gas pipelines, 552 miles of crude oil pipelines, 1,254 miles of NGL pipelines, 2,684 miles of product pipelines, and no CO2 pipelines. There were 57,642 miles of gas distribution mains and 44,239 miles of service lines. There were 24 natural gas storage sites in the state with a working gas capacity of 231 Bcf.

Natural Gas and Oil Production

In 2015, Ohio produced 955 Bcf of dry natural gas, 36 million barrels of gas plant liquids, 21.1 million barrels of lease condensate, and 4.8 million barrels of crude. Ohio is the location of much of the Utica horizontal shale gas and liquids play, which also extends into Pennsylvania and West Virginia. While initial Utica efforts targeting the oil and wet gas windows, drilling has shifted to mostly gas and NGLs. Operator efforts have focused on bringing down well costs to better compete economically with the Marcellus play. Drilling activity in April, 2017 was 22 rigs, primarily directed toward the Utica wet gas play.

Exhibit 7-37: Ohio State Factsheet

Ohio			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	5,591	10,354	15,945	430	515	945	1,354	910	2,264
		Industrial	21,975	32,884	54,859	1,690	1,621	3,310	6,912	2,900	9,813
		Residential/ Commercial	10,079	10,997	21,076	677	570	1,247	2,882	994	3,875
		Export	2,670	2,271	4,941	193	115	308	213	202	415
		Transportation	25	18	43	1	1	2	4	2	6
	Infrastructure	Processing	4,122	4,453	8,576	280	212	492	641	406	1,047
		Pipelines	11,582	11,047	22,629	888	561	1,449	1,550	1,013	2,563
		Distribution	15,446	12,668	28,114	1,191	653	1,844	2,359	1,147	3,506
		Wholesalers, Marketers, Other	394	341	735	30	17	48	58	31	89
	Production	Natural Gas/ NGLs	16,978	14,593	31,571	1,327	692	2,019	1,825	1,300	3,126
	All Segments	Grand Total	88,863	99,626	188,489	6,708	4,956	11,664	17,797	8,906	26,703

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	9,922
	2	221210	Natural Gas Distribution	4,805
	3	237120	Oil & Gas Pipeline Construction	3,784
	4	213112	Support Activities for Oil & Gas Operations	2,018
	5	811310	Industrial Equip. & Machinery Repair & Maint.	1,979
	6	211111	Crude Petroleum & Natural Gas Extraction	1,925
	7	4841	Freight Truck	1,678
	8	331210	Iron & Steel Pipe & Tube Manufacturing	1,585
	9	333994	Industrial Process Furnace & Oven Manufacturing	1,185
	10	33241	Power Boiler & Heat Exchanger Manufacturing	1,136

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	3,294,010	285,306	$2,608
	Commercial Sector	269,981	166,602	$1,094
	Industrial Sector	6,502	276,004	$1,007
	Transportation	66	559	$4
	Power Sector	58	210,460	$480
	All Sectors	3,570,617	938,930	$5,193

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	57,642	44,239	24,066	9,796	552	1,254	2,684	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	955,358
	Gas Plant Liquids (barrels)	35,572,000
	Lease Condensate (barrels)	21,130,592
	Crude Oil (barrels)	4,770,408
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$3,353
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$3,536

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	28,172	426
	Gas Wells	26,599	148
	All Wells	54,771	574

Annual 2015 Data for Ohio Natural Gas Value Chain Basis

Oklahoma

Economic Impacts of Natural Gas

There were 117,700 jobs in the Oklahoma related to natural gas. These jobs represented 7.4 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, oil and gas extraction, and natural gas distribution. The contribution to the Oklahoma economy in terms of direct, indirect, and induced value added in 2015 was $16.7 billion, of which $4.68 billion was related to the end use segment, $5.78 billon was from the infrastructure segment, and $6.19 billion was from the production segment.

Natural Gas Consumers

In 2015, Oklahoma consumed 541 Bcf of natural gas in all sectors. There were a total of 1.04 million customers. The value of natural gas delivered to consumers was $2.32 billion.

Oklahoma has 941,100 residential customers who consumed 59 Bcf in 2015. Average consumption was 63 Mcf per household. Residential demand was 63 percent for space heating, 27 percent for water heating, 4 percent for cooking, and 6 percent for other uses.

Oklahoma has 96,500 commercial customers who consumed 42 Bcf in 2015. Average consumption per commercial customer was 435 Mcf. Commercial demand was 37 percent for space heating, 21 percent for water heating, 9 percent for cooking, and 33 percent for other uses.

There are 3,059 industrial customers who consumed 185 Bcf in 2015. Average consumption per customer was 60 MMcf in 2015. The top industries for gas consumption were Chemicals (NAICS code 325), Petroleum and Coal Products (324), Non-metallic mineral products (327), Food (311), and Primary Metals (331), representing 92 percent of industrial demand.

Oklahoma has 38 power plants consuming natural gas. In 2015, gas consumed was 255 Bcf, representing 45 percent of power generation in the state. Average consumption per customer was 6,702 MMcf.

Natural Gas Infrastructure

In 2015, Oklahoma had 93,610 producing oil wells and 49,852 producing gas wells. There were 48,138 miles of gas gathering lines and 75 gas processing plants in the state with a capacity of 6,568 MMcf/d. In addition, there were 11,843 miles of gas pipelines, 6,376 miles of crude oil pipelines, 4,955 miles of NGL pipelines, 2,166 miles of product pipelines, and 336 miles of CO2 pipelines. There were 26,352 miles of gas distribution mains and 7,645 miles of service lines. There were 13 natural gas storage sites in the state with a working gas capacity of 193 Bcf.

Natural Gas and Oil Production

In 2015, Oklahoma produced 2.34 Tcf of dry natural gas, 121 million barrels of gas plant liquids, 35 million barrels of lease condensate, and 123 million barrels of crude. Oklahoma has been a major focus of industry drilling since the early years of the horizontal drilling boom. The state has good existing upstream and midstream infrastructure. Significant plays include the Woodford gas play in the Arkoma Basin in southeast Oklahoma and the STACK, SCOOP and Granite Wash plays of the Anadarko Basin of western Oklahoma. The economics of liquids-

directed activity in the STACK and SCOOP plays are currently driving most of the drilling activity. Productive formations in this area include the Woodford and Mississippian carbonates. In April of 2017, approximately 125 rigs were active in the state, with most of the activity in western counties.

Exhibit 7-38: Oklahoma State Factsheet

Oklahoma			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	5,116	5,699	10,815	365	267	632	1,017	501	1,518
		Industrial	4,688	6,675	11,363	341	332	673	1,507	592	2,099
		Residential/ Commercial	2,638	2,710	5,348	187	146	333	670	245	915
		Export	1,070	684	1,754	73	33	106	80	61	141
		Transportation	23	12	36	1	1	1	4	1	5
	Infrastructure	Processing	3,598	2,338	5,936	284	116	401	904	214	1,118
		Pipelines	8,415	5,288	13,703	679	276	954	1,918	485	2,402
		Distribution	10,703	6,054	16,757	1,031	369	1,400	1,649	548	2,197
		Wholesalers, Marketers, Other	278	163	440	25	9	35	50	15	64
	Production	Natural Gas/ NGLs	36,813	14,722	51,535	3,491	757	4,249	4,880	1,312	6,192
	All Segments	Grand Total	73,342	44,345	117,687	6,477	2,307	8,784	12,678	3,973	16,652

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	11,082
	2	211111	Crude Petroleum & Natural Gas Extraction	10,161
	3	221210	Natural Gas Distribution	4,572
	4	237120	Oil & Gas Pipeline Construction	3,741
	5	33241	Power Boiler & Heat Exchanger Manufacturing	3,082
	6	213111	Drilling Oil & Gas Wells	2,412
	7	4841	Freight Truck	1,475
	8	486210	Pipeline Transportation of Natural Gas	1,345
	9	811310	Industrial Equip. & Machinery Repair & Maint.	1,223
	10	325	Chemical Manufacturing	890

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	941,137	59,387	$606
	Commercial Sector	96,471	41,977	$305
	Industrial Sector	3,059	184,627	$672
	Transportation	124	525	$5
	Power Sector	38	254,706	$734
	All Sectors	1,040,829	541,224	$2,322

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	26,352	7,645	48,138	11,843	6,376	4,955	2,166	336

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	2,336,234
	Gas Plant Liquids (barrels)	120,949,000
	Lease Condensate (barrels)	35,000,000
	Crude Oil (barrels)	122,770,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$9,865
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$15,385

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	93,610	1,713
	Gas Wells	49,852	318
	All Wells	143,462	2,032

Annual 2015 Data for Oklahoma Natural Gas Value Chain Basis

Oregon

Economic Impacts of Natural Gas

There were 46,100 jobs in Oregon related to natural gas. These jobs represented 2.6 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and industrial equipment and machinery repair and maintenance. The contribution to the Oregon economy in terms of direct, indirect, and induced value added in 2015 was $5.03 billion, of which $2.62 billion was related to the end use segment, $1.73 billon was from the infrastructure segment, and $0.68 billion was from the production segment.

Natural Gas Consumers

In 2015, Oregon consumed 232 Bcf of natural gas in all sectors. There were a total of 800,000 customers. The value of natural gas delivered to consumers was $1.25 billion.

Oregon has 718,000 residential customers who consumed 37 Bcf in 2015. Average consumption was 52 Mcf per household. Residential demand was 67 percent for space heating, 26 percent for water heating, 2 percent for cooking, and 5 percent for other uses.

Oregon has 81,000 commercial customers who consumed 26 Bcf in 2015. Average consumption per customer was 319 Mcf. Commercial demand was 34 percent for space heating, 22 percent for water heating, 8 percent for cooking, 2 percent for cogeneration, and 34 percent for other uses

There are 1,100 industrial customers in Oregon who consumed 55 Bcf in 2015. Average consumption per industrial customer was 49 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Food (311), Primary Metals (331), Non-metallic Mineral Products (327), and Wood Products (321), representing 79 percent of industrial demand.

Oregon has 21 power plants consuming natural gas. In 2015, gas consumed was 114 Bcf, representing 28 percent of power generation in the state. Average consumption per customer was 5,428 MMcf.

Natural Gas Infrastructure

In 2015, Oregon had no producing oil wells and 14 producing gas wells. There were 27 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 2,535 miles of gas pipelines, no crude oil or NGL pipelines, 415 miles of product pipelines, and no CO2 pipelines. There were 15,600 miles of gas distribution mains and 11,900 miles of service lines. There were 7 natural gas storage sites in the state with a working gas capacity of 16 Bcf.

Natural Gas and Oil Production

In 2015, Oregon produced 848 MMcf of dry natural gas, no plant liquids, no lease condensate, and no crude oil.

Exhibit 7-39: Oregon State Factsheet

Oregon			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,743	3,791	5,534	130	186	316	488	333	821
		Industrial	2,536	7,340	9,876	168	349	517	392	648	1,039
		Residential/ Commercial	2,074	3,198	5,272	143	168	311	335	289	624
		Export	732	802	1,534	52	40	93	57	72	129
		Transportation	8	7	15	0	0	1	1	1	2
	Infrastructure	Processing	754	1,335	2,089	54	66	120	60	122	181
		Pipelines	2,351	3,388	5,740	176	172	348	248	311	559
		Distribution	3,947	4,148	8,095	298	212	510	589	376	965
		Wholesalers, Marketers, Other	94	109	203	7	6	13	13	10	23
	Production	Natural Gas/ NGLs	3,081	4,678	7,758	242	229	471	266	417	683
	All Segments	Grand Total	17,320	28,797	46,116	1,271	1,428	2,699	2,450	2,577	5,026

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	1,070
	2	325	Chemical Manufacturing	385
	3	811310	Industrial Equip. & Machinery Repair & Maint.	382
	4	237120	Oil & Gas Pipeline Construction	322
	5	221112	Gas-fired Electric Power Generation	242
	6	45431NGL	NGL Retail	202
	7	236210	Industrial Construction	197
	8	33241	Power Boiler & Heat Exchanger Manufacturing	115
	9	811412	Household Appliance Repair & Maintenance	108
	10	333414	Heating Boilers & Fireplace Manufacturing	92

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	717,999	37,257	$461
	Commercial Sector	80,877	25,797	$257
	Industrial Sector	1,117	54,931	$223
	Transportation	18	184	$2
	Power Sector	21	113,988	$302
	All Sectors	800,032	232,158	$1,246

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	15,615	11,879	27	2,535	0	0	415	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	848
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$2
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$2

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	1
	Gas Wells	14	0
	All Wells	14	1

Annual 2015 Data for Oregon Natural Gas Value Chain Basis

Pennsylvania

Economic Impacts of Natural Gas

There were 178,100 jobs in Pennsylvania related to natural gas. These jobs represented 3.1 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, freight trucking, and crude petroleum and natural gas extraction. The contribution to the Pennsylvania economy in terms of direct, indirect, and induced value added in 2015 was $24.5 billion, of which $11.1 billion was related to the end use segment, $8.16 billon was from the infrastructure segment, and $5.21 billion was from the production segment.

Natural Gas Consumers

In 2015, Pennsylvania consumed 1.07 Tcf of natural gas in all sectors. There were a total of 2.98 million customers. The value of natural gas delivered to consumers was $5.65 billion.

Pennsylvania has 2.74 million residential customers who consumed 236 Bcf in 2015. Average consumption was 86 Mcf per household. Residential demand was 76 percent for space heating, 16 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

Pennsylvania had 242,000 commercial customers who consumed 152 Bcf in 2015. Average consumption per commercial customer was 629 Mcf. Commercial demand was 54 percent for space heating, 16 percent for water heating, 5 percent for cooking, and 25 percent for other uses.

There are 4,932 industrial customers of natural gas in Pennsylvania who consumed 241 Bcf in 2015. Average consumption per industrial customer was 49 MMcf. The top industries for gas consumption were Primary Metals (331), Chemicals (325), Petroleum and Coal Products (324), Paper (322), and Food (311) representing 72 percent of industrial demand.

Pennsylvania has 69 power plants consuming natural gas. In 2015, gas consumed was 439 Bcf, representing 28 percent of power generation in the state. Average consumption per customer was 6,366 MMcf.

Natural Gas Infrastructure

In 2015, Pennsylvania had 21,940 producing oil wells and 68,536 producing gas wells. There were 26,536 miles of gas gathering lines and 11 gas processing plants in the state with a capacity of 754 MMcf/d. In addition, there were 9,899 miles of gas pipelines, 24 miles of crude oil pipelines, 1,141 miles of NGL pipelines, 1,956 miles of product pipelines, and no CO2 pipelines. There were 47,954 miles of gas distribution mains and 28,711 miles of service lines. There were 49 natural gas storage sites in the state with a working gas capacity of 426 Bcf.

Natural Gas and Oil Production

In 2015, Pennsylvania produced 4.76 Tcf of dry natural gas, 24 million barrels of gas plant liquids, 4.9 million barrels of lease condensate, and 2.1 million barrels of crude. Pennsylvania is the location of most of the Appalachian Marcellus shale gas and NGL production, which has surged over the past decades and the Marcellus is by far the largest U.S. gas play. The Marcellus is characterized by prolific wells and excellent economics. The rapid growth of the play placed a strain on transport and processing capacity out of the region, but large midstream

investments for natural gas have been made and more are planned. A large effort has been underway to find domestic and export markets for large volumes of natural gas liquids such as ethane and propane. Several major gas pipelines have been reversed to allow transport out of the region. In April of 2017, about 33 rigs were active in the state.

Exhibit 7-40: Pennsylvania State Factsheet

Pennsylvania			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	6,026	10,366	16,392	452	509	961	2,517	911	3,429
		Industrial	11,172	21,497	32,669	809	1,042	1,850	3,146	1,898	5,044
		Residential/ Commercial	6,729	8,527	15,256	471	452	923	1,528	770	2,298
		Export	2,314	2,052	4,366	162	102	264	178	183	361
		Transportation	19	15	34	1	1	1	3	1	4
	Infrastructure	Processing	4,581	4,481	9,061	352	223	576	637	409	1,046
		Pipelines	13,144	11,429	24,573	1,041	590	1,630	2,533	1,048	3,581
		Distribution	13,459	11,503	24,962	1,097	613	1,711	2,392	1,042	3,435
		Wholesalers, Marketers, Other	378	325	702	30	17	48	69	30	99
	Production	Natural Gas/ NGLs	31,161	18,925	50,086	2,529	889	3,418	3,523	1,686	5,210
	All Segments	Grand Total	88,982	89,120	178,102	6,944	4,438	11,381	16,527	7,979	24,506

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	5,780
	2	4841	Freight Truck	4,945
	3	211111	Crude Petroleum & Natural Gas Extraction	4,526
	4	221210	Natural Gas Distribution	4,202
	5	237120	Oil & Gas Pipeline Construction	4,056
	6	325	Chemical Manufacturing	3,809
	7	331210	Iron & Steel Pipe & Tube Manufacturing	1,797
	8	811310	Industrial Equip. & Machinery Repair & Maint.	1,770
	9	486210	Pipeline Transportation of Natural Gas	1,504
	10	213111	Drilling Oil & Gas Wells	1,209

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	2,735,796	235,635	$2,529
	Commercial Sector	241,682	152,079	$1,171
	Industrial Sector	4,932	241,287	$884
	Transportation	73	439	$4
	Power Sector	69	439,248	$1,063
	All Sectors	2,982,552	1,068,687	$5,652

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	47,954	28,711	26,536	9,899	24	1,141	1,956	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	4,759,441
	Gas Plant Liquids (barrels)	23,501,000
	Lease Condensate (barrels)	4,869,408
	Crude Oil (barrels)	2,123,592
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$6,879
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$6,962

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	21,940	284
	Gas Wells	68,536	1,061
	All Wells	90,476	1,345

Annual 2015 Data for Pennsylvania Natural Gas Value Chain Basis

Rhode Island

Economic Impacts of Natural Gas

There were 7,400 jobs in the state related to natural gas. These jobs represented 1.6 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, industrial equipment and machinery repair and maintenance, and oil and gas pipeline construction. The contribution to the Rhode Island economy in terms of direct, indirect, and induced value added in 2015 was $1.04 billion, of which $0.62 billion was related to the end use segment, $0.35 billion was from the infrastructure segment, and $80 million was from the production segment.

Natural Gas Consumers

In 2015, Rhode Island consumed 91 Bcf of natural gas in all sectors. There were a total of 261,000 customers. The value of natural gas delivered to consumers was $615 million.

Rhode Island has 236,000 residential customers who consumed 20 Bcf in 2015. Average consumption was 85 Mcf per household. Residential demand was 69 percent for space heating, 22 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Rhode Island has 24,000 commercial customers who consumed 12 Bcf. Average consumption per commercial customer was 499 Mcf. Commercial demand was 53 percent for space heating, 7 percent for water heating, 3 percent for cooking, 5 percent for cogeneration, and 32 percent for other uses.

There are 260 industrial customers in Rhode Island who consumed 8.6 Bcf in 2015. Average consumption per industrial customer was 33 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Primary Metals (331), Food (311), Textile Mills (313), and Fabricated Metal Products (332), representing 72 percent of industrial demand.

Rhode Island has 8 power plants consuming natural gas. Gas consumed was 50 Bcf, representing 95 percent of power generation in the state. Average consumption per customer was 6,263 MMcf.

Natural Gas Infrastructure

Rhode Island had no production or producing wells and all natural gas consumed comes from other states. There were no gas gathering lines and no gas processing plants in the state. The state has 95 miles of gas pipelines, no crude oil or NGL pipelines, 13 miles of product pipelines, and no CO2 pipelines. There were 3,210 miles of gas distribution mains and 2,436 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-41: Rhode Island State Factsheet

Rhode Island			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	463	742	1,206	37	37	74	234	65	299
		Industrial	258	967	1,225	16	46	62	44	85	130
		Residential/ Commercial	444	563	1,007	29	29	57	112	51	162
		Export	64	103	166	5	5	10	5	9	14
		Transportation	5	3	8	0	0	0	1	0	1
	Infrastructure	Processing	65	171	236	5	9	13	5	16	21
		Pipelines	286	473	759	21	24	46	24	43	68
		Distribution	1,023	810	1,833	76	41	118	183	73	257
		Wholesalers, Marketers, Other	21	19	40	2	1	3	3	2	5
	Production	Natural Gas/ NGLs	278	633	911	22	31	53	24	56	80
	All Segments	Grand Total	2,906	4,485	7,391	212	224	436	636	401	1,038

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	432
	2	811310	Industrial Equip. & Machinery Repair & Maint.	141
	3	237120	Oil & Gas Pipeline Construction	120
	4	221112	Gas-fired Electric Power Generation	111
	5	236210	Industrial Construction	76
	6	45431NGL	NGL Retail	71
	7	811412	Household Appliance Repair & Maintenance	58
	8	333414	Heating Boilers & Fireplace Manufacturing	46
	9	333994	Industrial Process Furnace & Oven Manufacturing	26
	10	325	Chemical Manufacturing	20

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	236,323	20,042	$284
	Commercial Sector	24,088	12,016	$115
	Industrial Sector	260	8,624	$34
	Transportation	5	98	$1
	Power Sector	8	50,110	$181
	All Sectors	260,684	90,891	$615

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	3,210	2,436	0	95	0	0	13	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Rhode Island Natural Gas Value Chain Basis

South Carolina

Economic Impacts of Natural Gas

There were 58,800 jobs in South Carolina related to natural gas. These jobs represented 3.0 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, turbine and turbine generator manufacturing, and natural gas distribution. The contribution to the South Carolina economy in terms of direct, indirect, and induced value added in 2015 was $8.19 billion, of which $6.18 billion was related to the end use segment, $1.51 billon was from the infrastructure segment, and $0.50 billion was from the production segment.

Natural Gas Consumers

In 2015, South Carolina consumed 271 Bcf of natural gas in all sectors. There were a total of 679,000 customers. The value of natural gas delivered to consumers was $1.34 billion.

South Carolina has 621,000 residential customers who consumed 27 Bcf in 2015. Average consumption was 44 Mcf per household. Residential demand was 70 percent for space heating, 27 percent for water heating, 1 percent for cooking, and 2 percent for other uses.

South Carolina has 57,000 commercial customers who consumed 23 Bcf in 2015. Average consumption per commercial customer was 413 MMcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 1,400 industrial customers in South Carolina who consumed 84 Bcf in 2015. Average consumption per industrial customer was 59 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Paper (322), Primary Metals (331), Non-metallic Mineral Products (327), and Food (311), representing 77 percent of industrial demand.

South Carolina has 28 power plants consuming natural gas. Gas consumed was 135 Bcf, representing 17 percent of power generation in the state. Average consumption per customer was 4,830 MMcf.

Natural Gas Infrastructure

South Carolina had no oil and gas production or producing wells. There were no gas gathering lines and no gas processing plants in the state. In addition, there were 2,736 miles of gas pipelines, no crude oil pipelines, 227 miles of NGL pipelines, 585 miles of product pipelines, and no CO2 pipelines. There were 30,355 miles of gas distribution mains and 25,330 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-42: South Carolina State Factsheet

South Carolina			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,936	5,165	9,102	343	279	622	731	454	1,185
		Industrial	9,633	13,165	22,798	599	553	1,152	2,989	1,160	4,148
		Residential/ Commercial	2,192	2,829	5,021	165	156	321	417	256	673
		Export	1,109	815	1,924	93	45	138	103	73	175
		Transportation	2	2	3	0	0	0	0	0	0
	Infrastructure	Processing	1,063	1,293	2,356	77	62	140	87	118	204
		Pipelines	2,253	2,819	5,072	172	144	317	216	258	475
		Distribution	3,314	3,395	6,709	203	162	365	503	308	811
		Wholesalers, Marketers, Other	82	90	172	5	4	10	11	8	19
	Production	Natural Gas/ NGLs	2,187	3,503	5,689	171	172	342	188	312	500
	All Segments	Grand Total	25,771	33,075	58,846	1,829	1,577	3,406	5,245	2,947	8,191

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	5,160
	2	333611	Turbine and Turbine Generator Manufacturing	2,495
	3	221210	Natural Gas Distribution	813
	4	811310	Industrial Equip. & Machinery Repair & Maint.	677
	5	45431NGL	NGL Retail	575
	6	236210	Industrial Construction	493
	7	221112	Gas-fired Electric Power Generation	320
	8	237120	Oil & Gas Pipeline Construction	279
	9	333414	Heating Boilers & Fireplace Manufacturing	156
	10	4841	Freight Truck	134

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	620,555	27,417	$345
	Commercial Sector	56,871	23,494	$197
	Industrial Sector	1,438	84,405	$342
	Transportation	13	46	$0
	Power Sector	28	135,239	$451
	All Sectors	678,905	270,601	$1,335

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	20,799	16,168	0	2,736	0	227	585	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for South Carolina Natural Gas Value Chain Basis

South Dakota

Economic Impacts of Natural Gas

There were 6,500 jobs in South Dakota related to natural gas. These jobs represented 1.6 percent of total state jobs. The top three sectors with the greatest number of jobs were industrial equipment and machinery repair and maintenance, natural gas distribution, and NGL retail. The contribution to the South Dakota economy in terms of direct, indirect, and induced value added in 2015 was $726 million, of which $363 million was related to the end use segment, $278 million was from the infrastructure segment, and $87 million was from the production segment.

Natural Gas Consumers

In 2015, South Dakota consumed 73 Bcf of natural gas in all sectors. There were a total of 207,000 customers. The value of natural gas delivered to consumers was $348 million.

South Dakota has 183,000 residential customers who consumed 12 Bcf in 2015. Average consumption was 64 Mcf per household. Residential demand was 70 percent for space heating, 23 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

South Dakota has 24,000 commercial customers who consumed 10 Bcf in 2015. Average consumption per commercial customer was 434 Mcf. Commercial demand was 74 percent for space heating, 14 percent for water heating, 4 percent for cooking, and 8 percent for other uses.

There are 578 industrial customers in South Dakota who consumed 44 Bcf in 2015. Average consumption per customer was 76 MMcf. The top industries for gas consumption were Food (NAICS Code 331), Chemicals (325), Machinery (333), Fabricated Metal Products (332), and Agriculture (11), representing 75 percent of industrial demand.

South Dakota has 8 power plants consuming natural gas. In 2015, gas consumed was 69 Bcf, representing 8 percent of power generation in the state. Average consumption per customer was 885 MMcf.

Natural Gas Infrastructure

In 2015, South Dakota had 165 producing oil wells and 124 producing gas wells. There were 183 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 1,560 miles of gas pipelines, 220 miles of crude oil pipelines, no NGL pipelines, 523 miles of product pipelines, and no CO2 pipelines. There were 5,645 miles of gas distribution mains and 3,635 miles of service lines. There are no natural gas storage sites in the state.

Natural Gas and Oil Production

In 2015, South Dakota produced 15 Bcf of dry natural gas, no plant liquids, no lease condensate, and 1.7 million barrels of crude.

Exhibit 7-43: South Dakota State Factsheet

South Dakota			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	305	572	877	23	28	51	35	50	85
		Industrial	355	966	1,320	24	47	71	49	85	135
		Residential/ Commercial	357	481	839	22	24	46	85	43	129
		Export	64	95	159	5	5	9	5	8	14
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	106	195	301	7	9	16	7	18	25
		Pipelines	326	461	787	24	23	47	44	42	86
		Distribution	664	638	1,302	43	31	73	105	58	163
		Wholesalers, Marketers, Other	15	16	31	1	1	2	2	1	4
	Production	Natural Gas/ NGLs	327	600	927	27	30	57	33	53	87
	All Segments	Grand Total	2,519	4,025	6,544	174	197	371	366	361	726

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	811310	Industrial Equip. & Machinery Repair & Maint.	208
	2	221210	Natural Gas Distribution	181
	3	45431NGL	NGL Retail	118
	4	237120	Oil & Gas Pipeline Construction	110
	5	236210	Industrial Construction	98
	6	221112	Gas-fired Electric Power Generation	45
	7	811412	Household Appliance Repair & Maintenance	34
	8	4841	Freight Truck	29
	9	335221	Household Ovens Manufacturing	28
	10	326122	Plastics Pipe & Fittings manufacturing	26

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	182,568	11,751	$97
	Commercial Sector	24,040	10,434	$66
	Industrial Sector	578	44,094	$163
	Transportation	1	0	$0
	Power Sector	8	7,083	$22
	All Sectors	207,195	73,362	$348

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	5,645	3,635	183	1,556	220	0	523	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	14,511
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	1,666,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$34
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$106

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	165	2
	Gas Wells	124	0
	All Wells	289	2

Annual 2015 Data for South Dakota Natural Gas Value Chain Basis

Tennessee

Economic Impacts of Natural Gas

There were 86,700 jobs in Tennessee related to natural gas. These jobs represented 3.1 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, natural gas distribution, and other major household appliance manufacturing. The contribution to the Tennessee economy in terms of direct, indirect, and induced value added in 2015 was $12.94 billion, of which $9.52 billion was related to the end use segment, $2.62 billon was from the infrastructure segment, and $0.80 billion was from the production segment.

Natural Gas Consumers

In 2015, Tennessee consumed 305 Bcf of natural gas in all sectors. There were a total of 1.26 million customers. The value of natural gas delivered to consumers was $1.74 billion.

Tennessee has 1.12 million residential customers who consumed 67 Bcf in 2015. Average consumption was 60 Mcf per household. Residential demand was 72 percent for space heating, 24 percent for water heating, 2 percent for cooking, and 2 percent for other uses.

Tennessee has 132,000 commercial customers who consumed 53 Bcf in 2015. Average consumption per commercial customer was 401 Mcf. Commercial demand was 49 percent for space heating, 28 percent for water heating, 9 percent for cooking, 2 percent for cogeneration, and 12 percent for other uses.

There are 2,700 industrial customers in Tennessee who consumed 115 Bcf in 2015. Average consumption per customer was 43 MMcf. The top industries for gas consumption were Non-metallic Mineral Products (NAICS Code 327), Chemicals (325), Primary Metals (331), Food (311), and Transportation Equipment (336), representing 77 percent of industrial demand.

Tennessee has 17 power plants consuming natural gas. Gas consumed was 69 Bcf, representing 12 percent of power generation in the state. Average consumption per customer was 4,107 MMcf.

Natural Gas Infrastructure

In 2015, Tennessee had 250 producing oil wells and 1,089 producing gas wells. There were 861 miles of gas gathering lines and 1 gas processing plant in the state with a capacity of 25 MMcf/d. In addition, there were 4,900 miles of gas pipelines, 277 miles of crude oil pipelines, 14 miles of NGL pipelines, 864 miles of product pipelines, and 0 miles of CO2 pipelines. There were 39,050 miles of gas distribution mains and 26,113 miles of service lines. There were 2 natural gas storage sites in the state with a working gas capacity of 1.8 Bcf.

Natural Gas and Oil Production

In 2015, Tennessee produced 4 Bcf of dry natural gas, 0.3 million barrels of plant liquids, no lease condensate, and 0.3 million barrels of crude.

Exhibit 7-44: Tennessee State Factsheet

Tennessee			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	2,825	5,149	7,975	208	251	459	494	453	946
		Industrial	9,897	15,418	25,316	811	786	1,597	3,155	1,359	4,514
		Residential/ Commercial	10,063	8,706	18,769	609	418	1,028	3,113	787	3,899
		Export	952	981	1,933	67	49	116	74	87	161
		Transportation	11	10	21	1	0	1	2	1	3
	Infrastructure	Processing	1,078	1,695	2,773	75	82	157	84	154	238
		Pipelines	3,992	4,574	8,566	292	228	520	568	419	988
		Distribution	6,180	5,705	11,885	344	255	600	847	517	1,364
		Wholesalers, Marketers, Other	151	149	300	9	7	16	21	14	34
	Production	Natural Gas/ NGLs	3,665	5,536	9,201	275	268	543	304	493	797
	All Segments	Grand Total	38,815	47,923	86,738	2,691	2,346	5,036	8,660	4,284	12,944

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	4,835
	2	221210	Natural Gas Distribution	1,629
	3	335228	Other Major Household Appliance Manufacturing	1,498
	4	335221	Household Ovens Manufacturing	1,072
	5	45431NGL	NGL Retail	939
	6	33241	Power Boiler & Heat Exchanger Manufacturing	930
	7	811310	Industrial Equip. & Machinery Repair & Maint.	831
	8	237120	Oil & Gas Pipeline Construction	787
	9	236210	Industrial Construction	509
	10	486210	Pipeline Transportation of Natural Gas	478

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,124,572	67,301	$645
	Commercial Sector	132,392	53,041	$439
	Industrial Sector	2,651	114,673	$464
	Transportation	25	246	$2
	Power Sector	17	69,830	$190
	All Sectors	1,259,657	305,092	$1,740

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	39,050	26,113	861	4,882	277	14	864	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	3,937
	Gas Plant Liquids (barrels)	252,000
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	296,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$15
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$28

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	250	21
	Gas Wells	1,089	3
	All Wells	1,339	25

Annual 2015 Data for Tennessee Natural Gas Value Chain Basis

Texas

Economic Impacts of Natural Gas

There were 784,900 jobs in Texas related to natural gas. These jobs represented 6.8 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, oil and gas extraction, and oil and gas pipeline construction. The contribution to the Texas economy in terms of direct, indirect, and induced value added in 2015 was $114.0 billion, of which $41.5 billion was related to the end use segment, $33.6 billon was from the infrastructure segment, and $39.0 billion was from the production segment.

Natural Gas Consumers

In 2015, Texas consumed 3.64 Tcf of natural gas in all sectors. There were a total of 4.85 million customers. The value of natural gas delivered to consumers was $13.4 billion.

Texas has 4.52 million residential customers who consumed 211 Bcf in 2015. Average consumption was 47 Mcf per household. Residential demand was 42 percent for space heating, 41 percent for water heating, 7 percent for cooking, 1 percent for space cooling, and 9 percent for other uses.

Texas has 319,500 commercial customers who consumed 178 Bcf in 2015. Average consumption per commercial customer was 556 Mcf. Commercial demand was 36 percent for space heating, 20 percent for water heating, 9 percent for cooking, 3 percent for cogeneration and 32 percent for other uses.

There are 6,655 industrial customers in Texas who consumed 1.60 Tcf in 2015. Average consumption per industrial customer was 240 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Petroleum and Coal Products (324), Non-metallic mineral products (327), Primary Metals (331), and Food (311), representing 89 percent of industrial demand.

Texas has 185 power plants consuming natural gas. In 2015, gas consumed was 1.65 Tcf, representing 53 percent of power generation in the state. Average consumption per customer was 8,900 MMcf.

Natural Gas Infrastructure.

In 2015, Texas had 188,417 producing oil wells and 142,717 producing gas wells. There were 133,136 miles of gas gathering lines and 178 gas processing plants in the state with a capacity of 23,437 MMcf/d. In addition, there were 44,034 miles of gas pipelines, 21,737 miles of crude oil pipelines, 30,301 miles of NGL pipelines, 9,775 miles of product pipelines, and 1,808 miles of CO2 pipelines. There were 106,234 miles of gas distribution mains and 45,459 miles of service lines. There were 36 natural gas storage sites in the state with a working gas capacity of 546 Bcf.

Natural Gas and Oil Production

In 2015, Texas produced 7.33 Tcf of dry natural gas, 572 million barrels of gas plant liquids, 181 million barrels of lease condensate, and 1.16 billion barrels of crude. Texas continues to be a major contributor to U.S. oil and gas production. The state has been the location of a large

fraction of horizontal shale gas and tight oil development. The Permian Basin of West Texas and Southeastern New Mexico has some of the best well recoveries and economics for tight oil of any basin in the U.S. and is experiencing a large amount of activity. Horizontal oil and gas plays in the state include the Fort Worth Barnett Shale, the Eagle Ford, Permian Midland Basin tight oil and Permian Delaware Basin tight oil. Other plays include the Texas portion of Haynesville shale gas and the Austin Chalk play. The Panhandle region has the Granite Wash and similar gas plays. In April of 2017, approximately 415 rigs were active in Texas. The majority of rig activity is in the Permian Basin.

Exhibit 7-45: Texas State Factsheet

Texas			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	17,871	28,571	46,442	1,397	1,434	2,831	6,261	2,512	8,773
		Industrial	55,666	81,276	136,942	5,580	4,803	10,383	18,410	7,169	25,579
		Residential/ Commercial	11,750	18,200	29,950	788	942	1,730	2,246	1,644	3,890
		Export	17,825	9,649	27,474	1,318	494	1,812	2,305	860	3,165
		Transportation	207	162	369	10	9	14	33	18	51
	Infrastructure	Processing	20,584	16,686	37,270	2,160	1,023	3,183	5,887	1,522	7,409
		Pipelines	64,389	43,686	108,074	6,136	2,547	8,683	13,789	4,006	17,795
		Distribution	35,866	30,164	66,030	3,135	1,691	4,831	5,284	2,730	8,014
		Wholesalers, Marketers, Other	1,333	1,004	2,337	122	57	180	244	91	336
	Production	Natural Gas/ NGLs	229,721	100,310	330,031	23,737	5,522	29,259	30,077	8,939	39,015
	All Segments	Grand Total	455,212	329,708	784,920	44,384	18,522	62,906	84,538	29,491	114,028

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	59,296
	2	211111	Crude Petroleum & Natural Gas Extraction	40,278
	3	237120	Oil & Gas Pipeline Construction	26,722
	4	325	Chemical Manufacturing	25,932
	5	333132	Oil & Gas Field Machinery & Equipment Manufacturing	21,845
	6	213111	Drilling Oil & Gas Wells	17,661
	7	486210	Pipeline Transportation of Natural Gas	10,014
	8	4841	Freight Truck	9,795
	9	236210	Industrial Construction	9,551
	10	811310	Industrial Equip. & Machinery Repair & Maint.	8,912

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	4,523,977	211,370	$2,235
	Commercial Sector	319,512	177,594	$1,220
	Industrial Sector	6,655	1,599,279	$5,303
	Transportation	143	4,645	$35
	Power Sector	185	1,646,330	$4,593
	All Sectors	4,850,472	3,639,217	$13,388

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	106,234	45,459	133,136	44,034	21,737	30,301	9,775	1,808

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	7,326,087
	Gas Plant Liquids (barrels)	572,423,000
	Lease Condensate (barrels)	181,000,000
	Crude Oil (barrels)	1,160,000,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$37,251
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$89,393

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	188,417	7,931
	Gas Wells	142,717	1,978
	All Wells	331,134	9,909

Annual 2015 Data for Texas Natural Gas Value Chain Basis

Utah

Economic Impacts of Natural Gas

There were 29,400 jobs in Utah related to natural gas. These jobs represented 2.2 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas operations, crude petroleum and natural gas extraction, and natural gas distribution. The contribution to the Utah economy in terms of direct, indirect, and induced value added in 2015 was $3.66 billion, of which $1.29 billion was related to the end use segment, $1.45 billion was from the infrastructure segment, and $918 million was from the production segment.

Natural Gas Consumers

In 2015, Utah consumed 187 Bcf of natural gas in all sectors. There were a total of 958,000 customers. The value of natural gas delivered to consumers was $1.15 billion.

Utah has 892,000 residential customers who consumed 59 Bcf. Average consumption was 66 Mcf per household. Residential demand was 68 percent for space heating, 27 percent for water heating, 2 percent for cooking, and 3 percent for other uses.

Utah has 66,000 commercial customers who consumed 36 Bcf in 2015. Average consumption per commercial customer was 541 Mcf. Commercial demand was 54 percent for space heating, 17 percent for water heating, 12 percent for cooking, 3 percent for cogeneration, and 14 percent for other uses.

There are 320 industrial customers in Utah who consumed 37 Bcf in 2015. Average consumption per customer was 116 MMcf. The top industries for gas consumption were Petroleum and Coal Products (NAICS Code 324), Chemicals (325), Food (311), Primary Metals (331), Food (311), and Mining (21), representing 77 percent of industrial demand.

Utah has 25 power plants consuming natural gas. Gas consumed was 56 Bcf, representing 20 percent of power generation in the state. Average consumption per customer was 2,232 MMcf.

Natural Gas Infrastructure

In 2015, Utah had 4,810 producing oil wells and 8,739 producing gas wells. There were 5,440 miles of gas gathering lines and 13 gas processing plants in the state with a capacity of 2,017 MMcf/d. In addition, there were 3,130 miles of gas pipelines, 598 miles of crude oil pipelines, 605 miles of NGL pipelines, 719 miles of product pipelines, and 74 miles of CO2 pipelines. There were 17,500 miles of gas distribution mains and 9,800 miles of service lines. There were 3 natural gas storage sites in the state with a working gas capacity of 55 Bcf.

Natural Gas and Oil Production

In 2015, Utah produced 408 Bcf of dry natural gas, 11 million barrels of plant liquids, 2 million barrels of lease condensate, and 35 million barrels of crude.

Exhibit 7-46: Utah State Factsheet

Utah			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	848	1,784	2,632	64	88	153	202	157	359
		Industrial	931	3,137	4,068	62	151	212	143	277	419
		Residential/ Commercial	1,303	1,697	3,000	84	86	171	300	153	454
		Export	274	346	621	19	17	36	21	31	52
		Transportation	13	11	23	1	1	1	2	1	3
	Infrastructure	Processing	599	792	1,391	47	42	89	219	72	291
		Pipelines	2,033	2,022	4,055	146	100	246	370	185	555
		Distribution	2,495	2,250	4,745	176	114	290	387	204	591
		Wholesalers, Marketers, Other	65	61	127	5	3	8	11	6	16
	Production	Natural Gas/ NGLs	5,254	3,483	8,737	428	165	593	608	310	918
	All Segments	Grand Total	13,815	15,583	29,398	1,033	766	1,799	2,262	1,396	3,659

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	1,378
	2	211111	Crude Petroleum & Natural Gas Extraction	1,015
	3	221210	Natural Gas Distribution	692
	4	237120	Oil & Gas Pipeline Construction	685
	5	811310	Industrial Equip. & Machinery Repair & Maint.	364
	6	4841	Freight Truck	327
	7	486210	Pipeline Transportation of Natural Gas	212
	8	213111	Drilling Oil & Gas Wells	211
	9	4247NGL	NGL Wholesale	198
	10	811412	Household Appliance Repair & Maintenance	169

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	891,917	58,562	$567
	Commercial Sector	66,143	35,772	$275
	Industrial Sector	320	37,189	$141
	Transportation	91	286	$2
	Power Sector	25	55,797	$163
	All Sectors	958,496	187,605	$1,148

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	17,492	9,839	5,442	3,127	598	605	719	74

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	408,002
	Gas Plant Liquids (barrels)	10,998,000
	Lease Condensate (barrels)	2,000,000
	Crude Oil (barrels)	34,987,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$1,298
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$2,721

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	4,810	283
	Gas Wells	8,739	40
	All Wells	13,549	323

Annual 2015 Data for Utah Natural Gas Value Chain Basis

Vermont

Economic Impacts of Natural Gas

There were 4,000 jobs in Vermont related to natural gas. These jobs represented 1.3 percent of total state jobs. The top three sectors with the greatest number of jobs were NGL retail, natural gas distribution, and heating boilers and fireplace manufacturing. The contribution to the Vermont economy in terms of direct, indirect, and induced value added in 2015 was $478 million, of which $193 million was related to the end use segment, $238 million was from the infrastructure segment, and $46 million was from the production segment.

Natural Gas Consumers

In 2015, Vermont consumed 12 Bcf of natural gas. There were a total of 49,000 customers. The value of natural gas delivered to consumers was $114 million.

Vermont has 43,000 residential customers who consumed 3.8 Bcf in 2015. Average consumption was 89 Mcf per household. Residential demand was 69 percent for space heating, 22 percent for water heating, 4 percent for cooking, and 5 percent for other uses.

Vermont has 5,700 commercial customers who consumed 6 Bcf in 2015. Average consumption per customer was 1.0 MMcf. Commercial demand was 55 percent for space heating, 8 percent for water heating, 3 percent for cooking, and 34 percent for other uses.

There are 14 industrial customers in Vermont who consumed 2.0 Bcf in 2015. Average consumption per customer was 146 MMcf. The top industries for gas consumption were Agriculture (NAICS Code 11), Food (311), Chemicals (325), Mining (21), and Non-metallic Mineral Products (327), representing 74 percent of industrial demand.

Vermont has 2 power plants consuming natural gas. In 2015, gas consumed was 19 Bcf, representing 0.1 percent of power generation in the state. Average consumption per customer was 10 MMcf.

Natural Gas Infrastructure

Vermont has no production or producing wells and all gas consumed comes from other states. There were no gas gathering lines and no gas processing plants in the state. In addition, there were 74 miles of gas pipelines, 117 miles of crude oil pipelines, no NGL pipelines, no product pipelines, and no CO2 pipelines. There were 3,210 miles of gas distribution mains and 2,436 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-47: Vermont State Factsheet

Vermont			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	70	250	320	5	12	17	6	22	28
		Industrial	101	505	606	7	25	32	13	45	57
		Residential/ Commercial	277	334	610	19	17	36	70	30	100
		Export	38	58	97	3	3	6	3	5	8
		Transportation	0	0	0	0	0	0	0	0	0
	Infrastructure	Processing	42	100	142	3	5	8	3	9	12
		Pipelines	160	265	426	12	13	25	14	24	38
		Distribution	681	549	1,230	46	28	73	135	50	184
		Wholesalers, Marketers, Other	13	12	26	1	1	2	2	1	4
	Production	Natural Gas/ NGLs	166	359	524	13	18	31	14	32	46
	All Segments	Grand Total	1,549	2,432	3,981	107	122	229	260	218	478

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	45431NGL	NGL Retail	256
	2	221210	Natural Gas Distribution	171
	3	333414	Heating Boilers & Fireplace Manufacturing	69
	4	237120	Oil & Gas Pipeline Construction	57
	5	811310	Industrial Equip. & Machinery Repair & Maint.	29
	6	4247NGL	NGL Wholesale	19
	7	811412	Household Appliance Repair & Maintenance	11
	8			
	9			
	10			

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	43,267	3,833	$56
	Commercial Sector	5,696	5,918	$47
	Industrial Sector	14	2,040	$11
	Transportation	3	3	$0
	Power Sector	2	19	$0
	All Sectors	48,982	11,814	$114

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	789	631	0	74	117	0	0	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Vermont Natural Gas Value Chain Basis

Virginia

Economic Impacts of Natural Gas

There were 73,200 jobs in Virginia related to natural gas. These jobs represented 2.0 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, oil and gas pipeline construction, and natural gas distribution. The contribution to the Virginia economy in terms of direct, indirect, and induced value added in 2015 was $9.72 billion, of which $6.12 billion was related to the end use segment, $2.63 billion was from the infrastructure segment, and $975 million was from the production segment.

Natural Gas Consumers

In 2015, Virginia consumed 485 Bcf of natural gas in all sectors. There were a total of 1.30 million customers. The value of natural gas delivered to consumers was $2.63 billion.

Virginia has 1.19 million residential customers who consumed 85 Bcf in 2015. Average consumption was 72 Mcf per household. Residential demand was 60 percent for space heating, 28 percent for water heating, 5 percent for cooking, 1 percent for clothes drying, and 6 percent for other uses.

Virginia has 100,000 commercial customers who consumed 69 Bcf in 2015. Average consumption per customer was 694 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 1,100 industrial customers in Virginia who consumed 87 Bcf in 2015. Average consumption per customer was 78 MMcf. The top industries for gas consumption were Chemicals (NAICS Code 325), Paper (322), Non-metallic Mineral Products (327), Primary Metals (331), and Food (311), representing 82 percent of industrial demand.

Virginia has 38 power plants consuming natural gas. In 2015, gas consumed was 243 Bcf, representing 39 percent of power generation in the state. Average consumption per customer was 6,397 MMcf.

Natural Gas Infrastructure

In 2015, Virginia had no oil wells and 8,111 producing gas wells. There were 2,780 miles of gas gathering lines and no gas processing plants in the state. In addition, there were 3,155 miles of gas pipelines, no crude oil pipelines, no NGL pipelines, 1,135 miles of product pipelines, and no CO2 pipelines. There were 21,300 miles of gas distribution mains and 19,100 miles of service lines. There were 2 natural gas storage sites in the state with a working gas capacity of 5.4 Bcf.

Natural Gas and Oil Production

In 2015, Virginia produced 128 Bcf of dry natural gas, no plant liquids, no lease condensate, and 11 million barrels of crude.

Exhibit 7-48: Virginia State Factsheet

Virginia			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	3,719	6,256	9,975	289	313	603	1,280	550	1,830
		Industrial	6,618	12,920	19,538	487	624	1,111	1,980	1,139	3,119
		Residential/ Commercial	2,795	4,268	7,063	186	220	407	625	386	1,011
		Export	830	1,011	1,841	59	51	110	65	90	155
		Transportation	10	10	21	0	1	1	2	1	3
	Infrastructure	Processing	989	1,756	2,745	66	85	151	72	160	232
		Pipelines	4,408	5,105	9,513	296	247	543	536	468	1,004
		Distribution	5,318	5,617	10,935	391	286	677	848	509	1,357
		Wholesalers, Marketers, Other	140	153	294	10	8	18	21	14	34
	Production	Natural Gas/ NGLs	4,807	6,450	11,257	333	306	639	400	575	975
	All Segments	Grand Total	29,636	43,548	73,183	2,119	2,139	4,258	5,829	3,892	9,721

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	3,002
	2	237120	Oil & Gas Pipeline Construction	1,665
	3	221210	Natural Gas Distribution	1,401
	4	4841	Freight Truck	1,050
	5	811310	Industrial Equip. & Machinery Repair & Maint.	978
	6	33241	Power Boiler & Heat Exchanger Manufacturing	931
	7	45431NGL	NGL Retail	643
	8	221112	Gas-fired Electric Power Generation	592
	9	236210	Industrial Construction	587
	10	486210	Pipeline Transportation of Natural Gas	306

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,194,338	85,464	$968
	Commercial Sector	99,643	69,107	$514
	Industrial Sector	1,118	86,817	$326
	Transportation	20	231	$2
	Power Sector	38	243,116	$817
	All Sectors	1,295,157	484,734	$2,627

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	21,298	19,077	2,782	3,155	0	0	1,135	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	127,584
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	11,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$302
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$303

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	3	0
	Gas Wells	8,111	109
	All Wells	8,114	109

Annual 2015 Data for Virginia Natural Gas Value Chain Basis

Washington State

Economic Impacts of Natural Gas

There were 64,400 jobs in Washington related to natural gas. These jobs represented 2.1 percent of total state jobs. The top three sectors with the greatest number of jobs were natural gas distribution, chemical manufacturing, and oil and gas pipeline construction. The contribution to the Washington economy in terms of direct, indirect, and induced value added in 2015 was $7.52 billion, of which $4.08 billion was related to the end use segment, $2.55 billion was from the infrastructure segment, and $807 million was from the production segment.

Natural Gas Consumers

In 2015, Washington State consumed 296 Bcf of natural gas in all sectors. There were a total of 1.24 million customers. The value of natural gas delivered to consumers was $1.93 billion.

Washington has 1.13 million residential customers who consumed 72 Bcf in 2015. Average consumption was 63 Mcf per household. Residential demand was 67 percent for space heating, 26 percent for water heating, 2 percent for cooking, and 5 percent for other uses.

Washington has 102,000 commercial customers who consumed 50 Bcf. Average consumption per commercial customer was 489 Mcf. Commercial demand was 34 percent for space heating, 23 percent for water heating, 8 percent for cooking, and 35 percent for other uses.

There are 3,400 industrial customers in Washington who consumed 77 Bcf in 2015. Average consumption per customer was 23 MMcf. The top industries for gas consumption were Paper (NAICS Code 322), Petroleum and Coal Products (324), Food (311), Chemicals (325), and Transportation Equipment (336), representing 76 percent of industrial demand.

Washington has 23 power plants consuming natural gas. Gas consumed was 97 Bcf, representing 12 percent of power generation in the state. Average consumption per customer was 4,230 MMcf.

Natural Gas Infrastructure

Washington has no oil or gas production or producing wells. There were no gas gathering lines and no gas processing plants in the state. The state has 1,962 miles of gas pipelines, 69 miles of crude oil pipelines, 5 miles of NGL pipelines, 732 miles of product pipelines, and no CO2 pipelines. There were 3,210 miles of gas distribution mains and 2,436 miles of service lines. There was 1 natural gas storage site in the state with a working gas capacity of 25 Bcf.

Exhibit 7-49: Washington State Factsheet

Washington			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	1,895	4,979	6,874	140	245	385	345	438	782
		Industrial	3,446	10,505	13,951	226	499	725	642	927	1,569
		Residential/ Commercial	4,066	5,351	9,417	262	272	533	1,071	483	1,555
		Export	836	1,088	1,924	60	55	115	66	97	163
		Transportation	24	26	50	1	1	2	4	2	6
	Infrastructure	Processing	1,369	2,265	3,635	111	117	228	280	206	486
		Pipelines	2,988	4,751	7,738	227	243	470	268	436	703
		Distribution	4,730	5,665	10,395	372	296	668	816	513	1,329
		Wholesalers, Marketers, Other	115	150	265	9	8	17	17	14	31
	Production	Natural Gas/ NGLs	3,616	6,543	10,159	285	322	607	314	583	897
	All Segments	Grand Total	23,086	41,323	64,408	1,692	2,058	3,750	3,822	3,699	7,521

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	221210	Natural Gas Distribution	1,032
	2	325	Chemical Manufacturing	778
	3	237120	Oil & Gas Pipeline Construction	683
	4	811310	Industrial Equip. & Machinery Repair & Maint.	551
	5	45431NGL	NGL Retail	416
	6	236210	Industrial Construction	261
	7	4841	Freight Truck	258
	8	335228	Other Major Household Appliance Manufacturing	250
	9	221112	Gas-fired Electric Power Generation	230
	10	333414	Heating Boilers & Fireplace Manufacturing	223

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,133,629	71,952	$846
	Commercial Sector	102,266	49,967	$467
	Industrial Sector	3,385	76,600	$302
	Transportation	29	538	$6
	Power Sector	23	97,300	$305
	All Sectors	1,239,332	296,358	$1,925

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	22,704	22,167	0	1,962	69	5	732	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Washington Natural Gas Value Chain Basis

West Virginia

Economic Impacts of Natural Gas

There were 35,800 jobs in West Virginia related to natural gas. These jobs represented 5.2 percent of total state jobs. The top three sectors with the greatest number of jobs were crude petroleum and natural gas extraction, chemical manufacturing, and oil and gas pipeline construction. The contribution to the West Virginia economy in terms of direct, indirect, and induced value added in 2015 was $5.80 billion, of which $2.13 billion was related to the end use segment, $1.81 billon was from the infrastructure segment, and $1.86 billion was from the production segment.

Natural Gas Consumers

In 2015, West Virginia consumed 87 Bcf of natural gas in all sectors. There were a total of 372,000 customers. The value of natural gas delivered to consumers was $570 million.

West Virginia has 338,000 residential customers who consumed 25 Bcf in 2015. Average consumption 73 Mcf per household. Residential demand was 72 percent for space heating, 20 percent for water heating, 3 percent for cooking, and 5 percent for other uses.

West Virginia has 34,000 commercial customers who consumed 23 Bcf in 2015. Average consumption per commercial customer was 656 Mcf. Commercial demand was 42 percent for space heating, 26 percent for water heating, 11 percent for cooking, and 21 percent for other uses.

There are 101 industrial customers who consumed 26 Bcf in 2015. Average consumption per industrial customer was 256 MMcf. The top industries for gas consumption were Mining (NAICS Code 21), Primary Metals (331), Chemicals (325), Agriculture (11), and Non-metallic Mineral Products (327), representing 95 percent of industrial demand.

West Virginia has 10 power plants consuming natural gas. In 2015, gas consumed was 13 Bcf, representing 2 percent of power generation in the state. Average consumption per customer was 1,328 MMcf.

Natural Gas Infrastructure

In 2015, West Virginia had 3,903 producing oil wells and 47,938 producing gas wells. There were 22,825 miles of gas gathering lines and 16 gas processing plants in the state with a capacity of 4,077 MMcf/d. In addition, there were 3,520 miles of gas pipelines, 5 miles of crude oil pipelines, 411 miles of NGL pipelines, 40 miles of product pipelines, and 0 miles of CO2 pipelines. There were 10,850 miles of gas distribution mains and 2,288 miles of service lines. There were 31 natural gas storage sites in the state with a working gas capacity of 259 Bcf.

Natural Gas and Oil Production

In 2015, West Virginia produced 1.24 Tcf of dry natural gas, 82 million barrels of gas plant liquids, 10 million barrels of lease condensate, and 2 million barrels of crude. West Virginia contains a large percentage of the Marcellus gas play area, and Marcellus production in the state has increased substantially in recent years. Efforts are underway to increase gas midstream infrastructure including gas transportation capacity.

Exhibit 7-50: West Virginia State Factsheet

West Virginia			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	340	789	1,129	25	39	64	49	69	119
		Industrial	3,877	4,887	8,764	320	249	569	1,357	430	1,787
		Residential/ Commercial	566	769	1,335	38	40	78	131	69	200
		Export	116	158	274	8	8	16	9	14	23
		Transportation	0	0	1	0	0	0	0	0	0
	Infrastructure	Processing	948	654	1,602	75	33	108	398	60	458
		Pipelines	3,117	2,023	5,140	264	110	374	634	186	820
		Distribution	2,491	1,670	4,161	179	84	263	363	151	514
		Wholesalers, Marketers, Other	77	51	129	6	3	9	13	5	18
	Production	Natural Gas/ NGLs	9,248	3,992	13,240	904	210	1,114	1,508	356	1,864
	All Segments	Grand Total	20,780	14,994	35,774	1,819	776	2,595	4,463	1,340	5,803

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	211111	Crude Petroleum & Natural Gas Extraction	3,082
	2	325	Chemical Manufacturing	2,302
	3	237120	Oil & Gas Pipeline Construction	1,948
	4	213112	Support Activities for Oil & Gas Operations	1,724
	5	221210	Natural Gas Distribution	703
	6	4841	Freight Truck	657
	7	213111	Drilling Oil & Gas Wells	654
	8	811310	Industrial Equip. & Machinery Repair & Maint.	392
	9	236210	Industrial Construction	235
	10	4247NGL	NGL Wholesale	160

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	337,643	24,807	$259
	Commercial Sector	34,448	22,598	$180
	Industrial Sector	101	25,901	$92
	Transportation	4	10	$0
	Power Sector	10	13,277	$39
	All Sectors	372,206	86,593	$570

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	10,850	2,288	22,825	3,520	5	411	40	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1,241,283
	Gas Plant Liquids (barrels)	82,021,000
	Lease Condensate (barrels)	10,000,000
	Crude Oil (barrels)	1,970,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$5,021
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$5,087

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	3,903	183
	Gas Wells	47,938	223
	All Wells	51,841	407

Annual 2015 Data for West Virginia Natural Gas Value Chain Basis

Wisconsin

Economic Impacts of Natural Gas

There were 74,400 jobs in Wisconsin related to natural gas. These jobs represented 2.7 percent of total state jobs. The top three sectors with the greatest number of jobs were chemical manufacturing, power boiler and heat exchanger manufacturing, and industrial equipment and machinery repair and maintenance. The contribution to the Wisconsin economy in terms of direct, indirect and induced value added in 2015 was $9.10 billion, of which $5.75 billion was related to the end-use segment, $2.46 billion was from the infrastructure segment, and $894 million was from the production segment.

Natural Gas Consumers

In 2015, Wisconsin consumed 455 Bcf of natural gas in all sectors. There were a total of 1.90 million customers. The value of natural gas delivered to consumers was $2.55 billion.

Wisconsin has 1.72 million residential customers who consumed 127 Bcf in 2015. Average consumption was 74 Mcf per household. Residential demand was 71 percent for space heating, 22 percent for water heating, 3 percent for cooking, and 4 percent for other uses.

Wisconsin has 169,000 commercial customers who consumed 90 Bcf in 2015. Average consumption per commercial customer was 532 Mcf. Commercial demand was 73 percent for space heating, 12 percent for water heating, 4 percent for cooking, and 11 percent for other uses.

There are 7,300 industrial customers of natural gas in Wisconsin who consumed 137 Bcf in 2015. Average consumption per industrial customer was 19 MMcf. The top industries for gas consumption were Paper (NAICS Code 322), Chemicals (325), Food (311), Primary Metals (331), and Fabricated Metal Products (332), representing 80 percent of the state's industrial demand.

Wisconsin has 65 power plants consuming natural gas. In 2015 gas consumed was 101 Bcf, representing 20 percent of power generation in the state. Average consumption per customer was 1,557 MMcf.

Natural Gas Infrastructure

Wisconsin has no producing oil or gas wells, gas gathering lines or gas processing plants as all natural gas consumed in the state comes from other states. The state has 4,536 miles of gas pipelines, 1,181 miles of crude oil pipelines, 238 miles of NGL pipelines, 1,113 miles of product pipelines, and no CO2 pipelines. There were 3,210 miles of gas distribution mains and 2,436 miles of service lines. There are no natural gas storage sites in the state.

Exhibit 7-51: Wisconsin State Factsheet

Wisconsin			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
Summary	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
	End-Use	Power Generation	3,385	5,755	9,140	235	272	507	518	506	1,024
		Industrial	6,800	12,448	19,248	421	558	979	1,785	1,099	2,884
		Residential/ Commercial	4,817	5,406	10,224	319	278	597	1,176	488	1,665
		Export	1,110	1,067	2,177	76	53	128	83	95	178
		Transportation	6	7	13	0	0	1	1	1	2
	Infrastructure	Processing	2,085	2,600	4,685	123	110	233	135	236	372
		Pipelines	3,648	4,535	8,183	274	229	503	347	416	763
		Distribution	4,864	5,314	10,179	338	267	606	810	482	1,292
		Wholesalers, Marketers, Other	124	142	266	9	7	16	18	13	31
	Production	Natural Gas/ NGLs	4,364	5,965	10,329	329	288	617	362	532	894
	All Segments	Grand Total	31,205	43,239	74,444	2,123	2,063	4,186	5,236	3,868	9,104

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	325	Chemical Manufacturing	2,250
	2	33241	Power Boiler & Heat Exchanger Manufacturing	1,020
	3	811310	Industrial Equip. & Machinery Repair & Maint.	995
	4	45431NGL	NGL Retail	822
	5	237120	Oil & Gas Pipeline Construction	798
	6	221210	Natural Gas Distribution	739
	7	4841	Freight Truck	683
	8	236210	Industrial Construction	487
	9	212322frac	Frac Sand Mining	427
	10	331210	Iron & Steel Pipe & Tube Manufacturing	423

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	1,721,640	126,854	$1,079
	Commercial Sector	169,271	90,175	$609
	Industrial Sector	7,280	136,709	$541
	Transportation	59	148	$1
	Power Sector	65	101,211	$319
	All Sectors	1,898,315	455,096	$2,549

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	39,274	29,812	0	4,536	1,181	238	1,113	0

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	0
	Gas Plant Liquids (barrels)	0
	Lease Condensate (barrels)	0
	Crude Oil (barrels)	0
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$0
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$0

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	0	0
	Gas Wells	0	0
	All Wells	0	0

Annual 2015 Data for Wisconsin Natural Gas Value Chain Basis

Wyoming

Economic Impacts of Natural Gas

There were 29,500 jobs in Wyoming related to natural gas. These jobs represented 10.5 percent of total state jobs. The top three sectors with the greatest number of jobs were support activities for oil and gas, crude petroleum and natural gas extraction, and oil and gas pipeline construction. The contribution to the Wyoming economy in terms of direct, indirect, and induced value added in 2015 was $4.6 billion, of which $0.26 billion was related to the end use segment, $2.03 billon was from the infrastructure segment, and $2.33 billion was from the production segment.

Natural Gas Consumers

In 2015, Wyoming consumed 72 Bcf of natural gas in all sectors. There were a total of 181,000 customers. The value of natural gas delivered to consumers was $375 million.

Wyoming has 160,000 residential customers who consumed 12 Bcf in 2015. Average consumption was 72 Mcf per household. Residential demand was 68 percent for space heating, 27 percent for water heating, 2 percent for cooking, and 3 percent for other uses.

Wyoming has 21,000 commercial customers who consumed 13 Bcf in 2015. Average consumption per commercial customer was 621 Mcf. Commercial demand was 55 percent for space heating, 17 percent for water heating, 13 percent for cooking, and 15 percent for other uses.

There are 99 industrial customers of natural gas in Wyoming in who consumed 48 Bcf in 2015. Average consumption per industrial customer was 481 MMcf. The top industries for gas consumption were Petroleum and Coal Products (NAICS Code 324), Chemicals (325), Mining (21), Fabricated Metal Products (332), and Food (311), representing 97 percent of industrial demand.

Wyoming has 19 power plants consuming natural gas. In 2015, gas consumed was 0.7 Bcf, representing 2 percent of power generation in the state. Average consumption per customer was 37 MMcf.

Natural Gas Infrastructure

In 2015, Wyoming had 9,951 producing oil wells and 25,279 producing gas wells. There were 19,702 miles of gas gathering lines and 35 gas processing plants in the state with a capacity of 7,560 MMcf/d. In addition, there were 6,943 miles of gas pipelines, 4,160 miles of crude oil pipelines, 1,568 miles of NGL pipelines, 1,379 miles of product pipelines, and 658 miles of CO2 pipelines. There were 5,259 miles of gas distribution mains and 1,982 miles of service lines. There were 9 natural gas storage sites in the state with a working gas capacity of 74 Bcf.

Natural Gas and Oil Production

In 2015, Wyoming produced 1.75 Tcf of dry natural gas, 36 million barrels of gas plant liquids, 14 million barrels of lease condensate, and 72 million barrels of crude. In recent years, horizontal oil drilling activity has been concentrated in the Powder River basin in southeastern Wyoming, although activity to date has been just a fraction of that in Colorado. In April of 2017, Wyoming had 18 active rigs.

Exhibit 7-52: Wyoming State Factsheet

Wyoming			Employment (# of Workers)			Labor Income ($ million)			Value Added ($ million)		
	Segment	Category	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total	Direct & Indirect	Induced	Total
Summary	End-Use	Power Generation	92	290	381	7	14	21	21	25	47
		Industrial	300	699	999	20	35	55	42	62	104
		Residential/ Commercial	262	341	604	17	18	35	73	31	103
		Export	32	61	92	2	3	5	2	5	8
		Transportation	1	1	2	0	0	0	0	0	0
	Infrastructure	Processing	1,463	853	2,316	108	40	148	473	78	551
		Pipelines	4,161	2,230	6,392	312	110	422	1,002	205	1,206
		Distribution	1,342	859	2,201	86	40	127	176	78	254
		Wholesalers, Marketers, Other	69	40	109	5	2	7	14	4	18
	Production	Natural Gas/ NGLs	11,921	4,469	16,390	1,202	244	1,445	1,932	398	2,331
	All Segments	Grand Total	19,643	9,843	29,486	1,761	506	2,266	3,736	886	4,622

Jobs by Top Industries	Rank	NAICS	Industry Sector	Direct and Indirect Jobs
	1	213112	Support Activities for Oil & Gas Operations	3,872
	2	211111	Crude Petroleum & Natural Gas Extraction	3,560
	3	237120	Oil & Gas Pipeline Construction	2,163
	4	213111	Drilling Oil & Gas Wells	785
	5	486210	Pipeline Transportation of Natural Gas	608
	6	811310	Industrial Equip. & Machinery Repair & Maint.	323
	7	211112	Natural Gas Liquid Extraction	318
	8	221210	Natural Gas Distribution	222
	9	4841	Freight Truck	129
	10	45431NGL	NGL Retail	127

Customers	Sector	Customer Count	Consumption Volume (MMcf/ year)	Value of Natural Gas Delivered to Customers ($million)
	Residential Sector	159,925	11,576	$107
	Commercial Sector	20,816	12,937	$91
	Industrial Sector	99	47,667	$174
	Transportation	14	29	$0
	Power Sector	19	706	$3
	All Sectors	180,873	72,916	$375

Infrastructure	Gas Distribution Main (miles)	Gas Distribution Services (miles)	Gas Gathering (miles)	Gas Pipelines (miles)	Crude Oil Pipelines (miles)	NGL Pipelines (miles)	Oil Product Pipelines (miles)	CO2 Pipelines (miles)
	5,259	1,982	19,702	6,943	4,160	1,568	1,379	658

Production	Product	Annual Production
	Dry Natural Gas (mmcf)	1,745,165
	Gas Plant Liquids (barrels)	35,632,000
	Lease Condensate (barrels)	14,000,000
	Crude Oil (barrels)	72,499,000
	Annual Value Counted Toward Natural Gas Value Chain ($million)	$5,674
	Annual Value of All Produced Oil, Gas, NGLs ($million)	$8,620

Wells	Well Type	Operating Wells	New Wells Drilled
	Oil Wells	9,951	710
	Gas Wells	25,279	59
	All Wells	35,230	770

Annual 2015 Data for Wyoming Natural Gas Value Chain Basis

8. Appendix B: Fuel vs. Fuel Comparison: Jobs Supported by Electricity Generation Alternatives

This section presents estimates for how many U.S. jobs are supported by different kinds of electricity generation. One set of calculations relates to the planning, construction and operation of new utility-scale power plants and a second set looks at the continued operation of existing power plants. The estimates of supported jobs should be understood to be approximations given that there are a wide variety of power plant designs, performance characteristics and costs. Also, there is a range of possible procurement practices in terms of how much the materials and equipment used in plant construction and plant operation and maintenance (O&M) is domestically sourced *versus* imported. Assumptions of low capital and O&M costs combined with a large fraction of imported goods lead to fewer domestic jobs, while assumptions of higher costs and more domestic sourcing lead to larger U.S. job estimates.

The data shown here for expenditures and supported jobs reflect national averages for the following generation types:

- New Wind Power Plants
- New Solar Power Plants (2 variations based on source of photovoltaic modules)
- New Natural Gas Combined Cycle (NGCC) Power Plants
- New Coal Power Plants (with 30% carbon sequestration)
- New Nuclear Power Plants
- Existing NGCC Power Plants
- Existing Coal-fired Power Plants
- Existing Nuclear Power Plants

The characteristics and cost for the new units are shown below in Exhibit 8-1. These parameters are taken from the national average assumptions used to prepare the EIA AEO forecasts.[53] The assumption of a useful life of 30 years is used to spread the capital cost and associated jobs over a certain number of MWh.

Exhibit 8-1: New Power Plant Characteristics and Costs Used for Job Estimates

Variable	Units	Coal-fired with 30% Carbon Capture	Advanced Gas-fired Combined Cycle	Advanced Nuclear	Onshore Wind Turbine	Solar Photovoltaic (Imported Modules)	Solar Photovoltaic (Domestic Modules)
Size	MW	650	429	2,234	100	150	150
Capacity Utilization	%	85.0%	87.0%	90.0%	39.0%	24.0%	24.0%
Useful Life	Years	30	30	30	30	30	30
Lead Time	Years	4.0	3.0	6.0	3.0	2.0	2.0
Heat Rate	Btu/kWh	9,750	6,300	10,449	9,541	9,541	9,541
Capital Costs	$/kW	$5,098	$1,080	$6,108	$1,644	$2,480	$2,552
Variable O&M	$/MWh	$6.95	$1.96	$2.25	$0.00	$0.00	$0.00
Fixed O&M	$/kW/year	$68.49	$9.78	$98.11	$45.98	$21.33	$21.33

[53] Assumptions to AEO2016, January 2017 at https://www.eia.gov/outlooks/aeo/assumptions/.

The characteristics and cost for the existing units are shown below in Exhibit 8-2. There are no capital costs associated with these plants since they have already been built. The heat rates for these plants are the 2015 average heat rates estimated by EIA and the fixed and variable O&M costs are adjusted from those applying to new plants to better match actual O&M costs reported by EIA.

Exhibit 8-2: Existing Power Plant Characteristics and Costs Used for Job Estimates

Variable	Units	Existing Coal	Existing Gas-fired Combined Cycle	Existing Nuclear
Size	**MW**	500	400	1,000
Capacity Utilization	**%**	54.6%	56.3%	92.3%
Useful Life	**Years**	N/A	N/A	N/A
Lead Time	**Years**	N/A	N/A	N/A
Heat Rate	**Btu/kWh**	10,059	7,655	10,449
Capital Costs	**$/kW**	N/A	N/A	N/A
Variable O&M	**$/MWh**	$3.48	$2.51	$2.86
Fixed O&M	**$/kW/year**	$34.25	$12.52	$124.60

Note: Useful life, lead times and capital cost are not applicable to the job calculations for existing plants. Capacity utilization, heat rates and O&M costs are actual data for 2015 derived from EIA data.

The methodology for estimating jobs for new and existing power plants is the same as the job estimates presented throughout this report. The process begins by estimating the physical units and costs of materials and energy going into and out of the process (here the process is a power plant) and the capital and non-fuel operating costs for the process. Then those physical unit and expenditure values are multiplied by an input/out matrix to determine the labor units (job-years) and other economic impact measures associated with that activity. The job-years reported here are for direct and indirect activities which include the direct purchase of materials, equipment and services plus all the activities that take place in the U.S. to produce those materials, equipment, and services.

The results of this methodology for the new power plants are shown in the next several exhibits starting with a new combined cycled natural gas power plant in Exhibit 8-3. There are four rows of cost data: capital expenditures (or CAPEX), variable O&M expenditures, fixed O&M expenditures and finally expenditures on fuels. The fuel costs are from the AEO 2016 Reference Case for plants starting operation circa 2022. There also is a subtotal for operating expenditures (that is, everything other than capital expenditures) and a total for all expenditures.

The first column of data is expenditures over the useful life of the power plant, which is assumed to be 30 years for the purpose of the calculations. The second column of data is expenditures in $/MW, which is computed as the first column divided by the MW capacity of the plant. The third column of data is expenditures in $/MWh, which is the first column divided by the megawatt-hours that will be produced at the plant over the 30 year useful life. The gas-fired advanced combined cycle power plant, total expenditures would be $4.3 billion over 30 years or $43.56/MWh. This $/MWh value for expenditures is simply the expenditures divided by the megawatt-hours and does not take into account the time value of money (neither during the

construction period or during the operating period) or income taxes that would be paid by the plant owner.[54]

Exhibit 8-3: New 429 MW Gas-fired Power Plant: Expenditure and Job Estimates

	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$463,320,000	$1,080,000	$4.72	3,577	8.3	36
Variable O&M	$192,246,294	$448,127	$1.96	1,822	4.2	19
Fixed O&M	$125,868,600	$293,400	$1.28	1,193	2.8	12
Fuel	$3,491,330,022	$8,138,298	$35.60	21,189	49.4	216
Subtotal Operating Costs	$3,809,444,916	$8,879,825	$38.84	24,204	56.4	247
Total All Costs	**$4,272,764,916**	**$9,959,825**	**$43.56**	**27,781**	**64.8**	**283**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

The fourth to sixth columns of data in Exhibit 8-3 are the estimated direct and indirect jobs reported in units of job-years (one employee working one year). The fourth column is total job-years over 30 years of operations and the fifth column is the fourth column dived by the MW capacity. The sixth column is job-years divided by the megawatt-hours times one million. The total job-years for the gas-fired combined cycle plant add up to 27,781 over 30 years or 283 job-years per million MWh. Because gas-fired combined cycle plants have relatively low capital cost and non-fuel O&M costs, only 13% of the jobs are related to the plant itself while some 87% of the jobs are associated with natural gas fuel supply (production, gathering, processing, transmission, storage, distribution and marketing).

The results for the 100 MW onshore wind turbine facility are shown in Exhibit 8-4. Such a facility could be made up of 40 turbines each with 2.5 MW capacity. Note that wind turbines have no variable O&M costs and no fuel costs. (The same will be true for the two solar photovoltaic examples to be shown in the next two exhibits.) The job-years associated with the wind turbines are less than half of those of the natural gas plants on a per-MW of capacity basis (25.1 *versus* 64.8 for natural gas) but are closer on a per-million-MWh basis (245 *versus* 283 for natural gas) due to the much lower capacity utilization rates for the wind turbines (39% *versus* 87% for natural gas). For these calculations it is assumed that nearly all of the wind turbine components (tower, rotor blades, rotor hub, rotor bearings, main shaft, main frame, gear box, power converter, transformer, positioning and brake systems, and nacelle housing) are manufactured in the U.S. with the exception of the generator. Taking into account imported finished goods, intermediate goods (parts used to assemble the components) and imported machinery used in the manufacturing processes, the average domestic content for the wind capital expenditures is about 83%. The corresponding value for capital expenditures on natural gas and coal fossil plants is about 88% domestic content.

[54] The expenditures per MWh would be the same as the levelized cost of electricity (LCOE) only if the LCOE were to be computed assuming zero cost of capital and zero income tax.

Exhibit 8-4: New 100 MW Wind Power Plant: Expenditure and Job Estimates

	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$164,400,000	$1,644,000	$16.04	1,199	12.0	117
Variable O&M	$0	$0	$0.00	-	-	-
Fixed O&M	$137,940,000	$1,379,400	$13.46	1,308	13.1	128
Fuel	$0	$0	$0.00	-	-	-
Subtotal Operating Costs	$137,940,000	$1,379,400	$13.46	1,308	13.1	128
Total All Costs	**$302,340,000**	**$3,023,400**	**$29.50**	**2,507**	**25.1**	**245**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

The two solar photovoltaic examples are shown in Exhibit 8-5 and Exhibit 8-6. The two cases are identical except that in the first case it is assumed that the photovoltaic modules are imported from China while in the second case they are assumed to be made in the U.S. The imported photovoltaic modules represent $715/kW out of the $2,480/kW total capital costs for the first case. The cost for the domestic modules used in the second case is $72/kW or 10% higher and so the total capital cost is $2,552/kW. The total domestic content in the capital expenditures for these two solar examples is 69% with imported modules and 88% with U.S. manufactured modules. The number of U.S. jobs related to both capital and operating expenditures is 272 job-years per million MWh for the case with imported modules and 349 job-years when the modules are manufactured in the U.S.

Exhibit 8-5: New 150 MW Solar Power Plant: Expenditure and Job Estimates (imported photovoltaic modules)

	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$372,000,000	$2,480,000	$39.32	1,660	11.1	175
Variable O&M	$0	$0	$0.00	-	-	-
Fixed O&M	$95,985,000	$639,900	$10.15	910	6.1	96
Fuel	$0	$0	$0.00	-	-	-
Subtotal Operating Costs	$95,985,000	$639,900	$10.15	910	6.1	96
Total All Costs	**$467,985,000**	**$3,119,900**	**$49.47**	**2,570**	**17.1**	**272**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

Exhibit 8-6: New 150 MW Solar Power Plant: Expenditure and Job Estimates (U.S. manufactured photovoltaic modules)

	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$382,752,122	$2,551,681	$40.46	2,390	15.9	253
Variable O&M	$0	$0	$0.00	-	-	-
Fixed O&M	$95,985,000	$639,900	$10.15	910	6.1	96
Fuel	$0	$0	$0.00	-	-	-
Subtotal Operating Costs	$95,985,000	$639,900	$10.15	910	6.1	96
Total All Costs	**$478,737,122**	**$3,191,581**	**$50.60**	**3,300**	**22.0**	**349**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

The cases for new coal-fired and nuclear power plants are shown in Exhibit 8-7 and Exhibit 8-8 respectively. These types of power plant are characterized by high capital cost per unit of capacity and so the job counts for the capital components are much higher than for the natural gas and renewable plants. There are 484 job-years for the coal plant per million MWh and 400 job-years for nuclear. The nuclear plant has more job-years than coal for capital expenditures but fewer job-years related to fuel.

Exhibit 8-7: New 650 MW Coal-fired Plant: Expenditure and Job Estimates

	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$3,313,700,000	$5,098,000	$22.82	25,579	39.4	176
Variable O&M	$1,009,119,150	$1,552,491	$6.95	9,566	14.7	66
Fixed O&M	$1,335,555,000	$2,054,700	$9.20	12,660	19.5	87
Fuel	$4,014,697,050	$6,176,457	$27.65	22,442	34.5	155
Subtotal Operating Costs	$6,359,371,200	$9,783,648	$43.80	44,668	68.7	308
Total All Costs	**$9,673,071,200**	**$14,881,648**	**$66.62**	**70,247**	**108.1**	**484**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

Exhibit 8-8: New 2,234 MW Advanced Nuclear Power Plant: Expenditure and Job Estimates

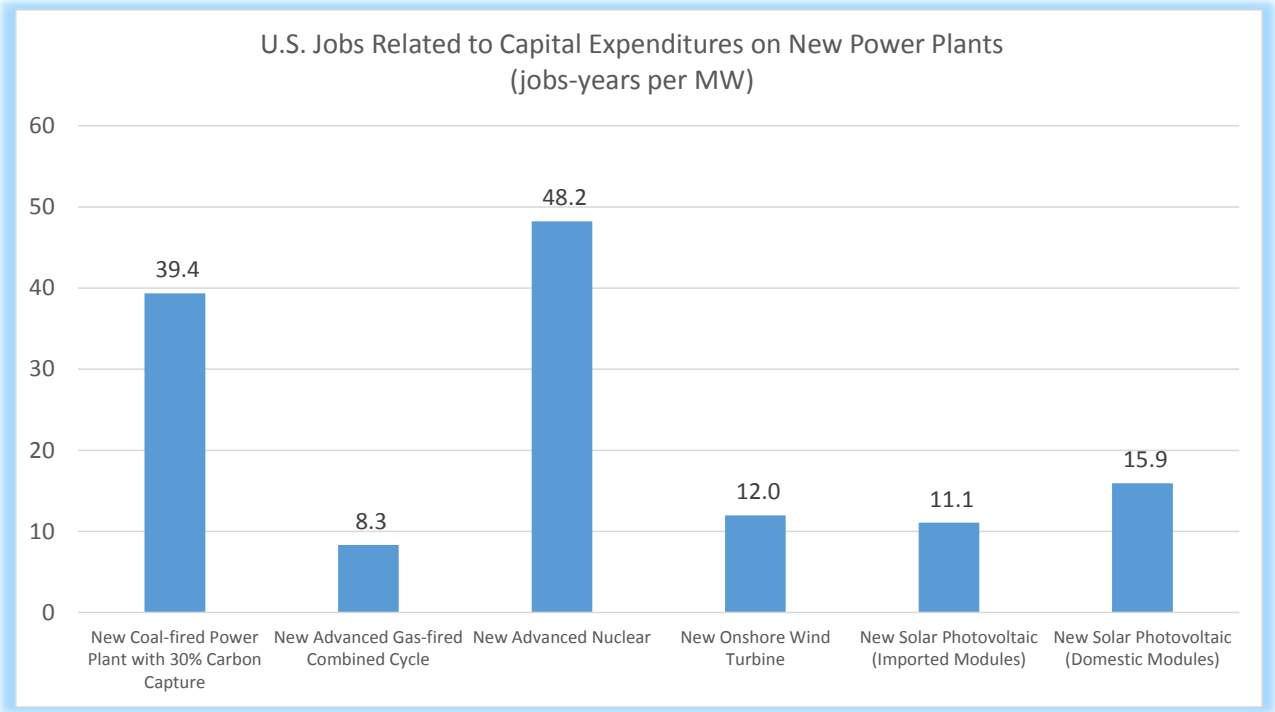
	Expenditures over Useful Life			U.S. Direct & Indirect Jobs		
	$/Plant	$/MW	$/MWh	Job-years/ plant	Job-years/ MW	Job-years/ million MWh
Capital Costs	$13,645,272,000	$6,108,000	$25.82	107,726	48.2	204
Variable O&M	$1,188,867,780	$532,170	$2.25	11,269	5.0	21
Fixed O&M	$6,575,332,200	$2,943,300	$12.44	62,329	27.9	118
Fuel	$4,993,244,676	$2,235,114	$9.45	29,959	13.4	57
Subtotal Operating Costs	$12,757,444,656	$5,710,584	$24.14	103,558	46.4	196
Total All Costs	**$26,402,716,656**	**$11,818,584**	**$49.97**	**211,283**	**94.6**	**400**

Note: Capital costs are overnight costs. They exclude time value of money during construction and return on capital and taxes during operating period. Expenditures in $/MWh is not the same as LCOE, which includes time value of money and taxes. Excludes expenditures and jobs related to electricity transmission and distribution.

A graphic comparison among the electricity generation options in terms of direct and indirect job-years related to the capital investment is shown in Exhibit 8-9. These are job-years that exist during the planning and construction phase of the power plants (the period of time shown as “lead time” in Exhibit 8-1). These include construction jobs, equipment manufacturing jobs, jobs related to producing materials, transportation jobs to move materials and equipment to the manufacturing plants and ultimately to the construction site, and various kinds of service jobs (engineering, legal, environmental assessment and permitting, etc.) related to planning and construction.

The highest number of jobs related to capital expenditures is for nuclear plants at 48.2 job-years/MW followed by coal at 39.4 job-years/MW. The solar plant cases have 11.1 to 15.9 job-years per MW, wind has 12.0 job-years per MW and natural gas has 8.3 job-years per MW. The relative number of CAPEX-related job-years per MW among the generating technologies is mostly a function of the capital cost per unit of capacity and the domestic content of that spending. Nuclear and coal plants have very high capital cost per unit of capacity and so have a large number of CAPEX-related jobs. Natural gas has low capital costs relative to the other technologies and, therefore, has the lowest CAPEX-related job count.

Exhibit 8-9: Capital Investment Jobs for New Power Plants (job-years during planning/ construction period only)



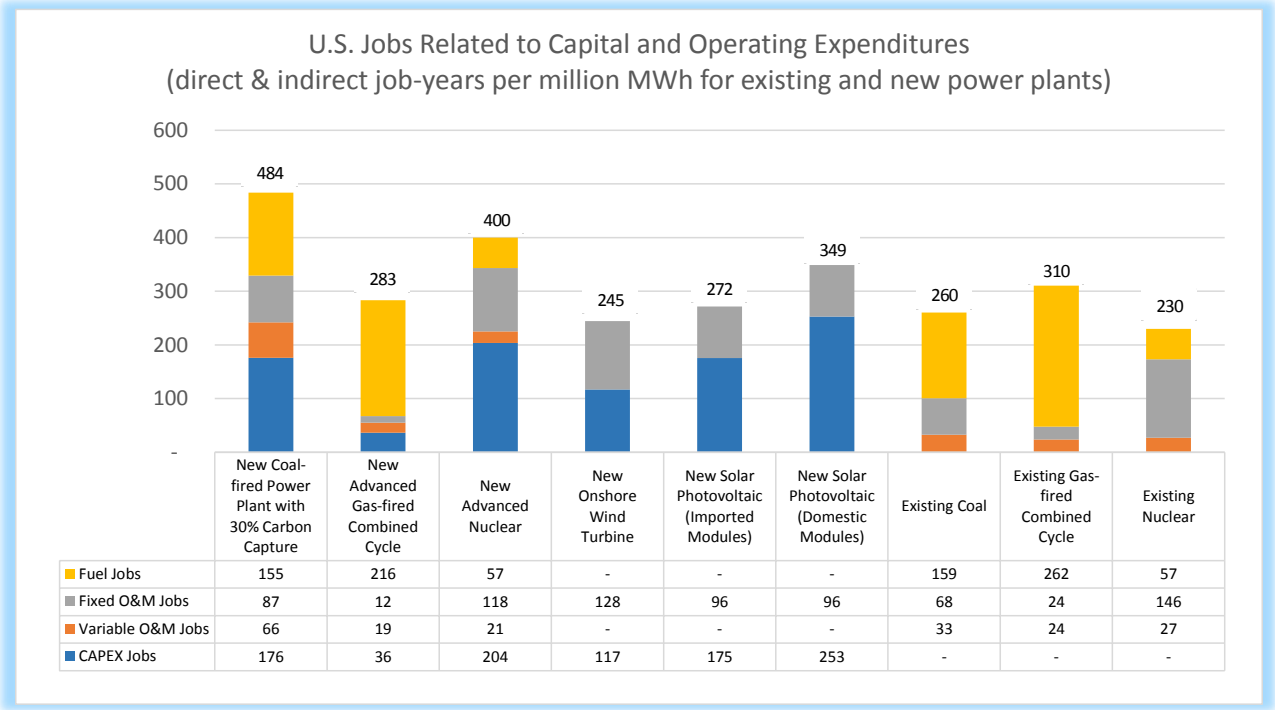
The comparison of job-years among the generation technologies over the life of the plants is shown in Exhibit 8-10 in units of job-years per million MWh. The bars are divided into job-years for CAPEX, variable O&M, fixed O&M and fuel supplies. For comparison purposes, the chart also shows similar data for the three cases of existing power plants using coal, natural gas and nuclear power. The existing plants have no jobs related to CAPEX since they have been built already.

The two most economic technologies for new power plants according to the EIA cost data are natural gas combined cycle and onshore wind. Natural gas combined cycle has 283 job-years per million MWh and wind has 245. The other generating technologies of solar, coal and nuclear are less economic for new power plants. This means that expenditures per unit of production are higher and so are the job counts over the life of the plants. The job-years for existing plants shown in Exhibit 8-10 are generally lower than those for new plants using the same fuel because the component for capital expenditures is zero. However, because the existing plants tend to have higher heat rates, the jobs related to fuel supply are usually higher.

These job calculations are based on EIA's national average capital and O&M costs and assume a single average capacity utilization rate for each type of plant. Given the variations among regional construction costs and regional capacity factors for renewables we might expect job-years per million MWh to range from 150% to 80% of the value for wind shown in Exhibit 8-10 going from the lowest-quality one-third to the best one-third of sites. The range for solar would be from 120% to 85% of the average. In other words, the lowest-quality renewable energy sites that might be developed in the next 30 years would generate electricity at higher costs and

would have more jobs associated with each unit of production while the best sites would have lower costs and fewer jobs per unit of production.

Exhibit 8-10: Capital Investment & Operating Jobs for New and Existing Power Plants (jobs-years over both planning/construction and operating periods)



	New Coal-fired Power Plant with 30% Carbon Capture	New Advanced Gas-fired Combined Cycle	New Advanced Nuclear	New Onshore Wind Turbine	New Solar Photovoltaic (Imported Modules)	New Solar Photovoltaic (Domestic Modules)	Existing Coal	Existing Gas-fired Combined Cycle	Existing Nuclear
Fuel Jobs	155	216	57	-	-	-	159	262	57
Fixed O&M Jobs	87	12	118	128	96	96	68	24	146
Variable O&M Jobs	66	19	21	-	-	-	33	24	27
CAPEX Jobs	176	36	204	117	175	253	-	-	-

9. Appendix C: Consumer Savings from Incremental Natural Gas Resources

The potential role that can be played by incremental natural gas resources in reducing consumers' energy costs is illustrated in this Appendix through comparisons between the results of the AEO 2016 Reference Case to those of the AEO 2016 High and Gas Resource Case. The comparisons are made for the years 2030 and 2040 and include consumer expenditures for natural gas as well as electricity. Electricity is included in the comparisons because lower natural gas prices will lead to more natural consumption by power generators and lower wholesale and retail electricity prices. To avoid any double counting of benefits, the cost savings to electricity generators themselves are not included in these comparisons since the reduced cost of their natural gas will be accounted for the in lower electricity prices paid by consumers.

The first year of data are shown in Exhibit 9-1 for 2030. In the AEO Reference Case total end-use consumption of natural gas (including for power generation) is 29.75 quadrillion Btus and the average price paid by all consumers (including transmission, distribution, and other charges) is $7.62 per MMBtu. In the High Oil and Gas Resource Case, natural gas supplies are assumed to be larger through a combination of better upstream technology and more access to resources. Due to more natural gas supplies, natural gas consumption increases by 15.2% and average natural gas prices fall by $1.65/MMBtu or about 22%. At the same time, electricity consumption increases by 1.8% and electricity prices fall by 0.8 cents per kilowatt hour in real dollars or 7.2%. Overall total end-use consumer costs of natural gas and electricity for 2030 decrease from $654.8 billion to $588.9 billion for a savings of $65.9 billion or 10.1%. These 2030 savings translated into $464 per household.[55]

Exhibit 9-1: Consumer Spending on Natural Gas and Electricity in AEO Cases: 2030

	Reference Case 2030			High Oil & Gas Resource Case 2030		
	Natural Gas & Electricity ($billion)	Energy Switched to Natural Gas & Electricity in HOGR Case ($billion)	Natural Gas, Electricity and Switched Energy in HOGR Case ($billion)	Natural Gas & Electricity ($billion)	Savings *versus* Reference Case ($billion)	Saving as %
Residential: Natural Gas	$57.7	$1.6	$59.3	$51.0	-$8.2	-13.9%
Commercial: Natural Gas	$36.7	$2.2	$39.0	$32.8	-$6.1	-15.7%
Industrial: Natural Gas	$54.3	$1.5	$55.8	$40.7	-$15.1	-27.1%
Vehicles: Natural Gas	$14.6	$2.8	$17.5	$15.6	-$1.8	-10.5%
All Sectors: Electricity	$475.2	$8.1	$483.4	$448.7	-$34.6	-7.2%
All Sectors: Natural Gas + Electricity	**$638.6**	**$16.2**	**$654.8**	**$588.9**	**-$65.9**	**-10.1%**

[55] There were 126 million households in the U.S. in 2016. The per-household savings estimated here are based on 142 million households in 2030 and 154 million households in 2040.

Note that because consumption of natural gas and electricity go up in the High Oil and Gas Resource Case, consumption of other fuels (primarily fuel oil and propane) is being reduced. The second column of Exhibit 9-1 shows the cost of the fuels which are replaced when natural gas prices go down. Those cost are included in the Reference Case cost to arrive at the $654.8 billion cost against which the High Oil and Gas Resource Case is compared.

Consumer savings in 2040 are shown in Exhibit 9-2. Going ten years further into the forecast increases the differences with the Reference Case as the additional natural gas resources brought on by greater upstream technologies and greater access to resources cause even bigger changes to production, consumption and prices. By 2040 the difference between the Reference Case and the High Oil and Gas Resource Case is a 22.8% increase in natural gas consumption and a decrease in average natural gas prices of $2.26/MMBtu or about 33%. Electricity consumption increases by 2.5% and electricity prices fall by 1.1 cents per kilowatt hour in real dollars or 8.3%. Total 2040 end-use consumer costs of natural gas and electricity decrease by $100.6 billion or 14.5%. These 2040 savings translated into $655 per household.

Exhibit 9-2: Consumer Spending on Natural Gas and Electricity in AEO Cases: 2040

	Reference Case 2040			High Oil & Gas Resource Case 2040		
	Natural Gas or Electricity ($billion)	Energy Switched to Natural Gas or Electricity in HOGR Case ($billion)	Natural Gas, Electricity and Switched Energy in HOGR Case ($billion)	Natural Gas or Electricity ($billion)	Savings *versus* Reference Case ($billion)	Savings as %
Residential: Natural Gas	$58.4	$2.1	$60.5	$49.5	-$10.9	-18.1%
Commercial: Natural Gas	$39.6	$3.1	$42.7	$33.8	-$8.9	-20.8%
Industrial: Natural Gas	$56.4	$1.4	$57.9	$34.4	-$23.5	-40.6%
Vehicles: Natural Gas	$17.0	$3.7	$20.7	$17.3	-$3.3	-16.0%
All Sectors: Electricity	$502.3	$12.1	$514.4	$460.4	-$54.0	-10.5%
All Sectors: Natural Gas + Electricity	**$673.7**	**$22.4**	**$696.1**	**$595.5**	**-$100.6**	**-14.5%**

Another way of looking at these results is shown on Exhibit 9-3, which computes the annual consumer savings that comes about due to an incremental one quadrillion Btu of natural gas supplies. In 2030 that increment of natural gas supply would produce annual consumer savings of $14.5 billion per year or $102 per household. By 2040 each one quadrillion Btu of additional gas supplies produces savings of $13.9 billion or $90 per household.

Exhibit 9-3: Annual Consumer Savings per Quadrillion Btu of Incremental Natural Gas Supply

	2030	2040
Change in Consumption/Supply (quads)	4.53	7.25
Consumer Savings ($billion)	$65.9	$100.6
Consumer Savings ($billion/quad)	$14.5	$13.9
Consumer Savings ($/quad/household)	$102	$90