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Supplying the Unconventional Revolution:

Sizing the unconventional oil and gas supply chain

Executive summary

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IHS™ Economics

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Contents

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This report offers an independent assessment of the importance of the unconventional oil and gas supply chain to the US economy. This research was prepared for the Energy Equipment and Infrastructure Alliance (EEIA).

EEIA represents the unconventional oil and gas supply chain: equipment manufacturers and distributors, construction contractors, service providers, material suppliers, and logistics companies. EEIA members provide equipment, materials, construction, services, logistics and workers to unconventional oil and gas exploration and production, transportation and processing.

IHS is exclusively responsible for this report and all of the analysis and content contained herein. The analysis and metrics developed during the course of this research represent the independent views of IHS and are intended to contribute to the dialogue on the role of the unconventional oil and gas supply chain in promoting employment and economic growth.

All of the gross output and labor income contributions throughout this report are expressed in terms of constant 2012 dollars.

Executive summary

Unconventional oil and gas development in the United States is a wide-reaching economic juggernaut that impacts dozens of industries beyond the oil and gas sector.[1] Furthermore, the impacts are distributed across suppliers from every state irrespective of whether oil and gas resources are native to the state. Major capital and operating expenditures flow to a lengthy supply chain that enables upstream, midstream, and downstream development activity. The unconventional oil and gas supply chain is composed of providers of materials, capital goods, construction and well services, professional and other services, and logistics and represents more than 40% of total unconventional oil and gas related employment over the 2012–25 period analyzed for this report.

In addition to the capital and operating spending stimulus that generates supply chain activity, unconventional oil gas development is also kindling new construction activity in the regions where drilling activity is occurring. While this supplemental construction activity is not a function of upstream operator spending, the ripple effect of the large capital investment is added housing, commercial buildings, and infrastructure vital to upstream operations and employees. Upstream, midstream, and downstream investment has indirectly generated construction activity at a time when the construction sector and its own supply chain is recovering from the worst construction recession since the Great Depression. This IHS analysis quantifies the economic contributions at a level of detail that comprehensively defines the unconventional supply chain effect across many industries and the lower 48 states.

Oil and gas operators in the upstream, midstream, and downstream sectors share a symbiotic relationship with their immense network of suppliers. Suppliers benefit from the enormous investment required for the exploration, production, processing, and transport of oil and gas resources. And it is the suppliers of materials, capital equipment and services that complete the virtuous circle by enabling operators to commercialize otherwise inaccessible hydrocarbons.

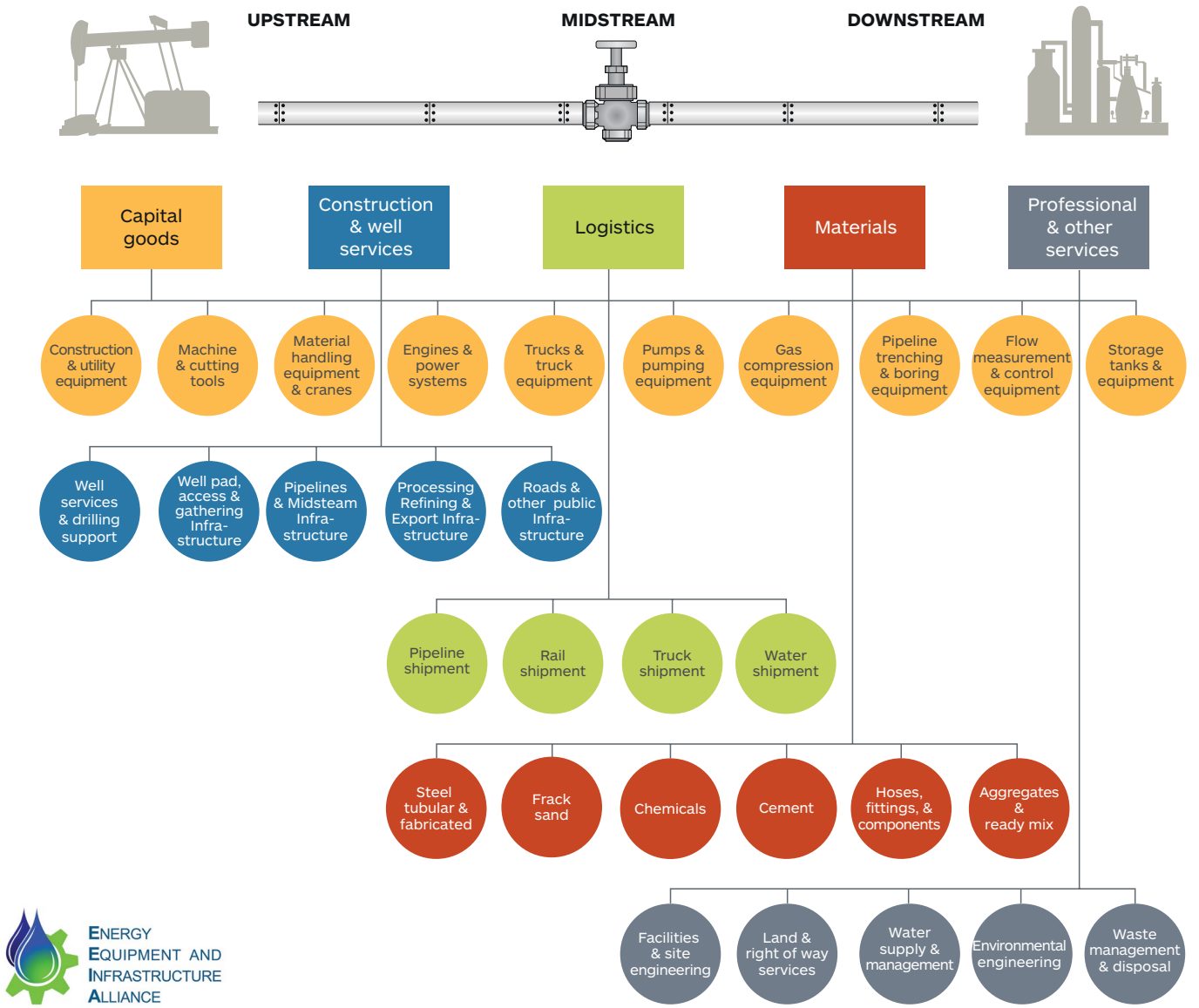
This IHS study is the first comprehensive assessment of the unconventional energy supply chain, focusing on the economic contributions associated with the oil and gas industry's broad network of suppliers and their important roles in advancing unconventional resources development, ultimately enhancing the energy and economic security of the United States. The contributions to the US economy identified in this study demonstrate the critical linkage between energy value chain investment and several sectors likely to experience above-trend economic growth over the next two decades. For example, employment growth in the unconventional oil and gas supply chain will outpace IHS's estimate for total US employment growth over 2012–25 by 2.9% vs. 1.1%.[2] Furthermore, the $79,000 average wage earned by the unconventional supply chain worker exceeds the average annual US wage of $68,000.

The following is a diagram of the unconventional energy supply chain sectors and components that demonstrates the expansive scope of its industries and their pervasive presence throughout the economy.

1 The word "unconventional" applies to oil and gas extracted using the major new technological advances in extraction, such as horizontal drilling and hydraulic fracturing.

2 Source: IHS Economics, August 2014 US macroeconomic forecasts.

The unconventional energy supply chain



Many of the suppliers in the unconventional oil and gas supply chain do not rely exclusively on the oil and gas industry for sustainable business. In response to the decline in domestic oil and gas production from 1970 to 2000, suppliers reduced their exposure to the industry. Yet, amid the sweeping economic chaos of the Great Recession, a resurgent domestic oil and gas industry began massive investment due to the increased commercial viability of hydraulic fracturing and horizontal drilling in shale and other tight oil formations. The result was a renewed focus on supplying the domestic oil and gas industry, particularly at a time when construction, the primary market for suppliers of machinery and materials, was experiencing an extraordinary decline. Today, the question for many suppliers to the domestic oil and gas industry is not whether their business is over-weighted in the sector, but whether they are adequately resourced to fully take advantage of the business opportunities that exist in unconventional oil and gas.

Remarkably, another important effect of the revival in domestic oil and gas production is that unconventional resources are now being developed in areas where little or no conventional energy was previously produced,

and companies with no previous energy-driven business are thriving by supplying this new activity. New businesses have been formed to take advantage of the unique needs of unconventional resource development, such as water management, proppant supply, and engineering services. Investment in unconventional oil and gas development has not only stimulated the Great Revival in domestic production, it has also shaped economic renewal following the Great Recession.

This study investigates three key areas where the unconventional oil and gas supply chain supports economic growth in the lower 48 states. First, the study evaluates the economic contributions of the unconventional oil and gas activity on its supply chain industries in terms of employment, labor income, government revenue, and gross output of goods and services. The rapid expansion in both domestic production capacity of unconventional oil and gas and the associated midstream and downstream energy infrastructure stimulates supply chain activity throughout the energy value chain. Second, the study breaks down the national results into state-by-state findings.

Third, the study examines the incremental levels of construction activity associated with unconventional oil and gas development. In addition to construction activity on drilling sites and pipelines fueled by operator capital and operating expenditures, considerable supplemental construction investment not borne by the operators is necessary to support upstream, midstream, and downstream activity. Examples of related construction activity include road widening and resurfacing to accommodate increased truck traffic and construction of new housing and lodging units in rural areas where the existing housing stock is insufficient to meet growing demand.

Key findings reveal that supply chain segments—capital goods, construction and well services, logistics, materials, professional and other services—have benefitted the most from the unconventional revolution in terms of number of jobs created, labor income, and overall gross output. Over the forecast period, 2012 to 2025, the total number of unconventional supply chain jobs is estimated to increase by 45%, from 524,000 jobs in 2012 to over 757,000 jobs in 2025. These employment estimates account for more than 40% of all jobs supporting unconventional energy activity. Additionally, the gross output estimates for the unconventional energy supply chain account for over 35% of total gross output supported by total unconventional energy activity.

US unconventional energy supply chain contribution*

	2012	2015	2020	2025	CAGR**
Employment (Number of workers)					
Supply chain total	524,413	615,910	638,762	757,802	2.9%
Energy activity total	1,100,573	1,419,214	1,562,229	1,834,306	4.0%
Share of supply chain in employment	47.6%	43.4%	40.9%	41.3%	
Gross output (2012 $M)					
Supply chain total	145,681	173,522	180,620	205,907	2.7%
Energy activity total	345,089	463,538	516,689	582,706	4.1%
Share of supply chain in gross output	42.2%	37.4%	35.0%	35.3%	
Labor income (2012 $M)					
Supply chain total	41,015	48,915	51,381	59,502	2.9%
Energy activity total	97,291	130,593	146,432	168,146	4.3%
Share of supply chain in labor income	42.2%	37.5%	35.1%	35.4%	

* Energy activity total represents the combined direct and indirect contributions of upstream, midstream, and downstream as reported in *America's New Energy Future*, Volume 3.

** Compound annual growth rate from 2012 to 2025.

Source: IHS

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Many of the major suppliers to unconventional oil and gas operators have lengthy supply chains of their own, further contributing to the multiplier effect of unconventional development. For example, throughout the upstream and midstream sectors, earth-moving construction machinery is necessary to excavate impoundment ponds, prepare access roads, dig pipeline trenches, and prepare the site of a natural gas processing plant. Thus while the original equipment manufacturers benefit from unconventional development, so do the steel plate producers, metal fabricators, and machine tool shops that create the inputs for finished machinery that end up on upstream and midstream worksites.

The sectors within the unconventional supply chain were assigned to one of five core groups:

1. **Capital goods**: Off-highway equipment and industrial machinery are widely used throughout the unconventional value chain, including construction and access machinery; pumps and compressors; power generators; power boilers and heat exchangers; and component suppliers to equipment manufacturers. Also related to this group are equipment distributors and rental companies.

2. **Construction and well services**: Construction activity is present through all aspects of the unconventional energy value chain as well as the supplemental construction within oil and gas producing regions that is not associated with oil and gas operator capital and operating expenditure. Suppliers within this group include general and specialty contractors, and building trades. Well services include well drilling and other oil and gas field support services performed on a contract basis.

3. **Logistics:** The logistics transportation system supporting unconventional energy activity consists of road, rail, water, and pipeline transportation. While truck transportation has been a principal mode of the unconventional energy supply chain, logistics, pipeline, water, and railway traffic are expected to increase in the coming years.

4. **Materials**: This group includes various raw materials producers such as steel and nonferrous metals; sand, gravel, and other aggregates; chemicals; and other value-added services such as metal fabrication and distribution. Key materials include oil country tubular goods and other pipe products, cement for well-casing, and sand and chemicals associated with hydraulic fracturing. These raw materials are also critical inputs for finished and semi-finished supply chain goods such as the gears and forgings in machinery.

5. **Professional and other services**: Typically associated with operational expenditures, the wide range of professional and other services include environmental engineering; occupational health and safety; architectural and civil engineering services; and financial, insurance, and real estate services.

Top-10 sectors: US unconventional energy supply chain employment*
(Number of workers)

		2012	2015	2020	2025	CAGR**
23[t]	Construction of Other New Nonresidential Structures	58,806	74,333	82,577	103,299	4.4%
5413	Architectural, Engineering, and Related Services	57,770	67,878	67,523	77,603	2.3%
213112	Support Activities for Oil and Gas Operations	54,757	72,351	87,337	108,828	5.4%
23[tt]	Construction of New Nonresidential Manufacturing Structures	74,362	50,343	16,709	13,414	-12.3%
212321	Construction Sand and Gravel Mining	28,228	36,434	42,197	49,944	4.5%
333515	Cutting Tool and Machine Tool Accessory Manufacturing	27,460	36,225	42,287	50,435	4.8%
4841	General Freight Trucking	24,139	32,079	37,724	44,545	4.8%
4238	Wholesale Machinery and Equipment	17,449	24,339	28,903	33,742	5.2%
3331	Agriculture, Construction, and Mining Machinery Manufacturing	18,155	21,832	21,818	25,382	2.6%
3312	Steel Product Manufacturing from Purchased Steel	14,662	16,192	15,175	17,814	1.5%
Top-10 total		**375,788**	**432,008**	**442,250**	**525,006**	**2.6%**
US total		**524,413**	**615,910**	**638,762**	**757,802**	**2.9%**

*The ranking for all years are based on employment in 2014.

** Compound annual growth rate from 2012 to 2025.

t Construction of upstream facilities and structures.

tt Construction of pipelines, rail, marine structures, storage facilities, LNG export facilities, and manufacturing structures.

Source: IHS Economics

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Appendix C of this report contains more detailed definitions of the range of specific products and services that are included within the industry descriptions.

IHS findings also demonstrate heightened infrastructure, residential and commercial construction activity necessary to support or facilitate unconventional development in regions where activity is either underway or anticipated in the forecast period. Beyond the construction investment typically made by upstream and midstream operators, non-operator construction investment will range between $2.8 billion and $3.6 billion annually over the forecast period. This activity includes public and private investment associated with new construction in road improvements, wastewater treatment, and lodging that is needed to accommodate increased vehicle traffic, resource usage, and workers. This supplemental construction investment translates to additional construction-related jobs over and above the construction impacts identified within operator capital expenditures in the upstream, midstream, and downstream sectors. These supplemental construction-related jobs are estimated to have peaked in 2013 with about 16,800 jobs, then decline over time to about 10,000 jobs in 2025. The residential segment within this supplemental construction activity will account for more than 75% of the total supplemental construction over the forecast period.

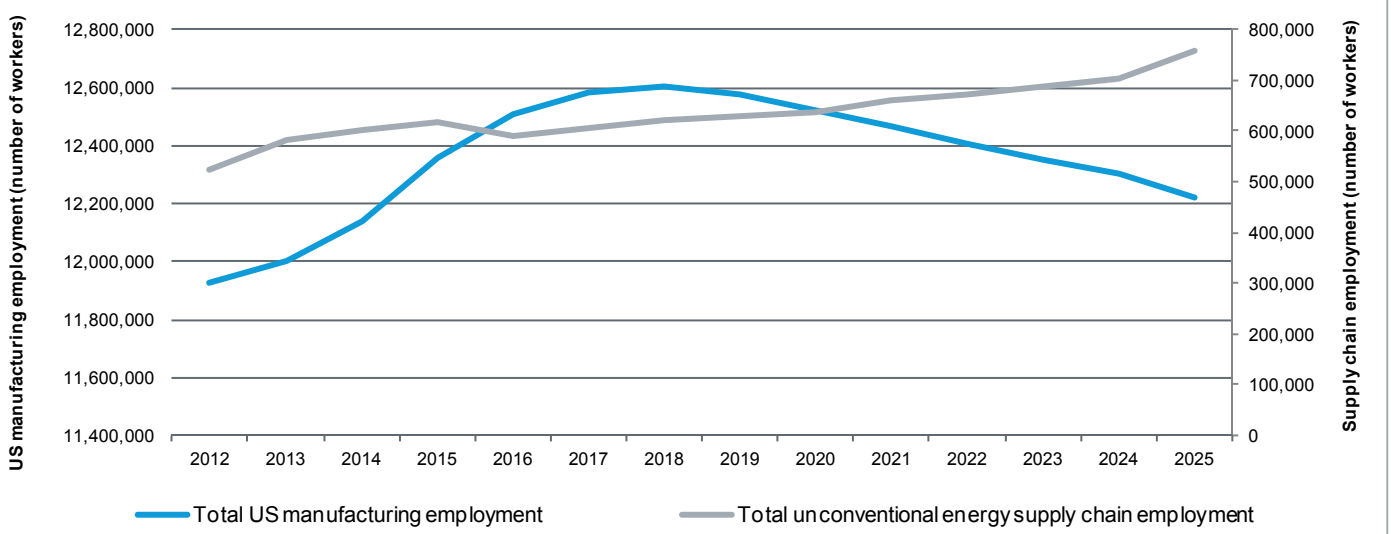
The study projects impressive growth rates in employment for several industries. For instance, Cutting Tool and Machine Tool Accessory Manufacturing (NAICS 333515), the largest capital goods sector of the supply chain, is expected to increase the number of workers tied to the unconventional energy supply chain from 27,000 workers in 2012 to more than 50,000 in 2025. This represents a compound annual growth rate of about 5% from 2012 to 2025. These growth rates are impressive by historical standards for this sector. According to the Bureau of Labor Statistics, the sector lost workers at an average compound rate of about 3% each year during 2001–12, falling from almost 36,000 workers in 2001 to about 25,000 in 2012.

National level key findings

IHS expects capital and operating expenditures to grow substantially between 2012 and 2025 supporting unconventional oil and natural gas production and expanding the upstream, midstream, and downstream value chain. The impact on employment, gross output, and labor income is expected to be significant throughout the supply chain:

- Total employment across the supply chain is estimated to grow at an annual compound rate of about 3%, from about 524,000 jobs in 2012 to 757,000 jobs in 2025, an increase of about 45%. This represents a much faster growth rate than the pace projected for total US employment in manufacturing, which is forecasted to increase at a compound growth rate of only 0.2% from 2012 to 2025, an overall increase of only 2.5%. While US manufacturing employment has been declining over the long term, manufacturing sectors within unconventional supply chain are bucking this trend.

Total US manufacturing employment vs. unconventional energy supply chain employment



Source: IHS Economics

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- The total supply chain-related gross output will increase from nearly $146 billion in 2012 to almost $206 billion in 2025. In the context of a $15–21 trillion US economy over this period, this translates into roughly 0.5% of total gross output in any given year of the forecast. Moreover, total supply chain-related gross output represents roughly 5% of total manufacturing output over the forecast years.

- The labor income generated by employment across the supply chain will grow from $41 billion in 2012 to close to $60 billion in 2025, representing, on average, approximately 36% of total labor income generated by unconventional oil and natural gas activity.

- The supply chain is spread across 56 North American Industry Classification System (NAICS) sectors, which represent between 40% and 47% of total employment supported by all unconventional energy activity.[3]

- Employment attributed to upstream, midstream, and downstream unconventional oil and natural gas activity will support more than 1.1 million direct and indirect jobs in 2012, growing to some 1.8 million in 2025.

3 The North American Industry Classification System (NAICS, pronounced "Nakes") was developed under the direction and guidance of the Office of Management and Budget (OMB) as the standard for use by Federal statistical agencies in classifying business establishments for the collection, tabulation, presentation, and analysis of statistical data describing the US economy. Use of the standard provides uniformity and comparability in the presentation of these statistical data. NAICS is based on a production-oriented concept, meaning that it groups establishments into industries according to similarity in the processes used to produce goods or services. NAICS replaced the Standard Industrial Classification (SIC) system in 1997.

- Total government revenues generated by the unconventional energy supply chain will increase from more than $13 billion in 2012 to more than $16 billion in 2015 and to about $23 billion in 2025.
- Average income per employee in the supply chain industries is estimated at about $79,000 between 2012 and 2025.

Supply chain core group key findings

- Two of the core groups, construction and well services and capital goods, account for more than 55% of total economic benefits supported by unconventional energy supply chain activity.
- In terms of employment, the top sector within the capital goods group is Cutting Tool and Machine Tool Accessory Manufacturing (NAICS 333515), followed closely by Wholesale of Machinery and Equipment (NAICS 4238). Employment supported by unconventional energy activity in these two sectors is estimated to increase by 87%, from about 45,000 workers in 2012 to more than 84,000 workers in 2025.
- Construction and well services activities associated with the unconventional energy supply chain is represented by four sectors: Construction of New Nonresidential Manufacturing Structures (part of NAICS 23—construction of pipelines, rail, marine structures, storage facilities, LNG export facilities, and manufacturing structures); Construction of Other New Nonresidential Structures (part of NAICS 23—construction of upstream facilities and structures); Drilling of Oil and Gas Wells (NAICS 213111); and Support Activities for Oil and Gas Operations (NAICS 213112). Through 2025, these four sectors are estimated to support on average 216,000 jobs per year related to unconventional energy activity.
- Within the materials group, Construction Sand and Gravel Mining (NAICS 212321) is the largest sector of the unconventional energy supply chain in terms of employment, gross output, and labor income contributions. The employment contribution in this sector is expected to almost double from 28,000 workers in 2012 to nearly 50,000 workers in 2025. Similarly, labor income in this sector will increase from $2.5 billion in 2012 to $4.3 billion in 2025. Gross output will increase from about $6 billion to more than $10 billion over the forecast horizon.
- Within the professional and other services group, the Architectural, Engineering, and Related Services (NAICS 5413) sector is projected to increase its number of workers associated with the unconventional energy supply chain activity from more than 57,000 in 2012 to about 77,000 in 2025, representing a compound annual growth rate of 2.3%
- Among the supply chain sectors in the logistics group, General Freight Trucking (NAICS 4841) experiences the largest employment contributions stemming from unconventional energy activity. The number of workers in this sector is estimated to increase from 24,000 in 2012 to more than 44,000 in 2025.
- In Heavy Duty Truck Manufacturing, both gross output and employment are expected to double between 2012 and 2025 from $1.1 billion to $2.3 billion and 3,000 workers to 6,000 workers, respectively.

State level key findings

- Unconventional energy supply chain jobs account for 2% of total state employment in Texas, Louisiana, and Oklahoma throughout the forecast period. Supply chain employment accounts for 1% of total state employment in Arkansas, Colorado, and Pennsylvania.
- In 2012, the supply chain industries across the producing states contributed about $126 billion to total US gross output; by 2015 this will grow to over $146 billion, stabilizing at nearly $170 billion by 2025. The supply chain industries in the nonproducing states are estimated to generate $19 billion in gross output in 2012, nearly $27 billion in 2015, and $36 billion by 2025.

- The top-10 producing states account for more than 70% of the energy supply chain contributions in terms of employment, labor income, and gross output. The top-10 producing states over the forecast period are: Texas, Louisiana, Pennsylvania, Colorado, North Dakota, Ohio, Oklahoma, California, Arkansas, and Utah.
- The top supply chain industries in terms of employment contributions across the oil and gas producing states are concentrated in Construction (part of NAICS 23), Support Activities for Oil and Gas Operations (NAICS 213112), General Freight Trucking (NAICS 4841), and Architectural, Engineering, and Related Services (NAICS 5413).
- The top supply chain industries that support the largest number of jobs across the nonproducing states are concentrated in the capital goods core group.