

America's New Energy Future: The Unconventional Oil and Natural Gas Revolution and the US Economy



Fueling Significant Growth?

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A Presentation
to:



Annual Conferences
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Agenda

- Introduction
- Background on Unconventional Energy in the US
- Measuring Economic Impact
- The Manufacturing Renaissance
- Conclusions



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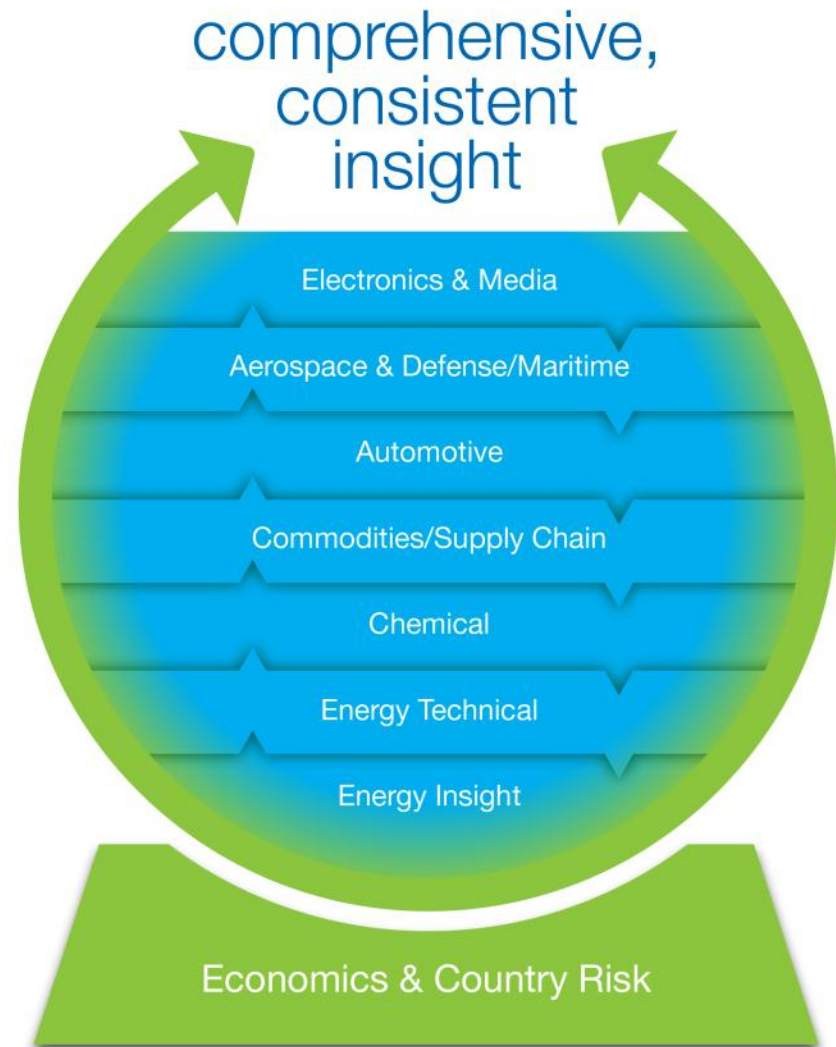
| Industry |
|---------------------|
| Aerospace & Defense |
| Automotive |
| Chemicals |
| Electronics & Media |
| Energy |
| Financial Services |
| Maritime |

| Workflows |
|------------------------|
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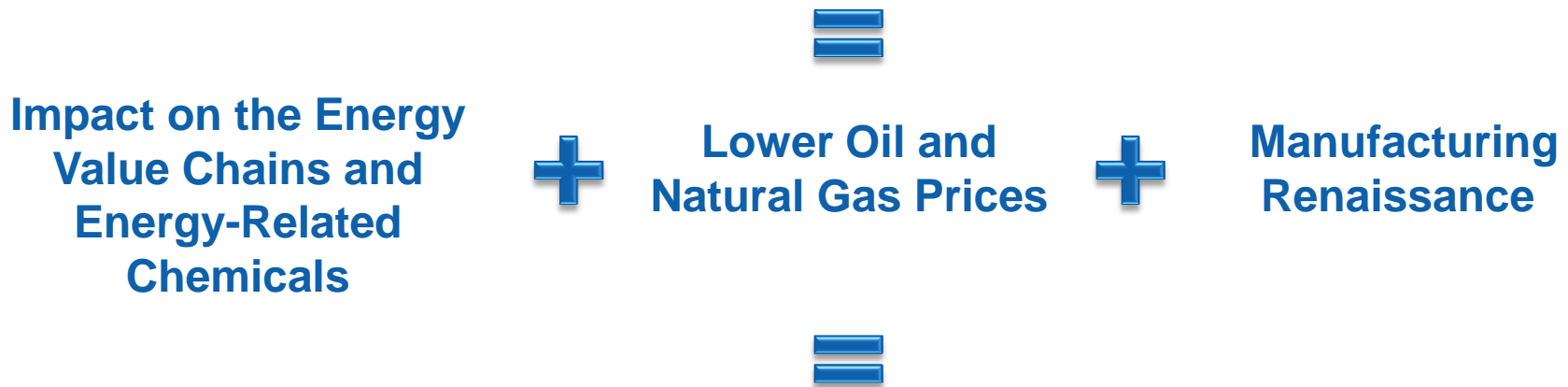


IHS Assessed the Contribution of Unconventional Oil and Natural Gas Activity to the US Economy on Three levels



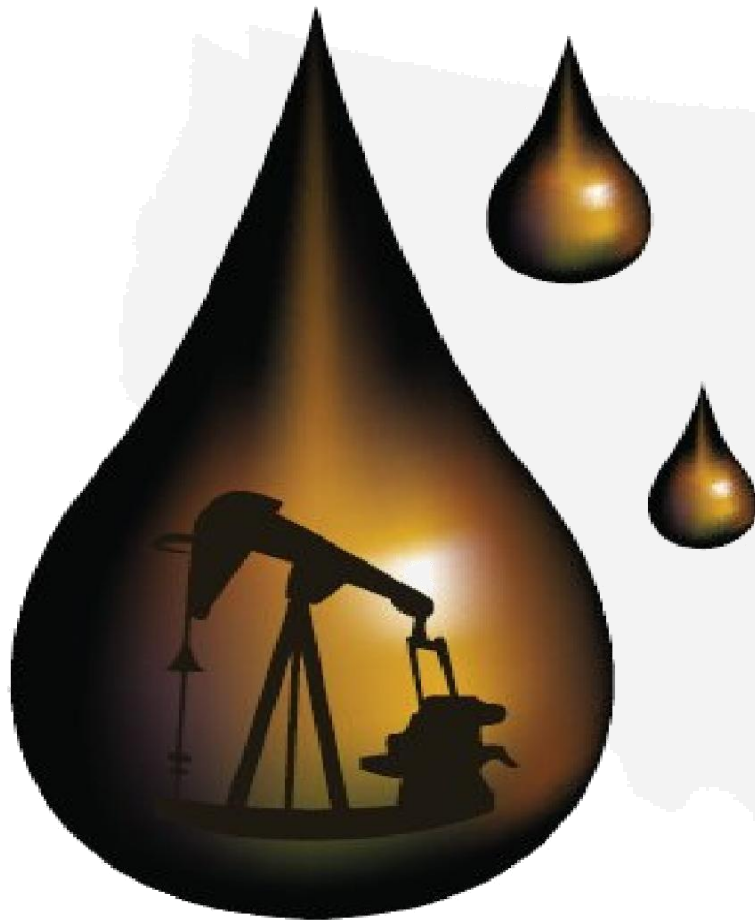
- **October 2012: National Economic Contributions**
 - The direct, indirect and induced contribution of upstream unconventional oil and natural gas activity on the US economy as measured in jobs, GDP contribution, labor income and government revenue.
- **December 2012: State Economic Contributions**
 - The national level contribution assessment is further broken down to the state level. The use of extensive domestic supply chains means benefits will accrue even to states that are not unconventional energy producers.
- **September 2013: A Manufacturing Renaissance**
 - An assessment of how unconventional oil and natural gas (as both an energy source and industrial feedstock) will make significant contributions to the US economy while enhancing the global competitiveness of US manufacturing.

Domestic Unconventional Oil and Natural Gas



**Transformation of both
US Energy and the US Economy**

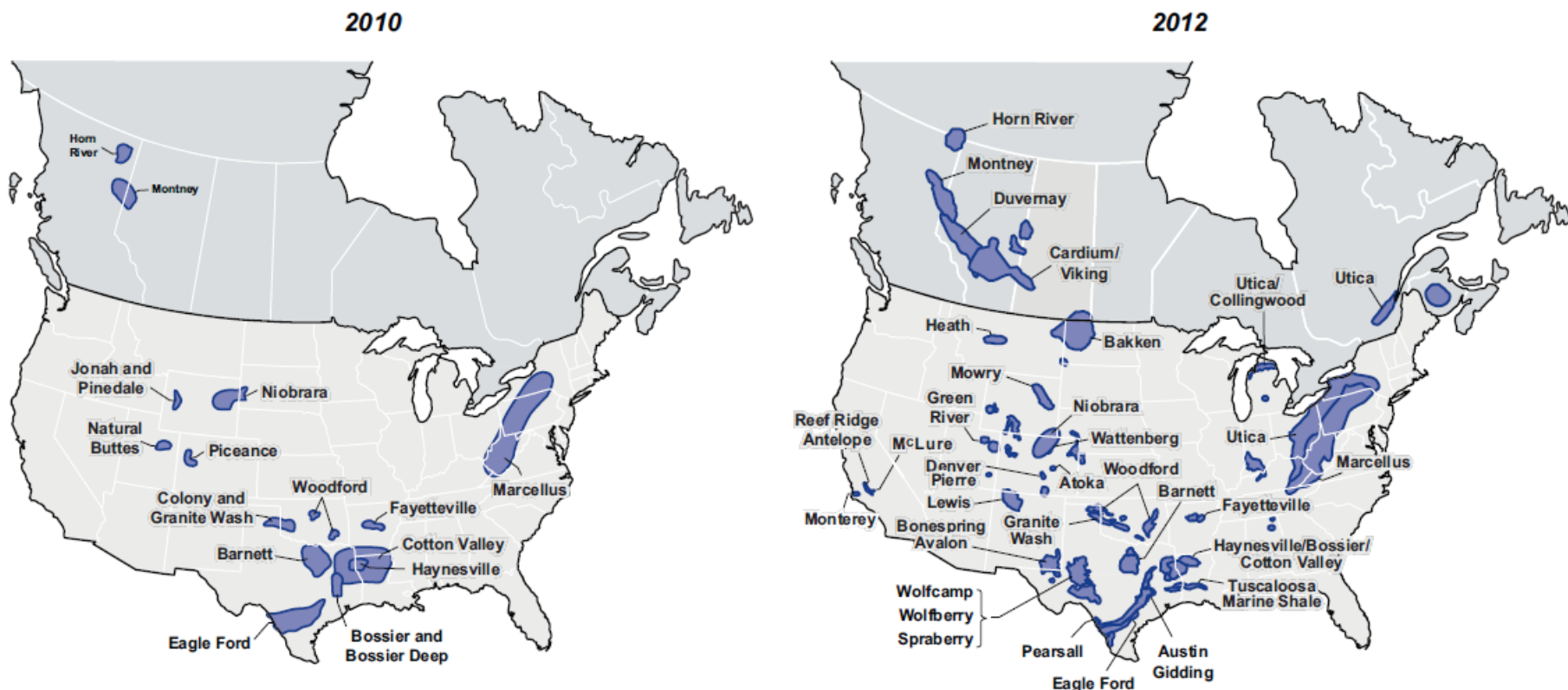
Snapshot of US Energy Landscape



- Unconventional oil sources have increased oil production by 25% from 2008.
- Twelve years ago, shale gas production was only 2% of total US natural gas production, today it represents 37%.
- The increase in US natural gas production from shale gas and tight gas plays is making it possible that the United States will become a net exporter of gas by the end of this decade
- US Employment attributable to unconventional energy will account for more than **3.9 million jobs** and add over **\$500 billion to US GDP** in 2025.

Unconventional Oil and Gas Plays in North America

Unconventional Hydrocarbon Plays in North America: Then and Now



Source: IHS CERA.
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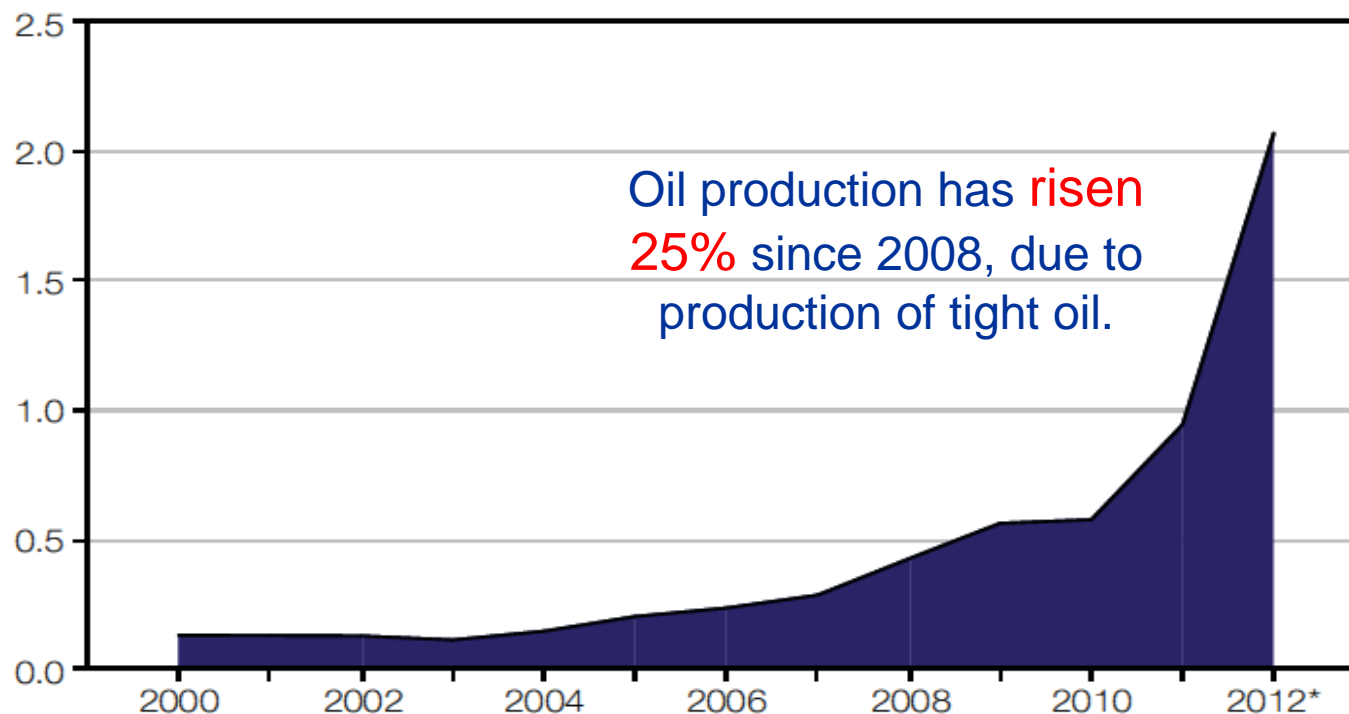
Enough to satisfy more than 100 years of consumption at current rates

Unconventional Oil is Unlocking New Domestic Sources of Supply

From 1970 to 2008, crude oil production fell from 9.6 mbd to 5 mbd. Unconventional oil has played a significant role in reversing oil production decline.

Average Daily US Tight Oil Production: 2000 to 2012

Million Barrels per Day



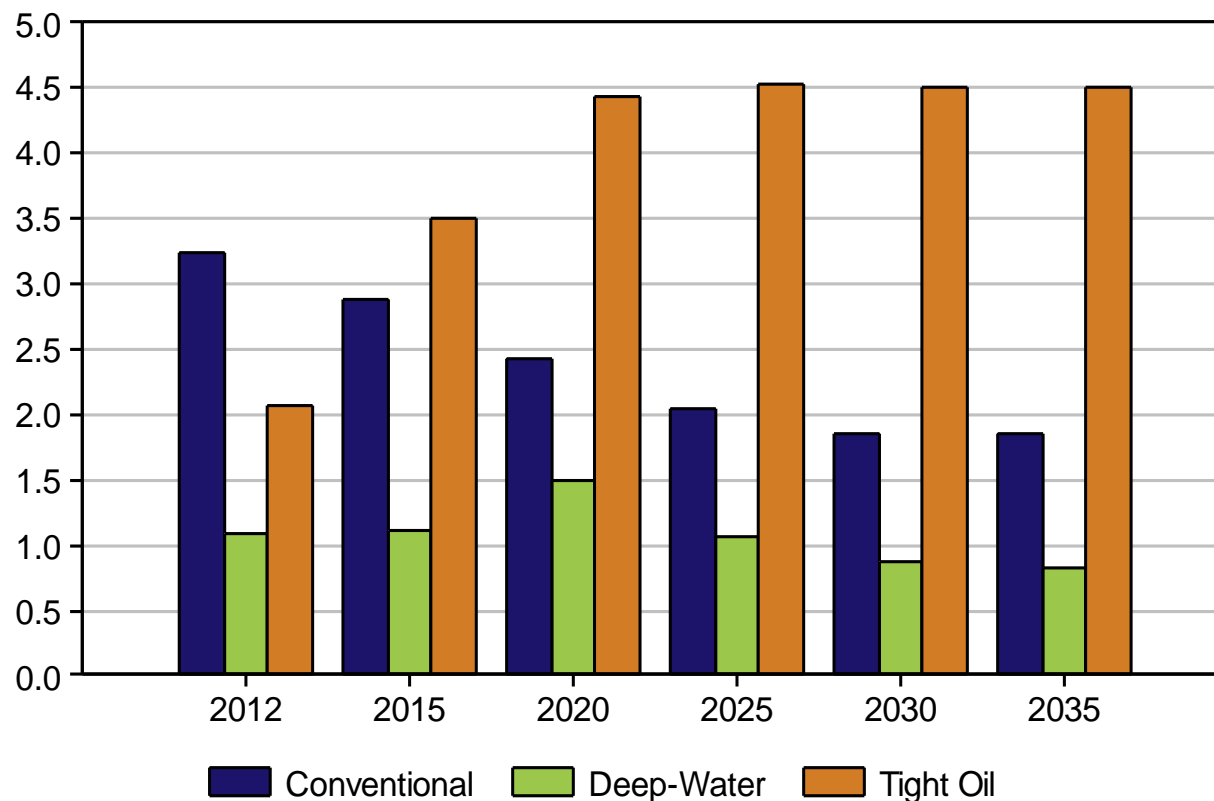
*Projections, Source: IHS CERA



Unconventional Tight Oil Will Dominate US by 2015

US Tight Oil Production Outlook: 2012 to 2035

Million Barrels per Day



Tight Oil production share

32% in 2012

53% in 2020

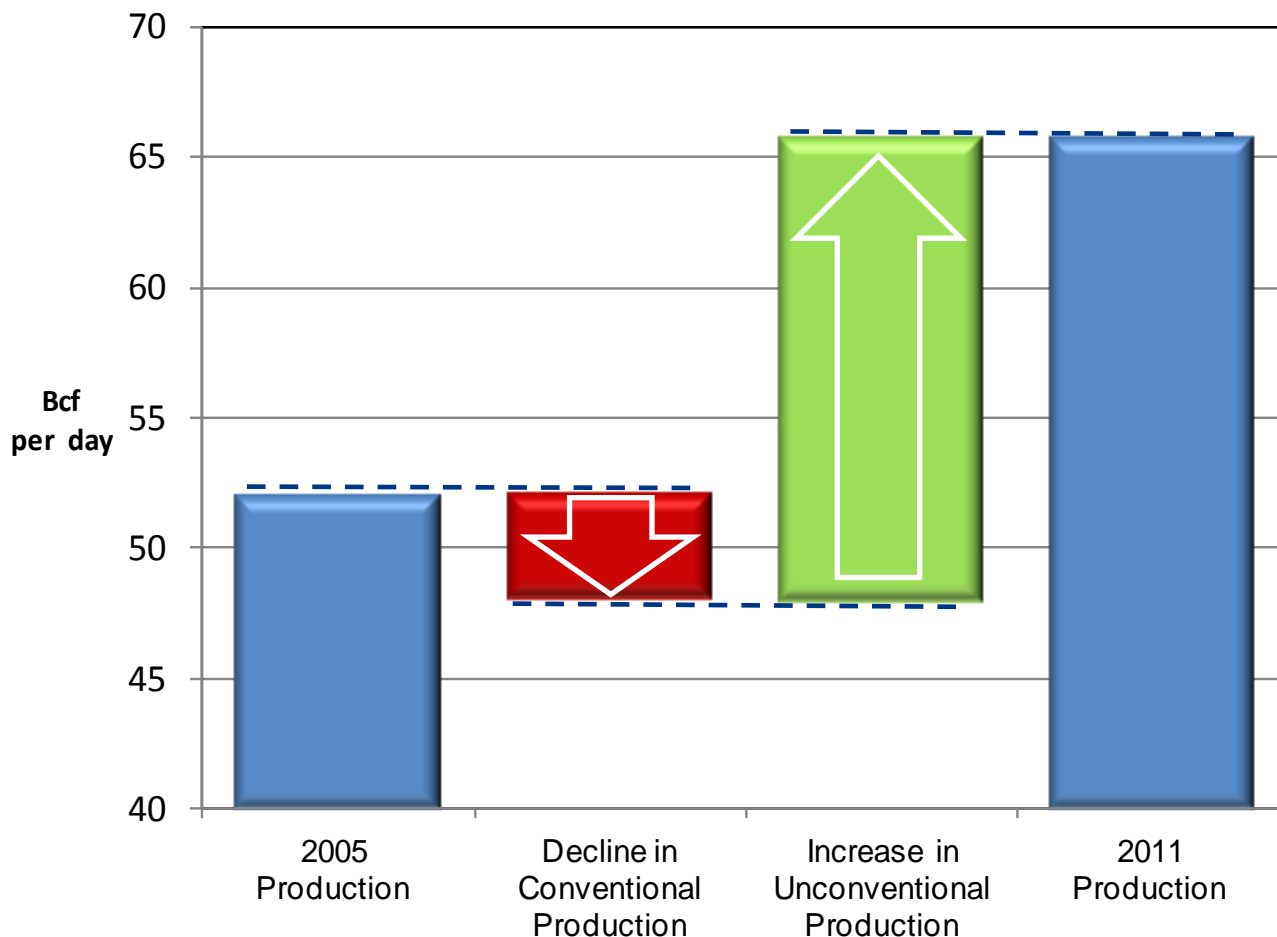
63% in 2035

US Oil import requirements down from 60% in 2005 to 42% today.



United States a Net Exporter of Gas by the End of Decade.

Sources of Changes in Annual Gas Production Levels, 2005 - 2011



US natural gas production **up 25%** from 2005 to today

Five years ago the US was on track to spend \$100B annual on LNG imports

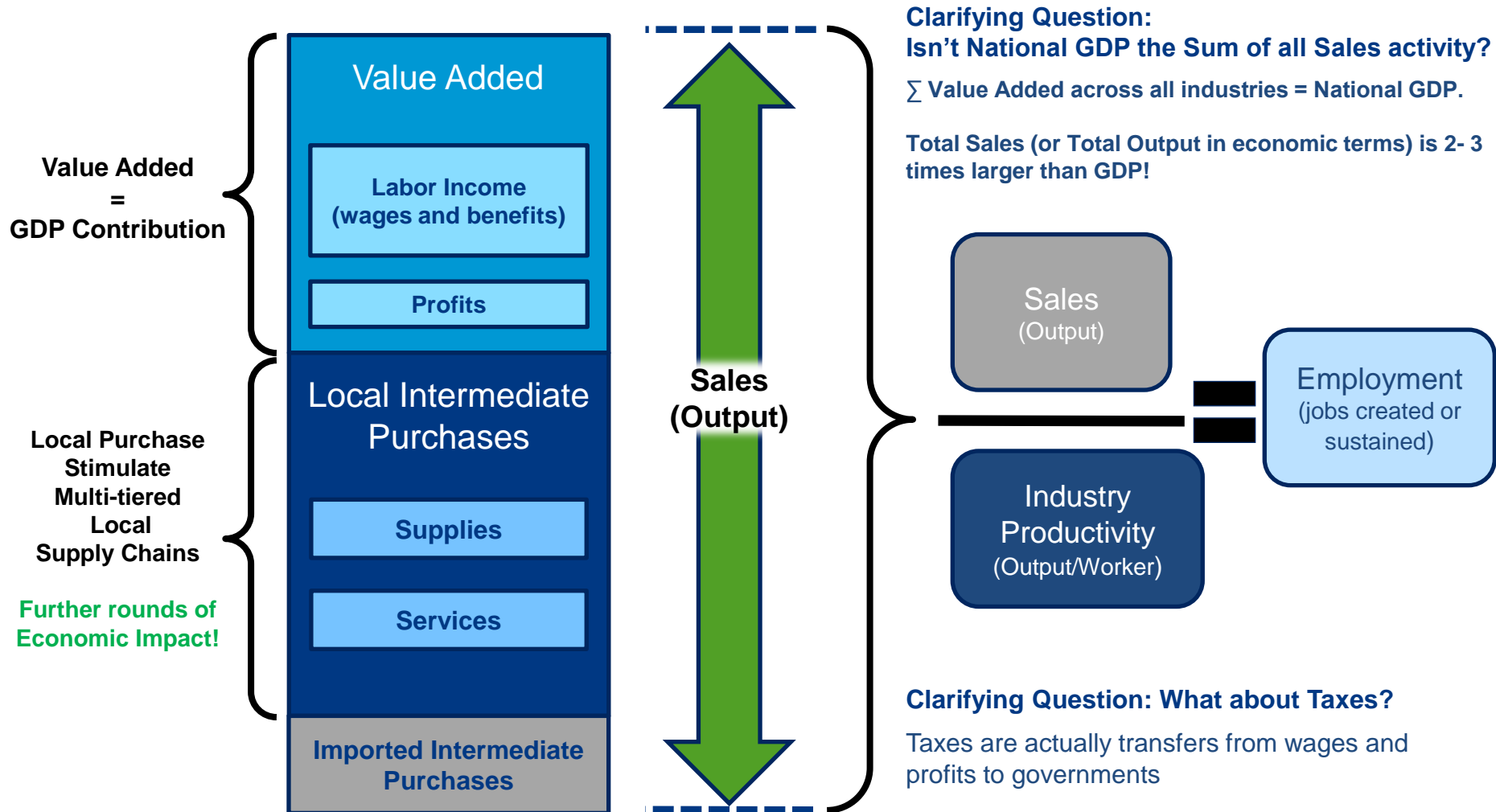


Measuring Economic Impact



How business transactions ripple through an economy

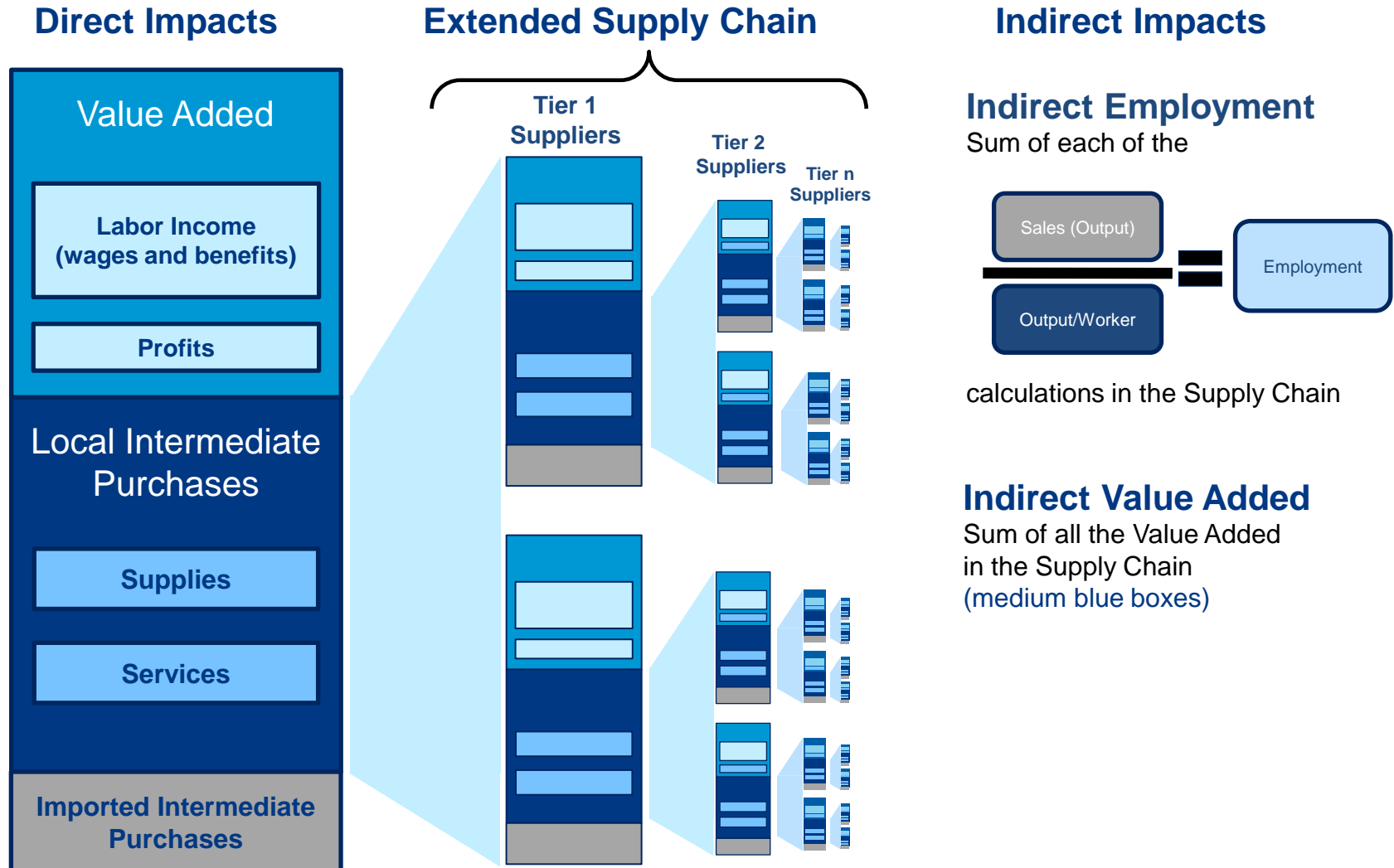
Part 1: Direct Economic Impact





How business transactions ripples through an economy

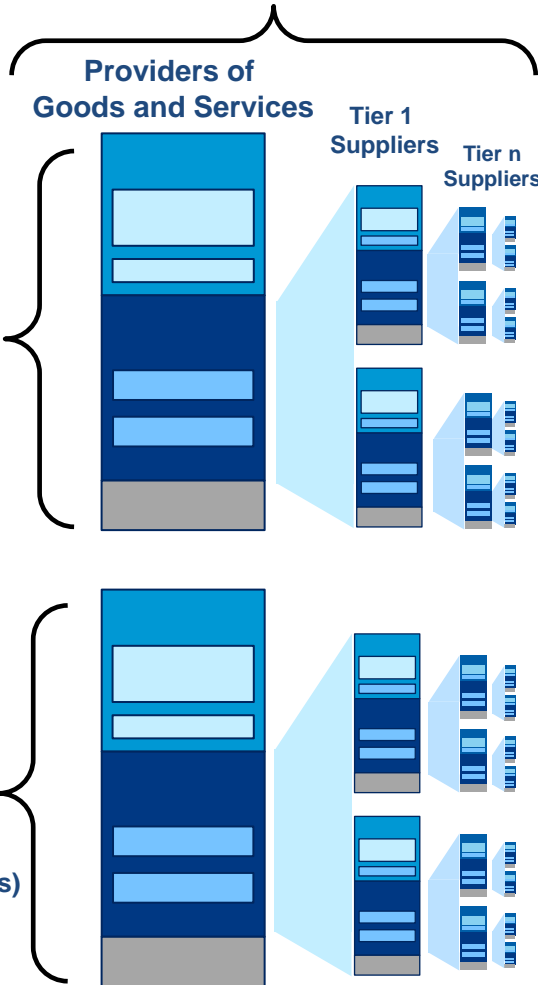
Part 2: From Direct to Indirect Economic Impact



How business transactions ripple through an economy

Part 3: Induced Impact

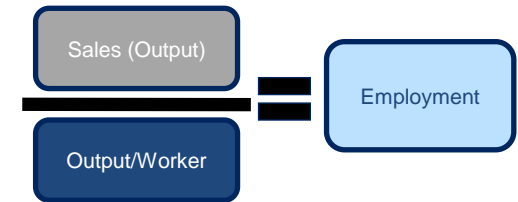
Induced Supply Chain



Induced Impacts

Induced Employment

Sum of each of the



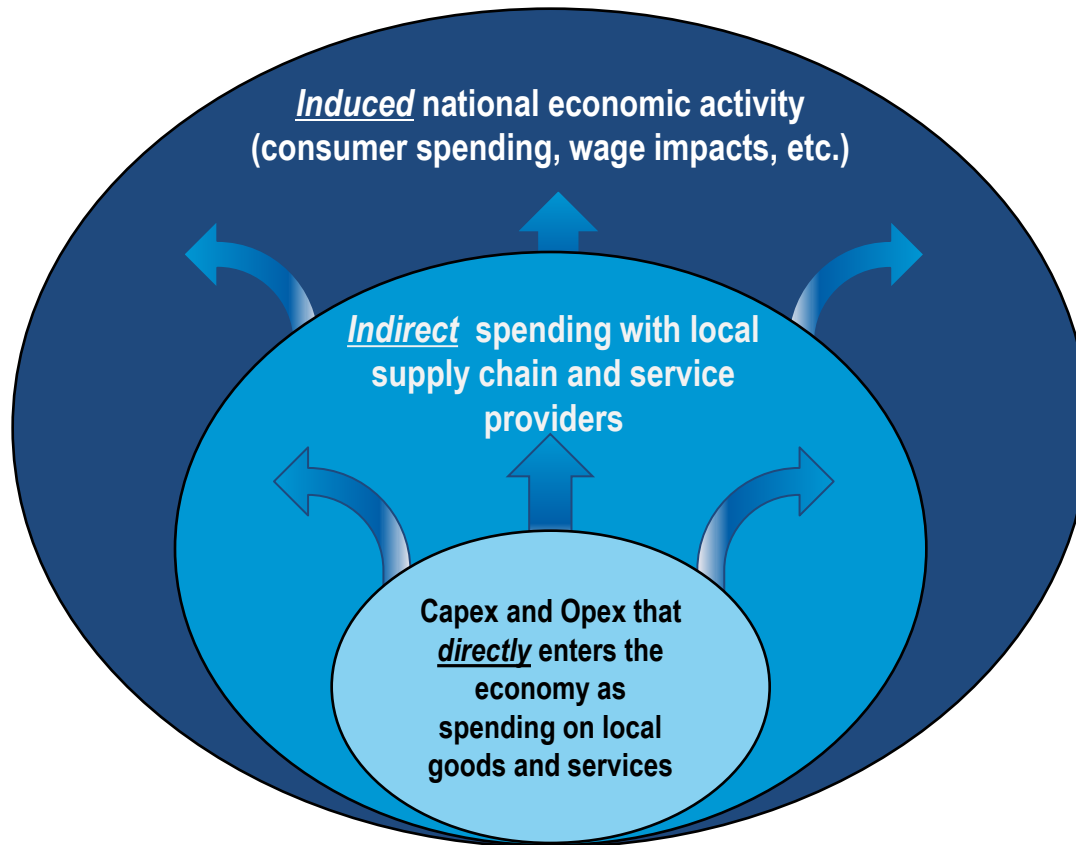
calculations in the Induced Supply Chain

Induced Value Added

Sum of all the Value Added in the Induced Supply Chain (medium blue boxes)

Direct and Indirect Workers spend a portion of their Labor Income in the General Economy

Modeling the internal economic linkages in a national economy, IHS is able to evaluate the ripple (or multiplier) effect of the direct local expenditures



Induced Effects (Income Effects)

Induced effects refer to the response of an economy to changes in household spending as a result of income generated by the direct and indirect effects.

Indirect Effects (Supplier Effects)

Indirect effects refer to the “ripple responses” of an economy to subsequent final demand shifts within industries that are dependent on the direct industries.

Direct Effects

Direct effects are the first-order responses of an economy to changes in the final demand of a given industry or set of industries.



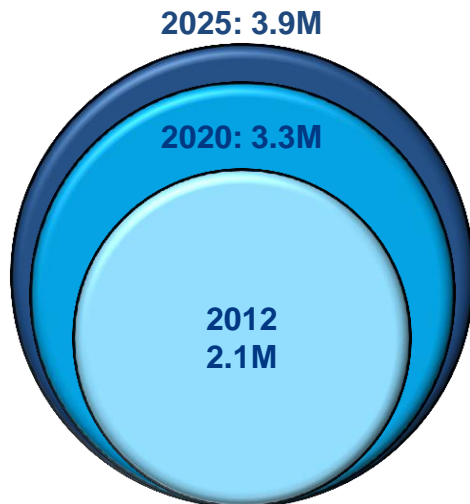
A Manufacturing Renaissance

Measuring the Transformative Contribution of Unconventional Energy to the US Economy



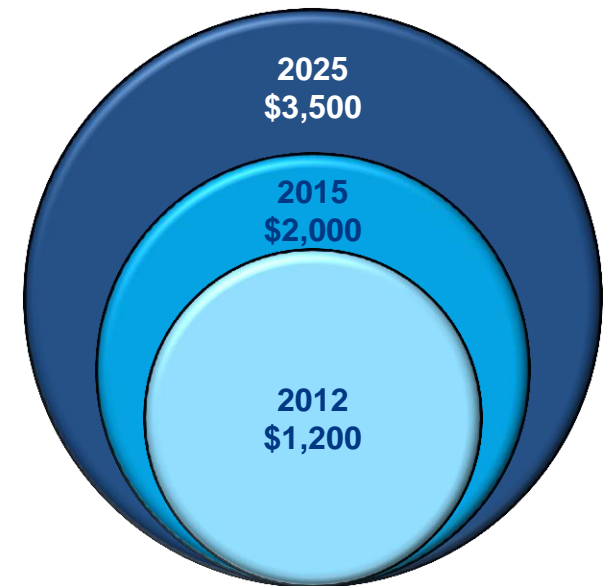
- Unconventional oil and natural gas activity is reshaping America's energy future and bringing significant benefits to the US economy in terms of jobs, government revenues, and GDP.
- A new era of affordable and abundant energy is creating significant competitive advantages for the US in both energy-intensive industries and industries that rely on natural gas derivatives as critical production feedstock.

Employment Contribution



- **Jobs:** 2.1 million jobs in 2012, 3.3 million in 2020 and 3.9 million in 2025.
- **GDP:** annual contributions will nearly double from \$284 billion in 2012 to \$533 billion in 2025.
- **Government revenues:** average \$115 billion annually, totaling over \$1.6 trillion from 2012 to 2025.
- **Real household disposable income:** increase of more than \$1,200 in 2012, \$2,000 in 2015 to more than \$3,500 in 2025

Contribution to Household Income



Unconventionals are redefining energy and the energy-related chemicals value chain...



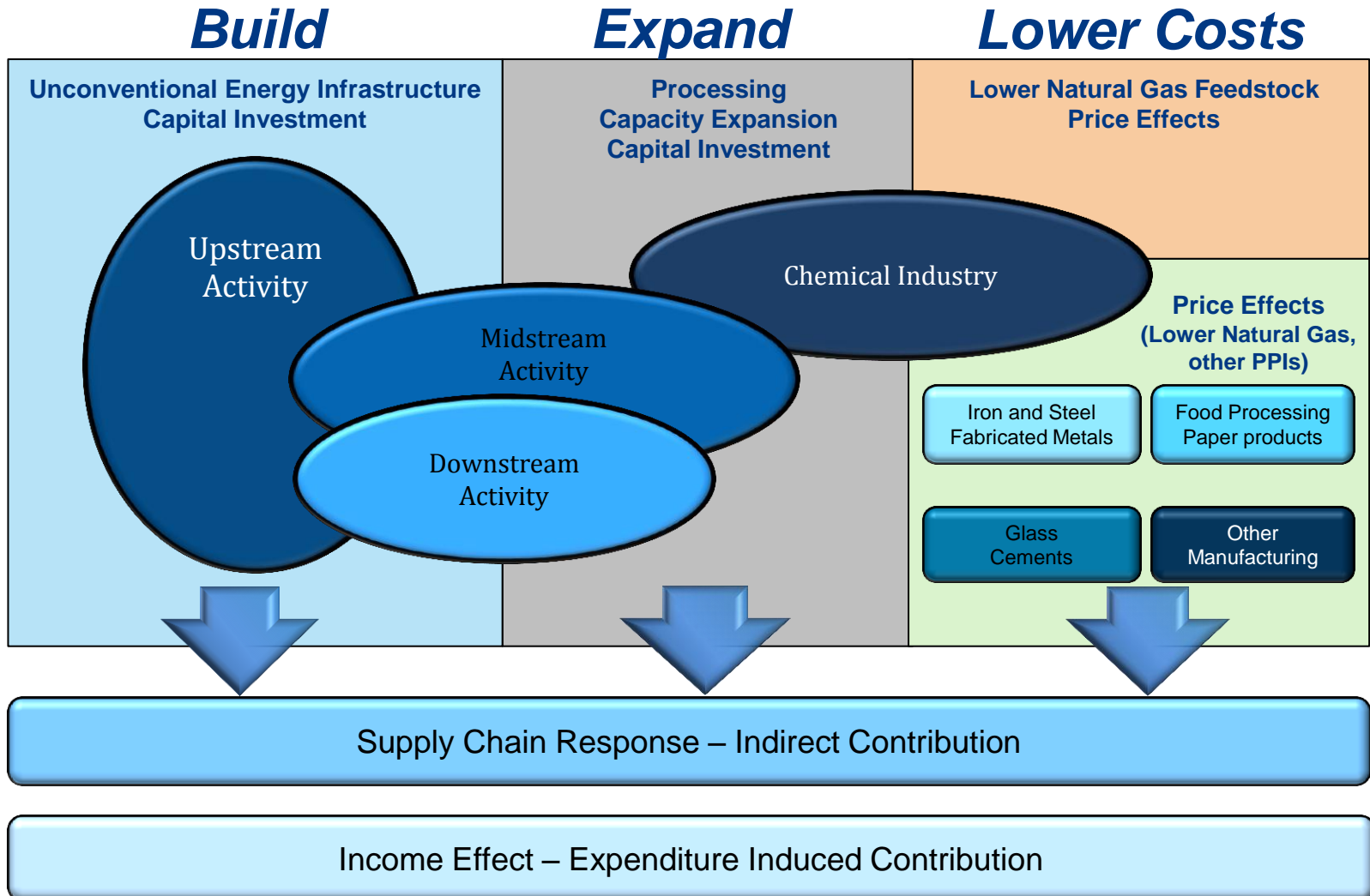
- The rise in production unlocked by the unconventional revolution has created significant near term expansion opportunities for midstream and downstream energy activity.
- Capacity expansion by energy-related chemicals starts modestly then expands substantially as midstream and downstream energy infrastructure is completed.
- By the end of the decade, production of energy-related chemicals will gain momentum, making it possible for the United States to become a net exporter of selected energy-related chemical products.
- End users and consumers will benefit from decreases in the cost of both energy and manufactured goods.

...and launching a game-changing transformation of US Manufacturing



- More than \$2.4 trillion of investment is expected to take place in the broad value chain until 2025.
 - Over \$87 billion in 2012 upstream investment was accompanied by nearly \$34 billion of midstream/downstream energy and energy-related chemicals spending.
- The Southern region (where refining capacity and chemical plants are concentrated) will lead with the majority of capital investments followed by the Midwest, while the supplier impact will be dispersed throughout the United States via an extensive network of domestic suppliers.
 - Fosters employment gains across many industries and regions of the US.
- Unconventional capital expenditures and operating expenditures creates jobs.
 - In 2012, unconventional supported more than 2.1 million jobs.
 - In 2020 and 2025, the number of jobs will rise to over 3.3 million and nearly 3.9 million jobs in 2020 and 2025, respectively.

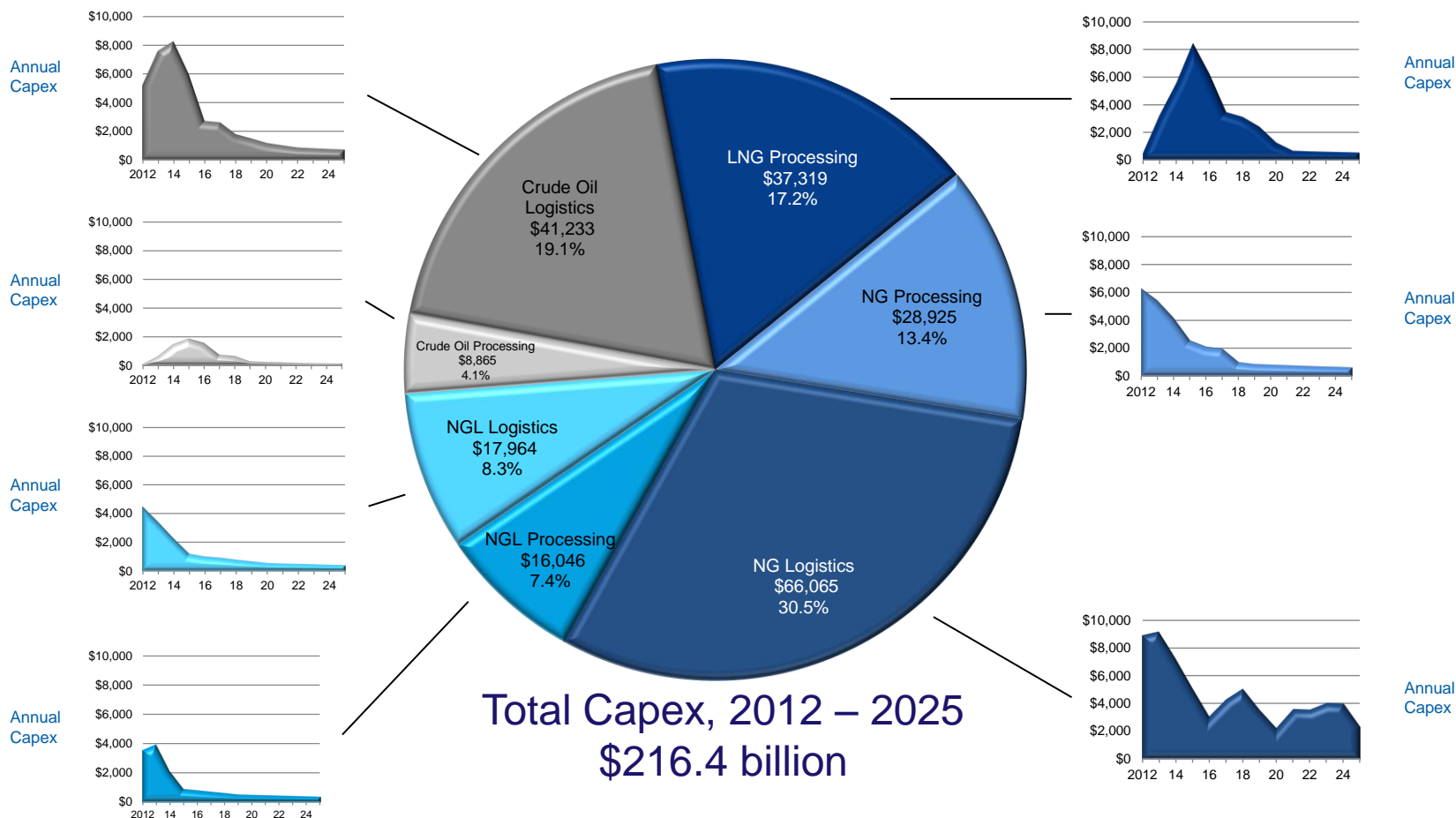
Impact of Unconventional Activity on US Manufacturing



Midstream and Downstream Capital Expenditures



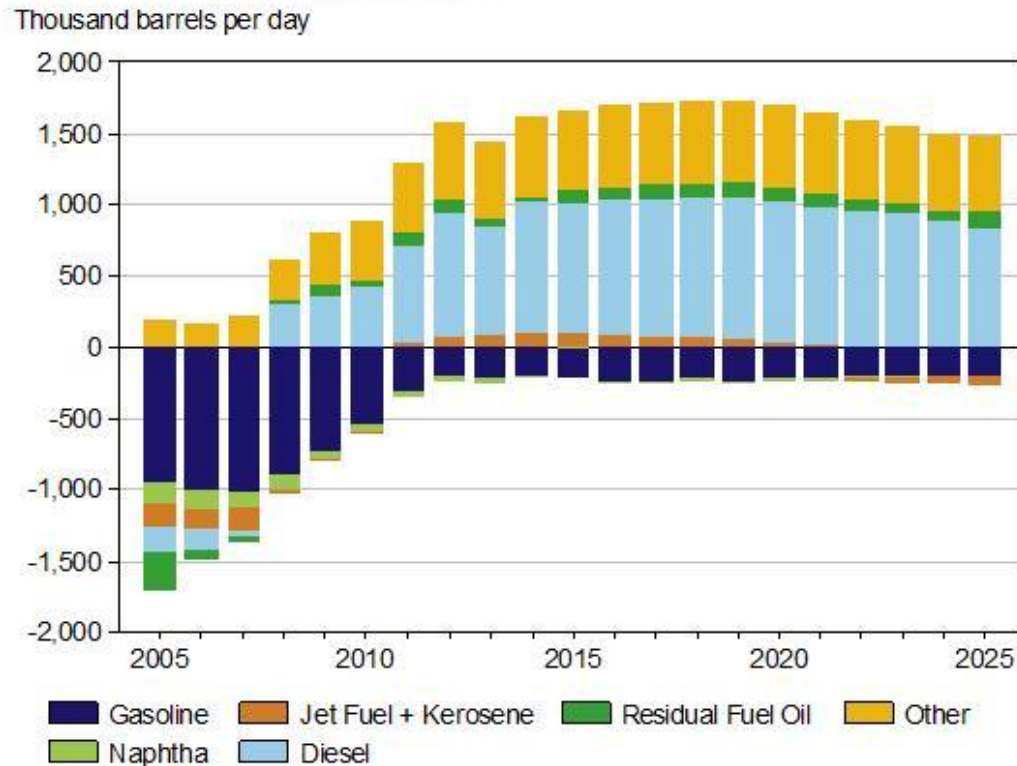
Initially, infrastructure expansion will be undertaken to support upstream activity – by the end of the forecast, capital expenditures moderates.



A Different Outlook for US Refined Products



US Refined Product Net Exports



Source: EIA and IHS Energy

- Increased domestic energy production and other factors are expected to reduce US imports of refined petroleum products and increase exports.
- Expected production increases by 2025 will reduce crude oil imports. At a \$95 per barrel oil price, the net improvement on trade is approximately \$87 billion annually.

The impact on chemicals is very broad

Affected product chains account for 45% of 2012 US chemical industry capacity

- Ripples through product chains are becoming evident further downstream
- Impact is transformational for the US
- Acrylics – Acrylic Acid, and Acrylonitrile
- Aromatics Chain – Aniline, Nitrobenzene
- Nitrogen Fertilizers – Ammonia, Ammonium Nitrate and Urea
- Chlor-alkali – Chlorine and Caustic
- Olefins – Ethylene, Propylene (PGCG), Hexene, Octene, Butene-1 and Butadiene
- Polyolefins – High Density PE, Low Density PE, Linear Low Density PE and Polypropylene
- Vinyls Chain – Ethylene Dichloride, Vinyl Chloride Monomer and PVC
- Glycols Chain – Ethylene Oxide, Propylene Oxide, Monoethylene Glycol, Diethylene Glycol, Triethylene Glycol, PEG, Ethoxylates
- Methanol Chain – Methanol, Formaldehyde, Methyl Methacrylate, MTBE and MDI

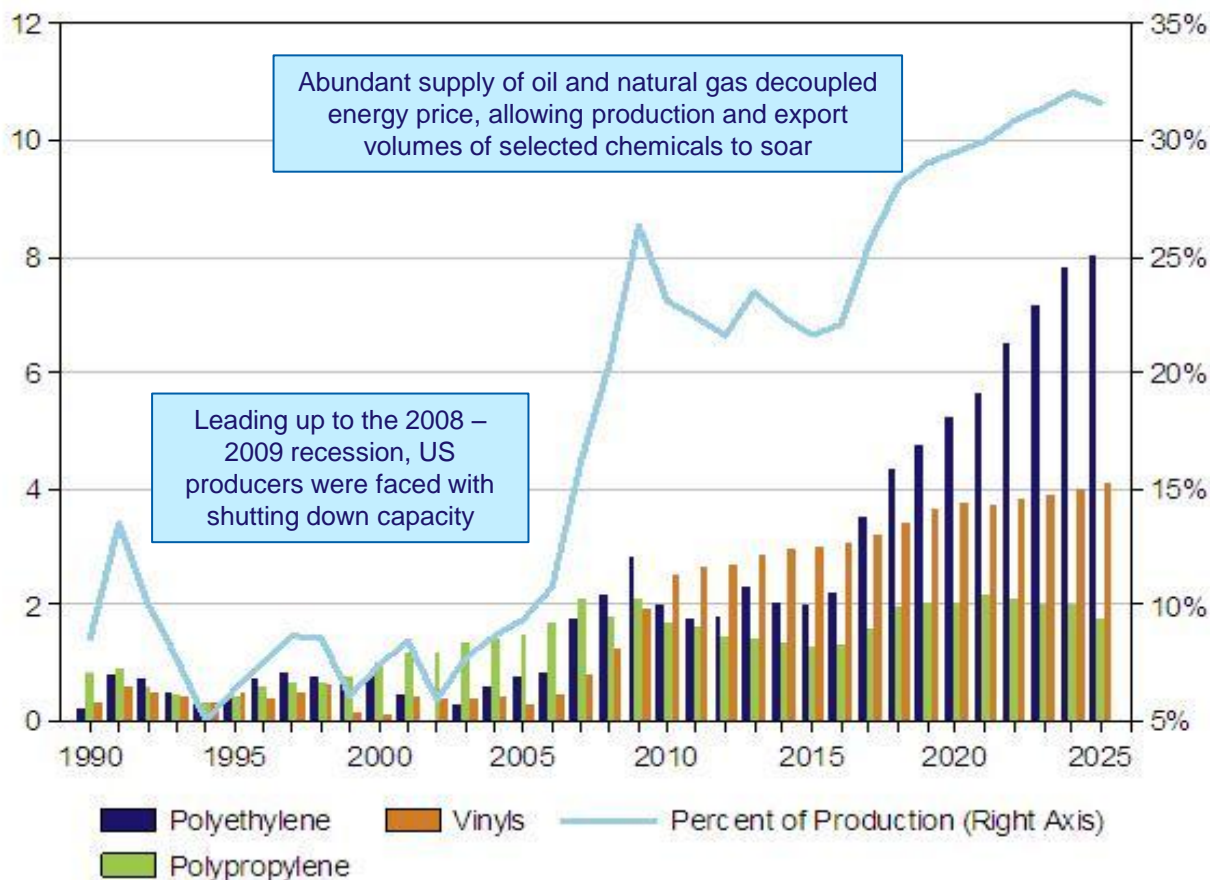


Unconventional Energy Provides US Chemical Producers with a Competitive Feedstock Position



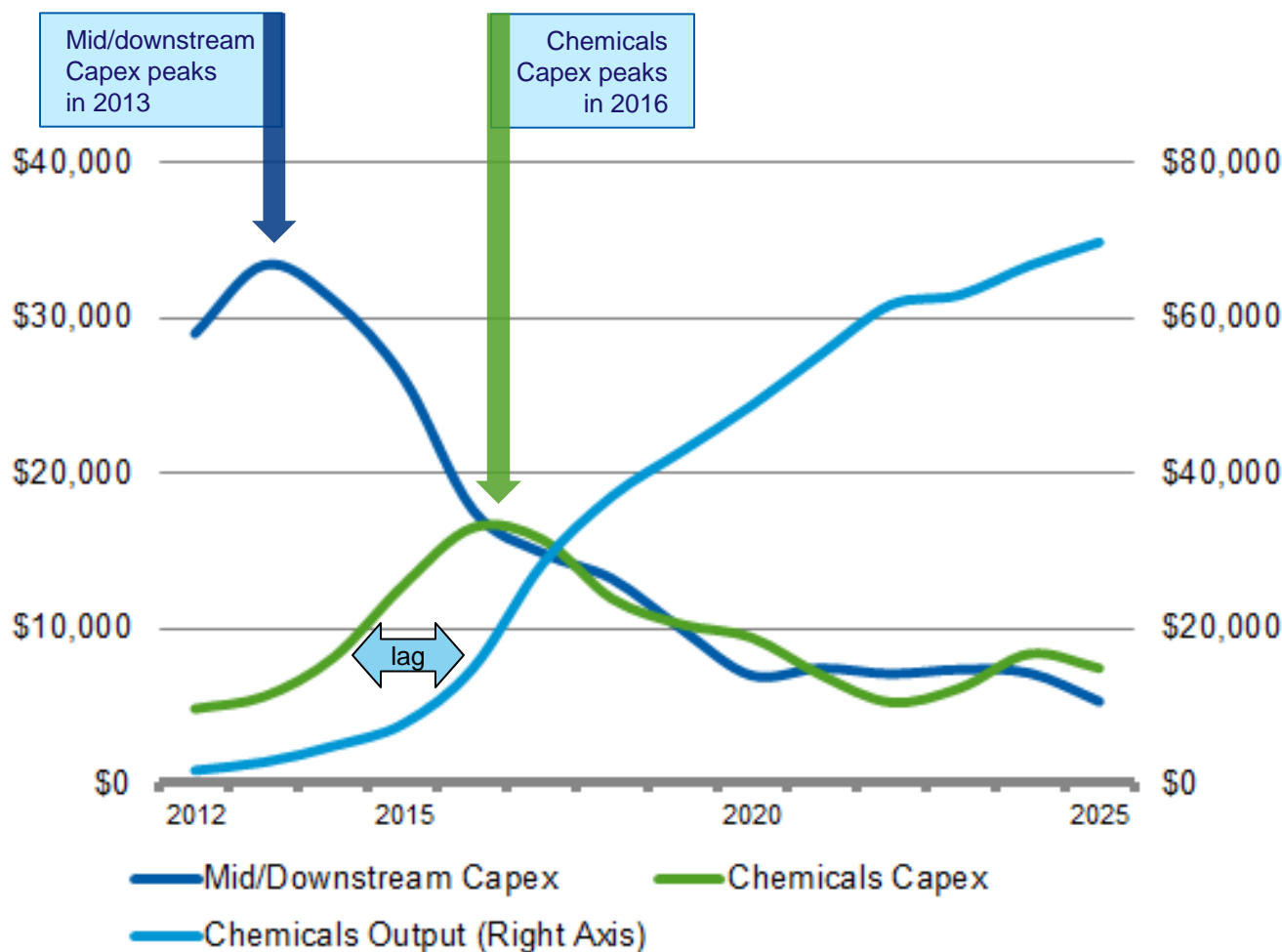
US Net Exports for Selected Products

Million metric tons



Source: IHS Chemical

The ramp up in Chemicals production will necessarily lag capex investment cycles



Source: IHS

US Based Energy-Related Chemicals Expands



- As energy infrastructure is built, capacity expansion in energy-related chemicals peaks mid-decade, leading to production gains toward the end of the forecast period.

Energy-Related Chemicals Value of Production and Capital Expenditures: United States

(Current \$M)

| | 2012 | 2015 | 2020 | 2025 | 2012-2025 |
|-----------------------------------|--------------|---------------|---------------|---------------|----------------|
| Value of Production | | | | | |
| Acrylics | 114 | 329 | 744 | 1,531 | 10,807 |
| Nitrogen Fertilizers | 333 | 697 | 5,003 | 6,411 | 53,747 |
| Chlor-alkali | 386 | 1,428 | 1,551 | 2,094 | 20,072 |
| Olefins | 28 | 436 | 3,720 | 5,890 | 36,990 |
| Polyolefins | 174 | 1,469 | 24,221 | 34,875 | 244,455 |
| Vinyls Chain | 112 | 705 | 4,706 | 7,969 | 49,893 |
| Glycols Chain | 378 | 731 | 3,648 | 4,360 | 35,457 |
| Methanol Chain | 170 | 1,914 | 5,041 | 6,524 | 53,342 |
| Aromatics Chain | 0 | 0 | 59 | 108 | 587 |
| Total Value of Production | 1,695 | 7,709 | 48,694 | 69,761 | 505,350 |
| Total Capital Expenditures | 4,818 | 12,787 | 9,408 | 7,427 | 129,305 |

Source: IHS Chemical

Segments of the Value Chain have Different Employment Contribution Trends



- The employment contribution trends of midstream and downstream energy versus energy-related chemicals reflect these industries' differing capacity expansion and production outlooks.
- During the forecast period, the employment contribution is expected to moderate in the midstream and downstream energy value chain while the energy-related chemicals value chain is expected to gain strength.

Employment Contribution due to the Unconventional Activity Value Chain: Base Case*

(Number of workers)

| | 2012 | 2020 | 2025 |
|--|------------------|------------------|------------------|
| Upstream Energy Activity | 1,748,604 | 2,985,168 | 3,498,678 |
| Midstream and Downstream Energy Activity | 323,648 | 73,530 | 56,989 |
| Energy-Related Chemicals Activity | 53,252 | 277,356 | 318,748 |
| Total Activity | 2,125,504 | 3,336,055 | 3,874,415 |

Manufacturing Employment Contribution



- Manufacturing will benefit from supply chain impacts and price effects attributable to unconventional development, which will help create and sustain jobs.
- Over the entire forecast period, IHS estimates that one out of every eight US jobs supported by unconventional oil and natural gas development will be in manufacturing.
- By 2015, 3.2% of all US manufacturing jobs will be linked to unconventional development. By 2025, this share will jump to 4.2%.
 - This means that unconventional development will support close to 400,000 manufacturing jobs in 2015 and just over 500,000 in 2025.

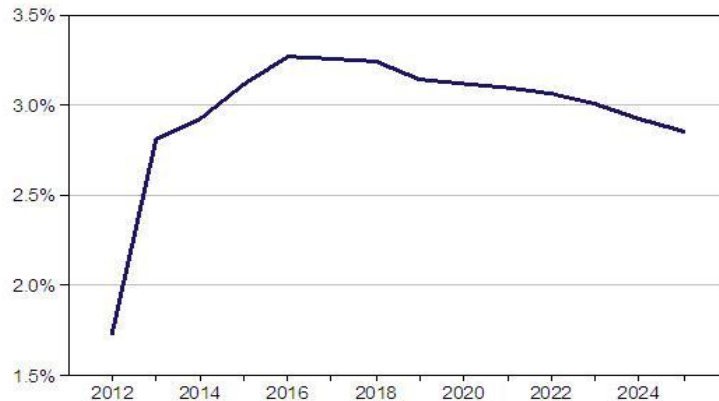
A Counterfactual Assessment of Unconventional's Contribution to the US Economy



Insights derived by comparing the US economy with unconventional activity to a counterfactual analysis that removes unconventional activity.

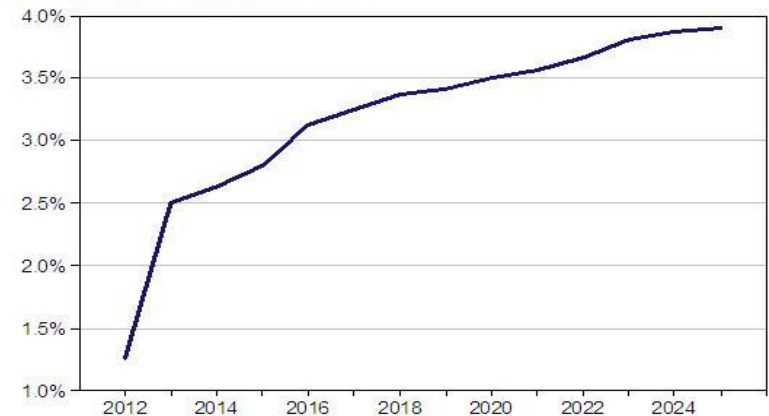
IHS estimates that, on average, unconventional energy will contribute 0.1% to annual GDP growth rates over the next decade.

Change in Gross Domestic Product due to the Unconventional Activity Value Chain: Base Case*



- GDP contribution under the unconventional revolution conditions will be higher, peaking at 3.2% in 2016 before moderating for the rest of the forecast period.

Change in Industrial Production Index due to the Unconventional Activity Value Chain: Base Case*

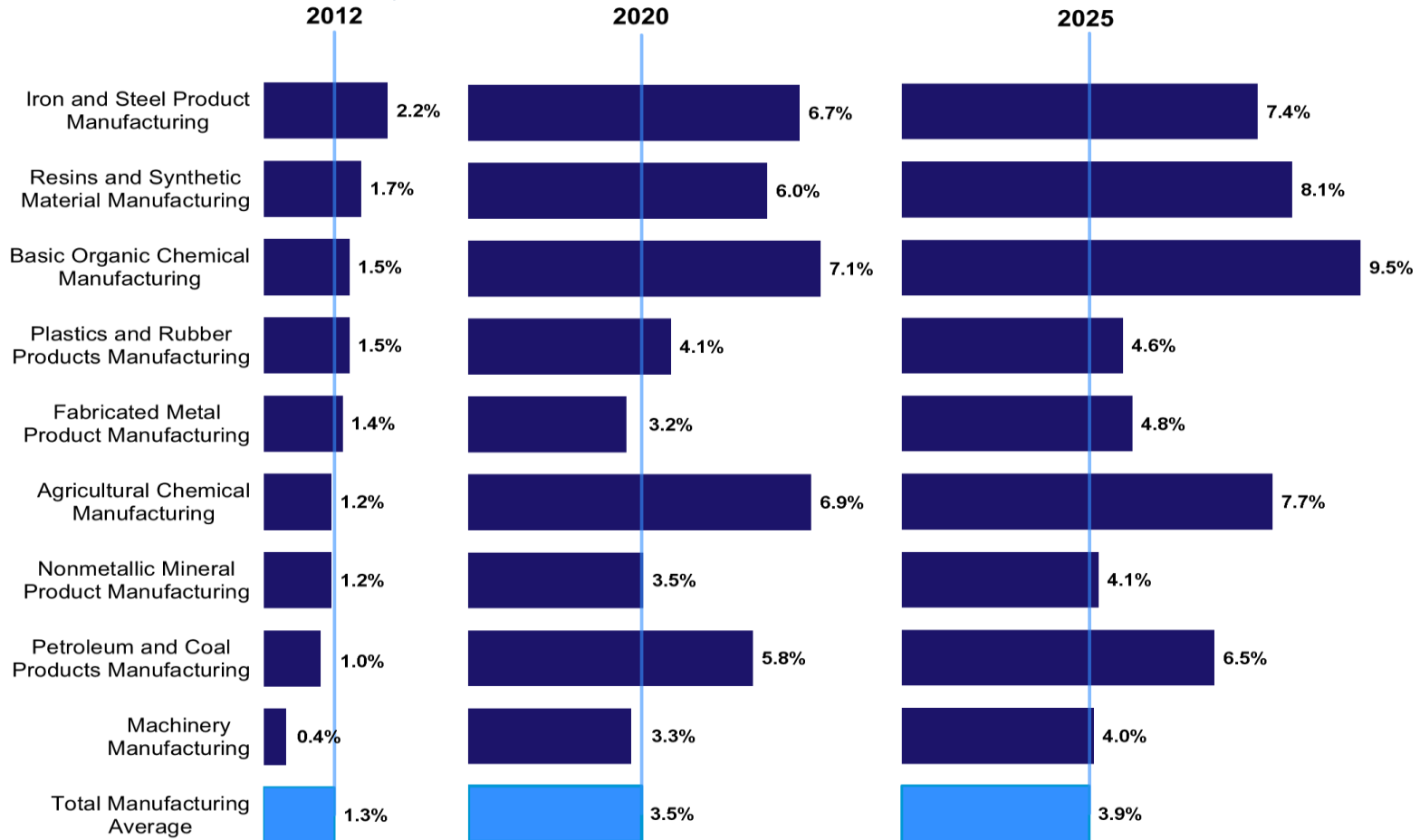


- The unconventional revolution will continue to benefit US manufacturing industries over longer term as the cost of energy plays a major role for many of the manufacturing sectors.

The Impact of the Unconventional Revolution over the Forecast Period is More Pronounced in Energy-Intensive Industries



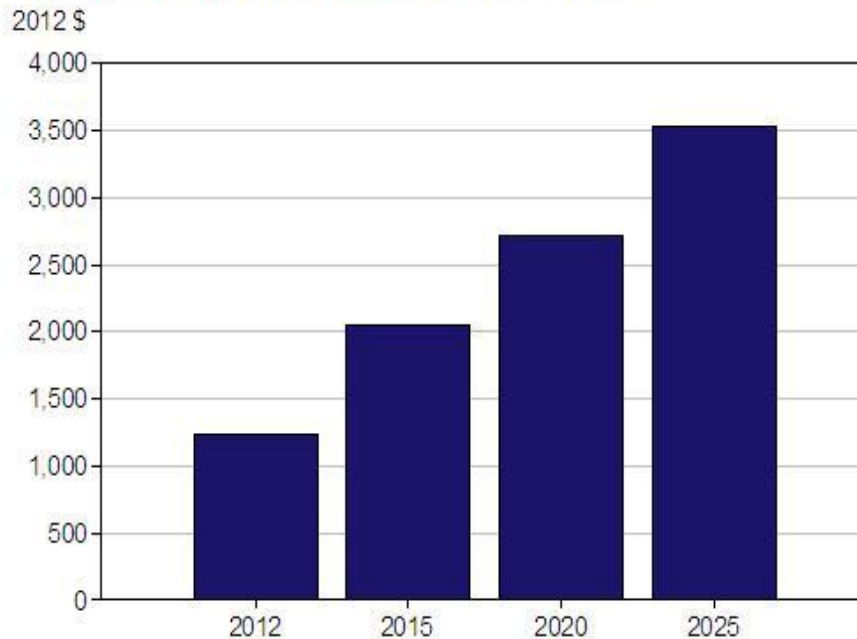
Percent Increase to Selected Industrial Production Indices due to the Unconventional Activity Value Chain



The Unconventional Revolution Increases US Household Income – Most Tangible Benefit for Many Americans



Change in Disposable Income per Household due to the Unconventional Activity Value Chain: Base Case*



Cumulative impact of increasing household wages and decreasing costs for energy and energy-intensive products.

- Wages increase as the manufacturing renaissance increases industrial activity.
- Direct consumption costs are reduced as natural gas used to heat homes and water becomes less expensive.
- Input costs for manufacturers of various consumer goods, including electricity prices, decline, reducing indirect costs for consumers.

These economic contributions are more significant when viewed against the backdrop of a struggling US economy, with slow growth and an unemployment rate that hovers above 7.5%, with 12 million individuals out of work and seeking employment.

Many Factors are in Concert with a US Manufacturing Renaissance



A confluence of many factors helped US manufacturing rebound from its 2009 recessionary trough and enter the manufacturing renaissance currently under way in the United States:

- Productivity gains for US workers,
- Significant technological advances, and
- Slower growth in hourly compensation relative to our global competitors.

These factors, in combination with the profound impacts of increasing unconventional oil and natural gas production, are revitalizing critical segments of the US manufacturing base.

- US manufacturers are benefitting from the availability of a secure supply of low-cost natural gas, especially manufacturers in energy-intensive industries.
- Energy-related chemicals, petroleum refining, aluminum, steel, glass, cement, and the food industry – these are key energy-intensive sectors that are expected to invest and increase their US operations in response to declining prices for their energy inputs.

Conclusion



- Unconventional oil and natural gas activity is reshaping America's energy future and bringing significant benefits to the US economy in terms of jobs, government revenues, and GDP.
- A new era of affordable and abundant energy is creating significant competitive advantages for the US in both energy-intensive industries and industries that rely on natural gas derivatives as critical production feedstock.
- The composite economic contributions include:
 - Jobs: 2.1 million jobs in 2012, 3.3 million by the end of the decade, and almost 3.9 million by 2025.
 - GDP: annual contributions will nearly double from \$284 billion in 2012 to \$533 billion in 2025.
 - Government revenues: average \$115 billion annually, totaling over \$1.6 trillion from 2012 to 2025.
 - Real household disposable income: increase of more than \$1,200 in 2012, just over \$2,000 in 2015 and more than \$3,500 in 2025.
 - With 120 million households in the country, this equates to an aggregate annual boost of over \$163 billion.

Thank You!



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