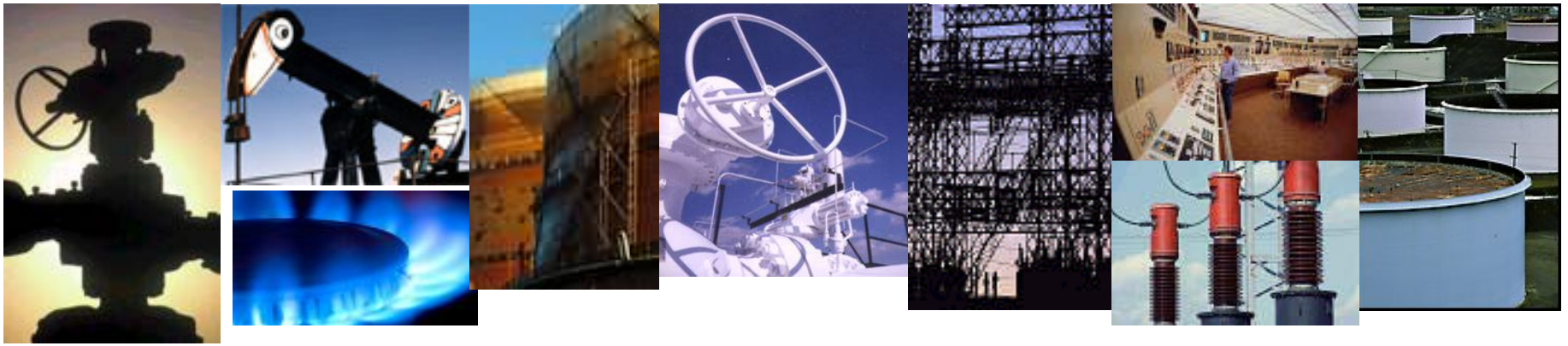

Natural Gas Leveraged Economic Development in the South

Southern Governors Association Meeting

August 16, 2014

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Center for Energy Studies
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Overview: Energy-Based Manufacturing

Overview: Why Future Economic Development Will Not be Uniformly Distributed

While the nature of manufacturing has admittedly changed given the "out-sourcing" prior to the 2008-2009 financial meltdown, the U.S. economy is beginning to emerge as a new manufacturing powerhouse.

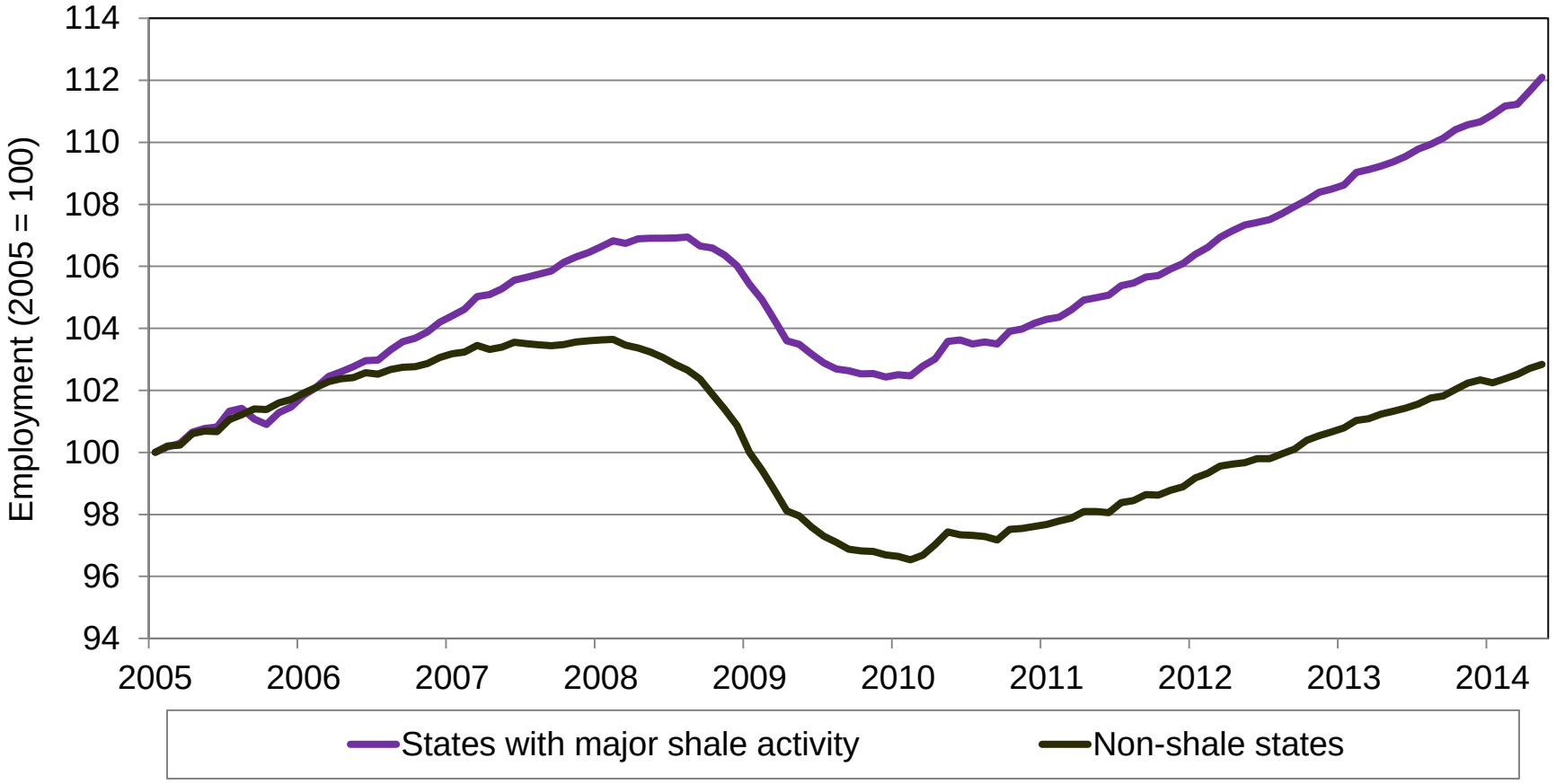
However, the U.S. economic recovery, and regional economic development opportunities over the next decade will likely be concentrated in a few states and regions. What determines the "winners" and "losers" in this economic resurgence?

The "winners" will be those areas with access to low-cost energy supplies and transportation infrastructure that can move those supplies to rapidly emerging economic development opportunities in manufacturing that were unimaginable as recently as five years ago.

Other important factors influencing manufacturing siting locations includes the presence of a skilled labor force, competitive wage levels, supportive tax policies, as well as fair and stable regulations and regulatory practices.

Relative Employment Changes, Shale vs. Non-Shale States (2005=100)

Total employment and employment growth has been faster in unconventional shale-based states than in those without these unconventional resources.



Note: Shale states include Arkansas, Colorado, Louisiana, North Dakota, Pennsylvania, Utah and Texas
Source: Bureau of Labor Statistics

Overview: Why Energy-Based Manufacturing

What is “energy-based manufacturing?”

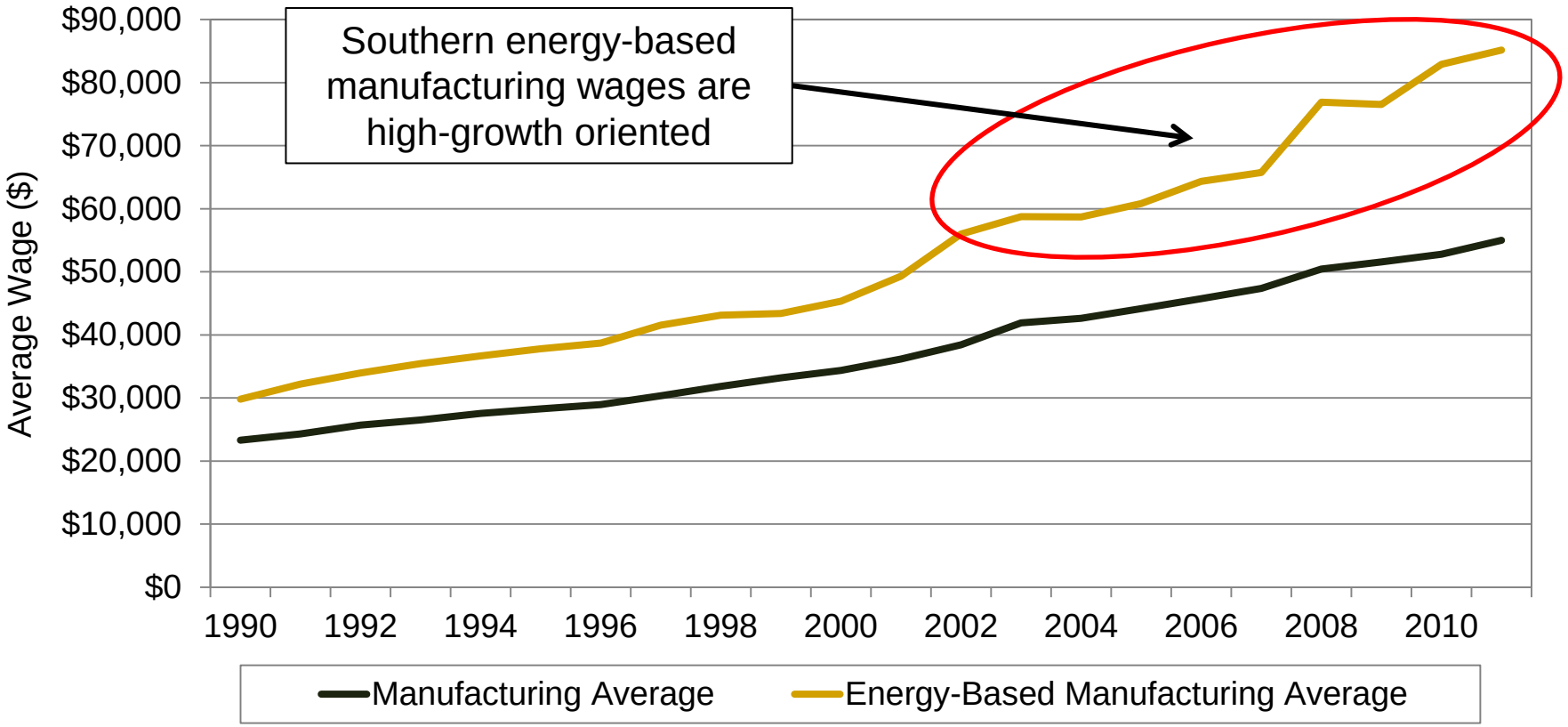
Energy-based manufacturing is comprised of industries that focus or rely heavily on energy as the primary input to make their respective products.

Energy is typically a “feedstock” for these industries which use energy to make a number of different products much like a baker uses a common input (flour) to make a variety of different products (biscuits, baguettes, pizza dough).

These energy-based manufacturing industries are large, capital-intensive, and compete globally. Energy-based manufacturing wages are even higher than the already-above average manufacturing wage levels.

Southern Manufacturing Wages vs. Southern Energy-Based Manufacturing Wages

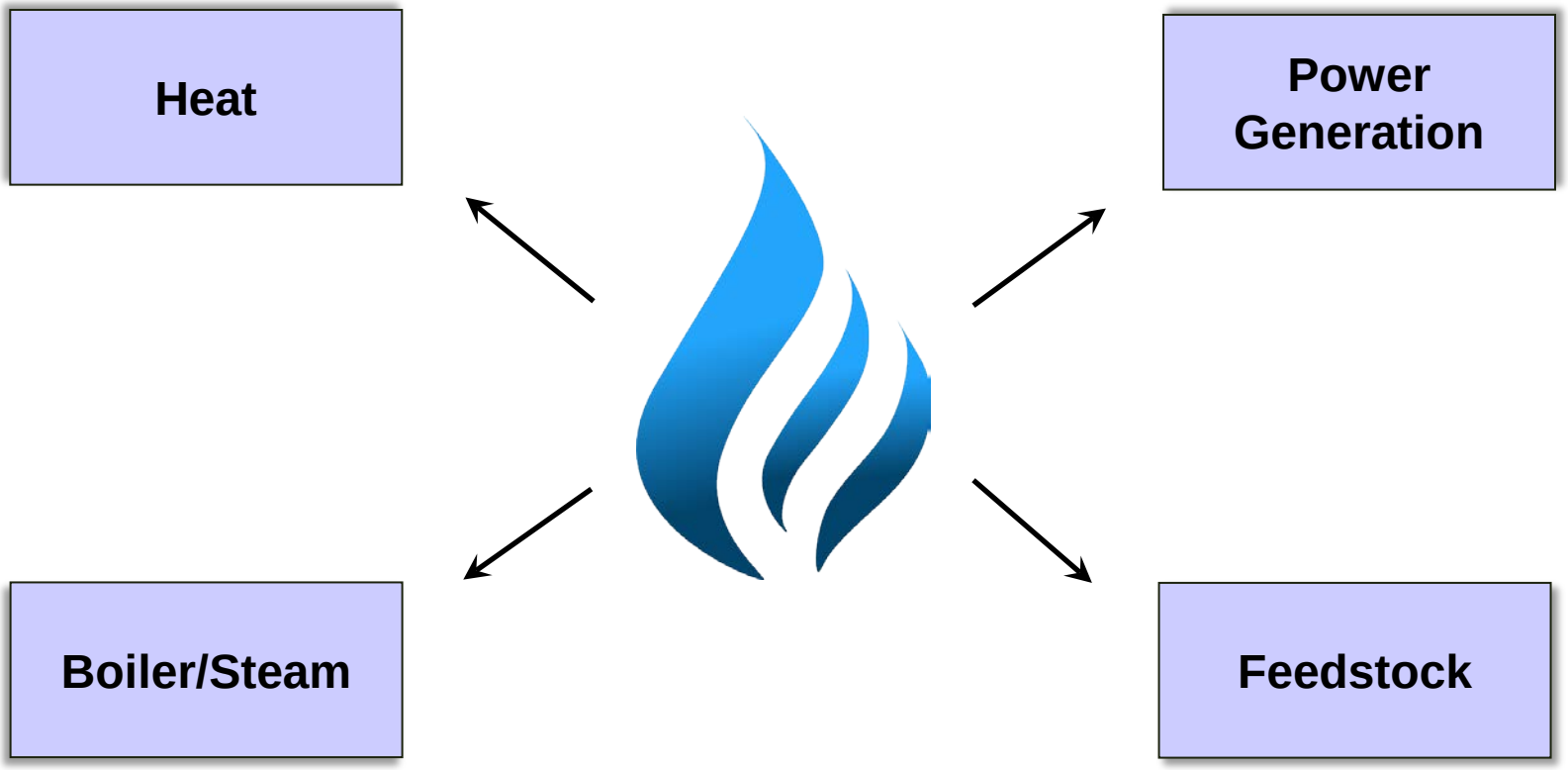
Energy-based manufacturing wages in the South are higher than the average manufacturing wage. In 2012, the average energy-based manufacturing wage was 1.5 times that of the average manufacturing wage growing at average annual rate of 5.2 percent (compared to the manufacturing average of 4.2 percent)



Note: Energy-based manufacturing includes: petroleum and coal products; chemical; and plastics and rubber products manufacturing.
Source: Bureau of Economic Analysis, U.S. Department of Commerce.

Industrial Natural Gas Usage

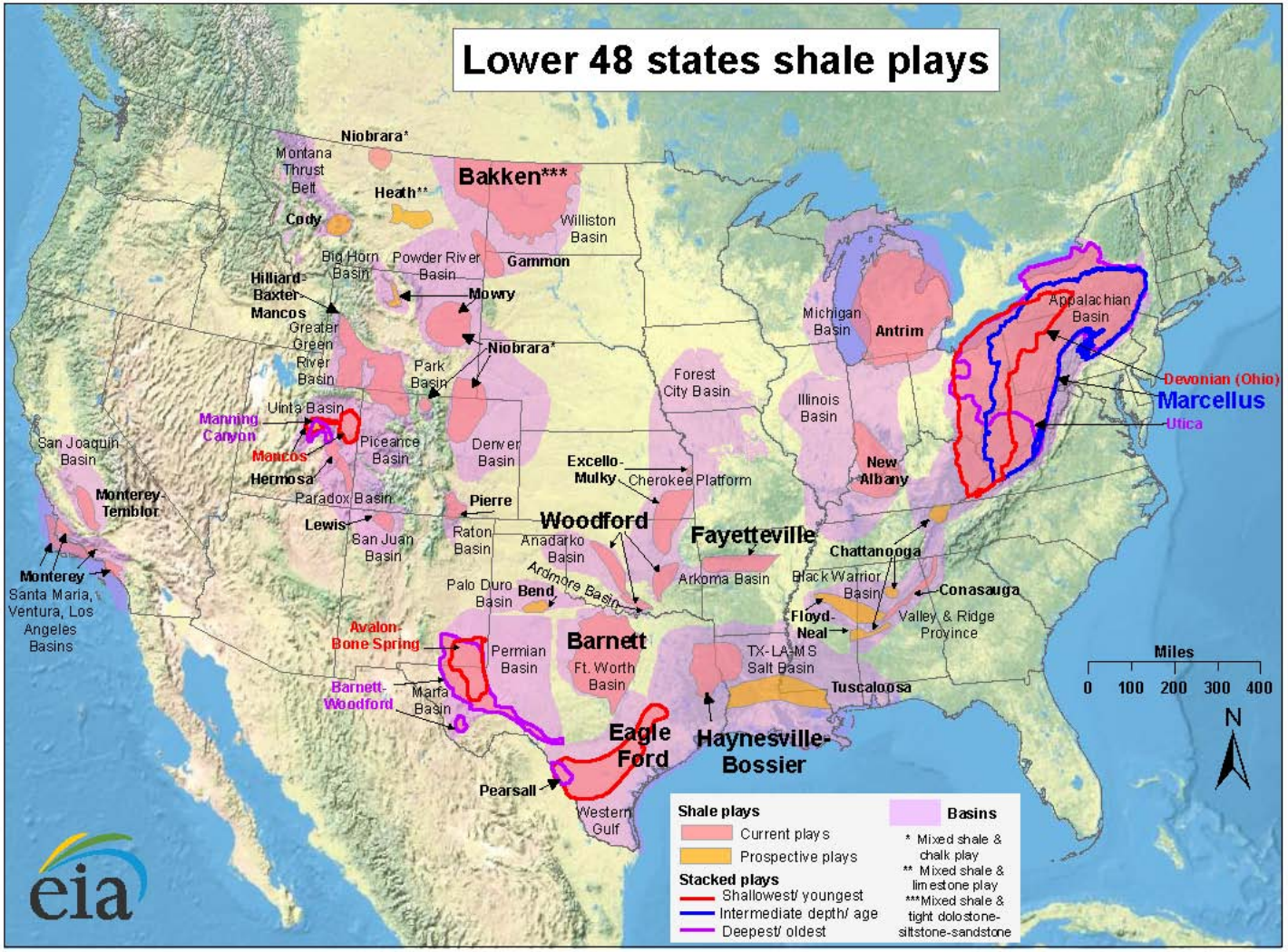
Manufacturing industries use natural gas in a range of applications that include the generation of heat, steam, and power. Feedstock uses are equally important and are the building blocks of modern petrochemical manufacturing.



The New Energy Production Revolution

Domestic Shale Basins and Plays

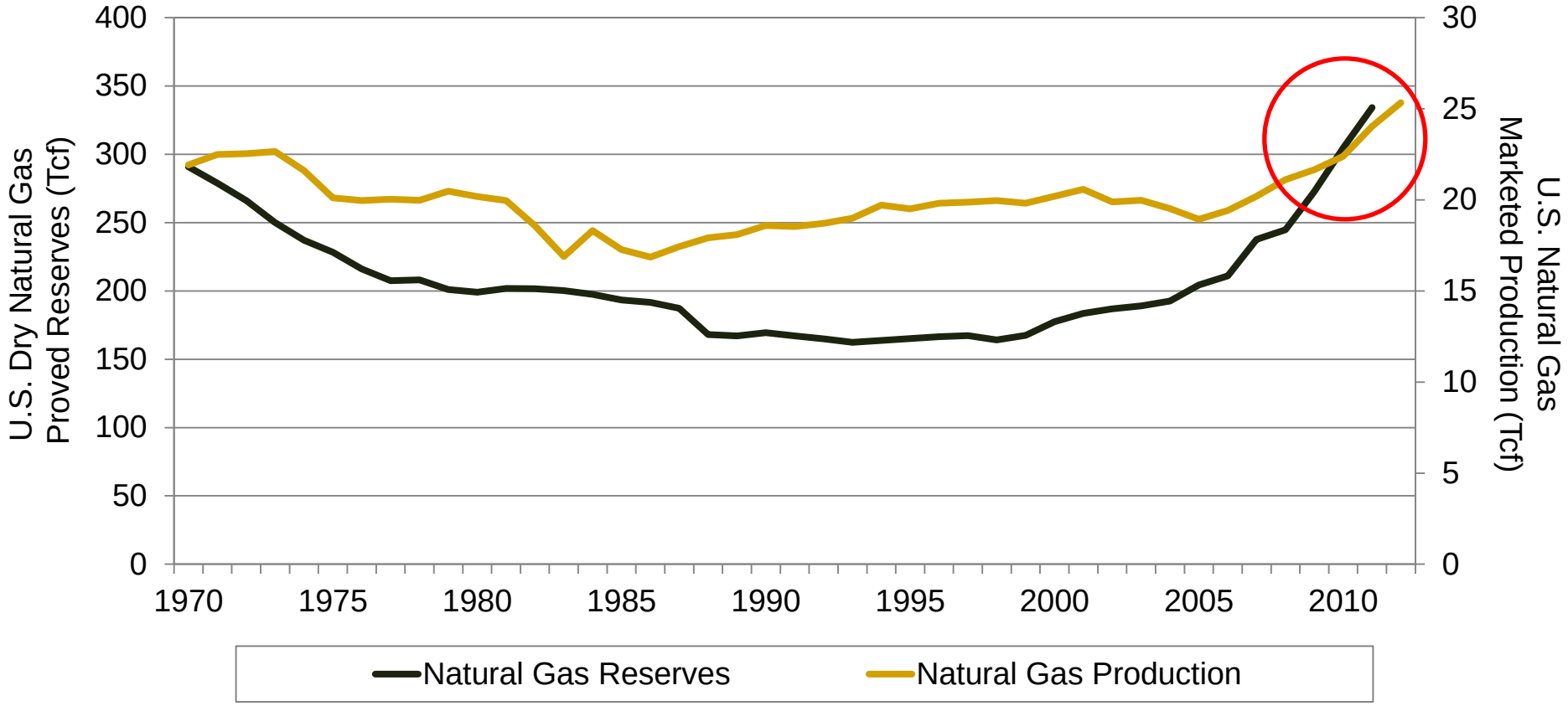
Unlike conventional resources, shale plays (natural gas, liquids, and crudes) are located throughout the U.S. and are the primary reason for the decrease in overall and regional natural gas prices.



Source: Energy Information Administration, U.S. Department of Energy

Changes in Reserves and Production

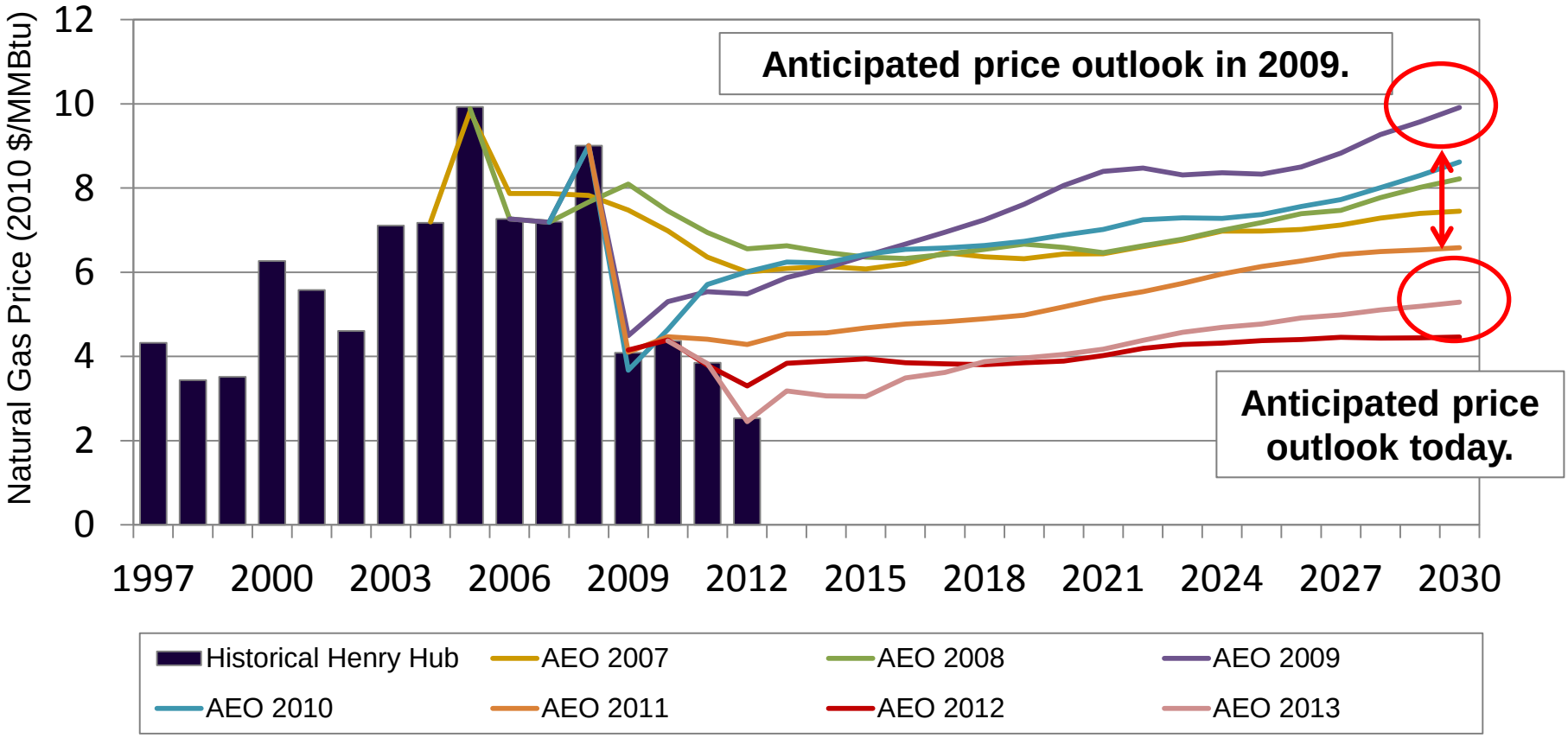
Natural gas production and reserves are at levels not seen since the 1970s. U.S. natural gas production is now at an all time high. These steady increases should lead to a consistent feedstock supply that does not impinge on other domestic natural gas uses.



Source: Energy Information Administration, U.S. Department of Energy.

Natural Gas Price Outlook – Annual Energy Outlook ("AEO")

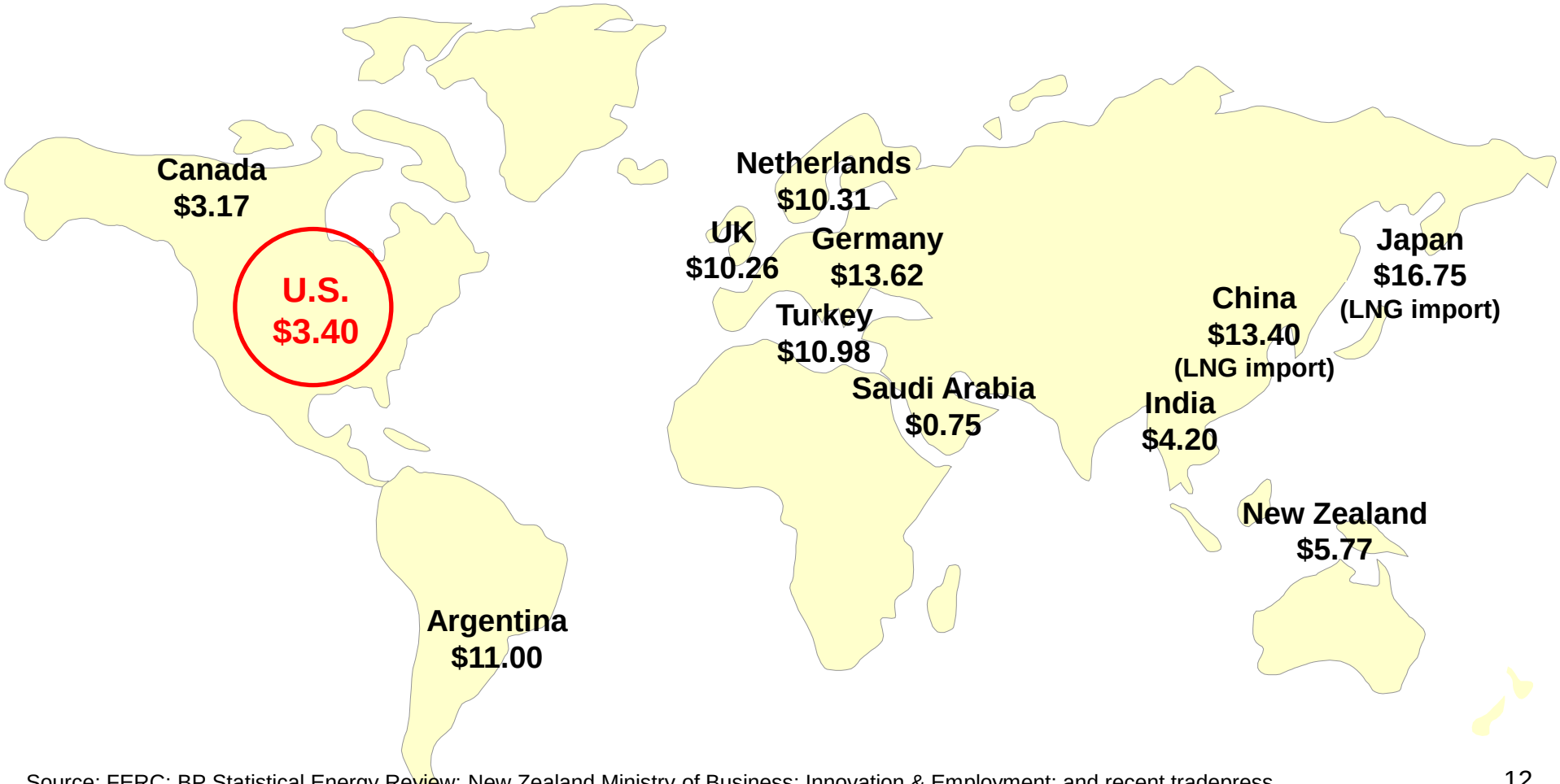
Shale reserves have a significant impact on future price outlook. Abundant supplies should keep prices stable. The current AEO forecasts natural gas prices in 2030 at $5.29/Mcf (47 percent less than the 2009 AEO forecast).



Source: Energy Information Administration, U.S. Department of Energy.

World Natural Gas Prices for Industry ($/MMBtu), 2012

U.S. natural gas prices are becoming increasingly competitive with other places around the globe that compete for new energy-based manufacturing investment.



Source: FERC; BP Statistical Energy Review; New Zealand Ministry of Business; Innovation & Employment; and recent tradepress.

Energy-Based Manufacturing Industries and Economic Footprint

Energy-based manufactruing industries have big economic footprint

	Ammonia	Methanol	Ethylene	Electric	LNG
Plant Capacity (million metric tons, Bcf/d, MW)	1.9	1.0	2.0	620.0	2.1
Capital Investment (million $)	$ 1,370.0	$ 1,100.0	$ 1,556.0	$ 568.5	$ 9,664.5
Average Investment Cost ($/ton, Bcf, MW)	$ 721.9	$ 1,100.0	$ 778.0	$ 917.0	$ 12.6
Typical Construction Duration (years)	2.3	2.3	4.0	2.5	5.0
Estimated In-State Purchases (million $)	$ 383.6	$ 308.0	$ 404.6	$ 213.6	$ 1,932.9
Estimated Direct Construction Employment (jobs)	1,450	800	800	675	3,000
Estimated Wages (million $)	$ 70.9	$ 39.1	$ 39.1	$ 33.0	$ 146.6
Estimated Natural Gas Use (Bcf)[1]	65.5	34.0	76.8	24.9	85.5
Estimated Annual Electricity Use (million MWh)[2]	17.1	5.5	8.3	n.a.	7.7
Estimated Annual Water Use (million gallons)[3]	398.5	509.7	2,788.1	635.5	n.a.
Estimated Annual Non-Energy Expenditures (million $)	$ 121.4	$ 156.3	$ 164.1	$ 13.9	$ 625.0
Estimated Annual Direct Employment (jobs)	85	125	125	25	125
Estimated Annual Direct Wages (million $)	$ 10.4	$ 18.4	$ 19.4	$ 3.0	$ 16.8

Note: All expenditure, employment and wage estimates are direct impacts only; and in-state only.
In-state purchases, wages and non-energy expenditures are estimated using IMPLAN.
Detailed assumptions are provided in the full report.

What the Strategic Factors Driving this Renewed Interest?

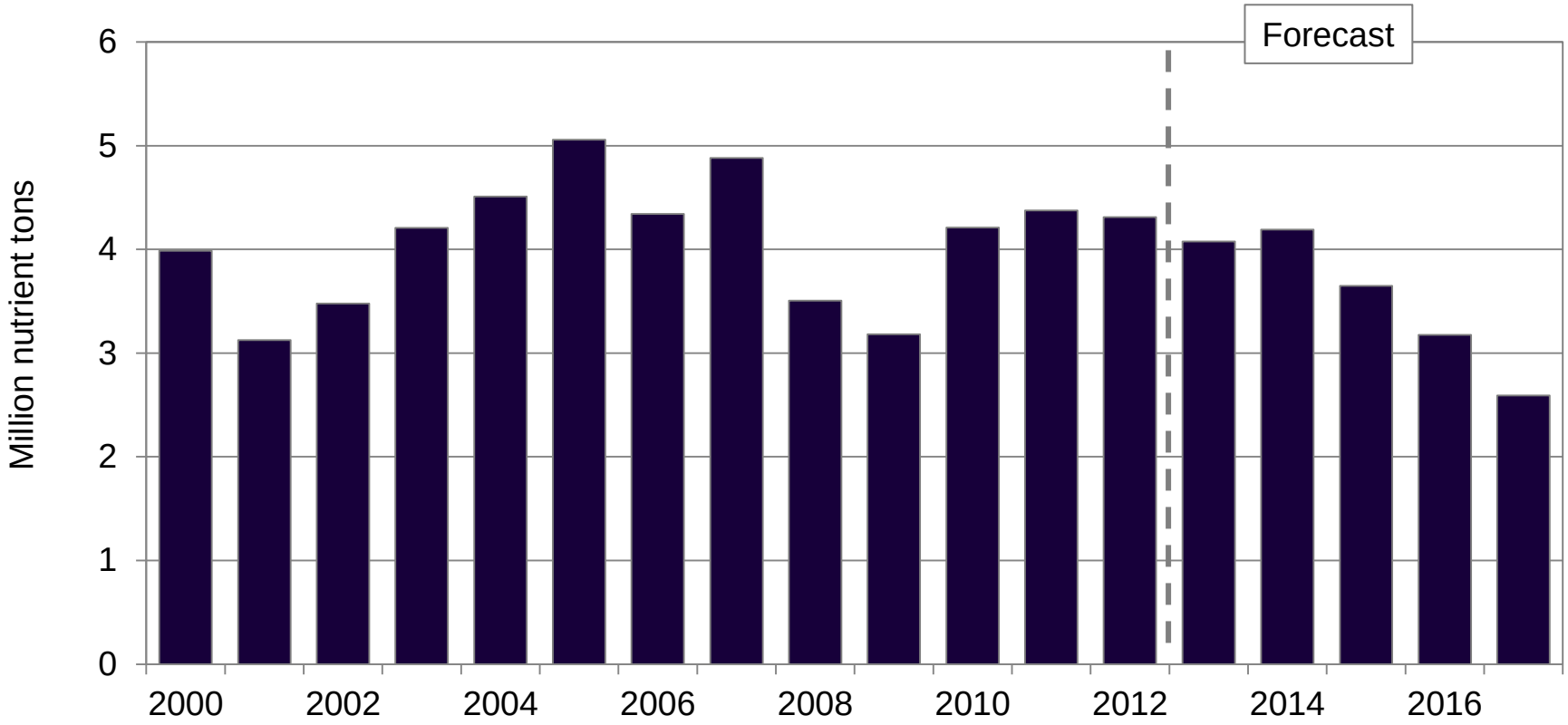
The factors driving renewed U.S. manufacturing, particularly chemical manufacturing include:

- Low natural gas price
- Increasing U.S. competitiveness
- (Relative) regulatory certainty
- Agricultural and other final chemical output price stability
- Product affordability
- Strong global demand for chemicals
- U.S. import displacement opportunities

Ammonia/Nitrogen Manufacturing

Forecasted U.S. Imports

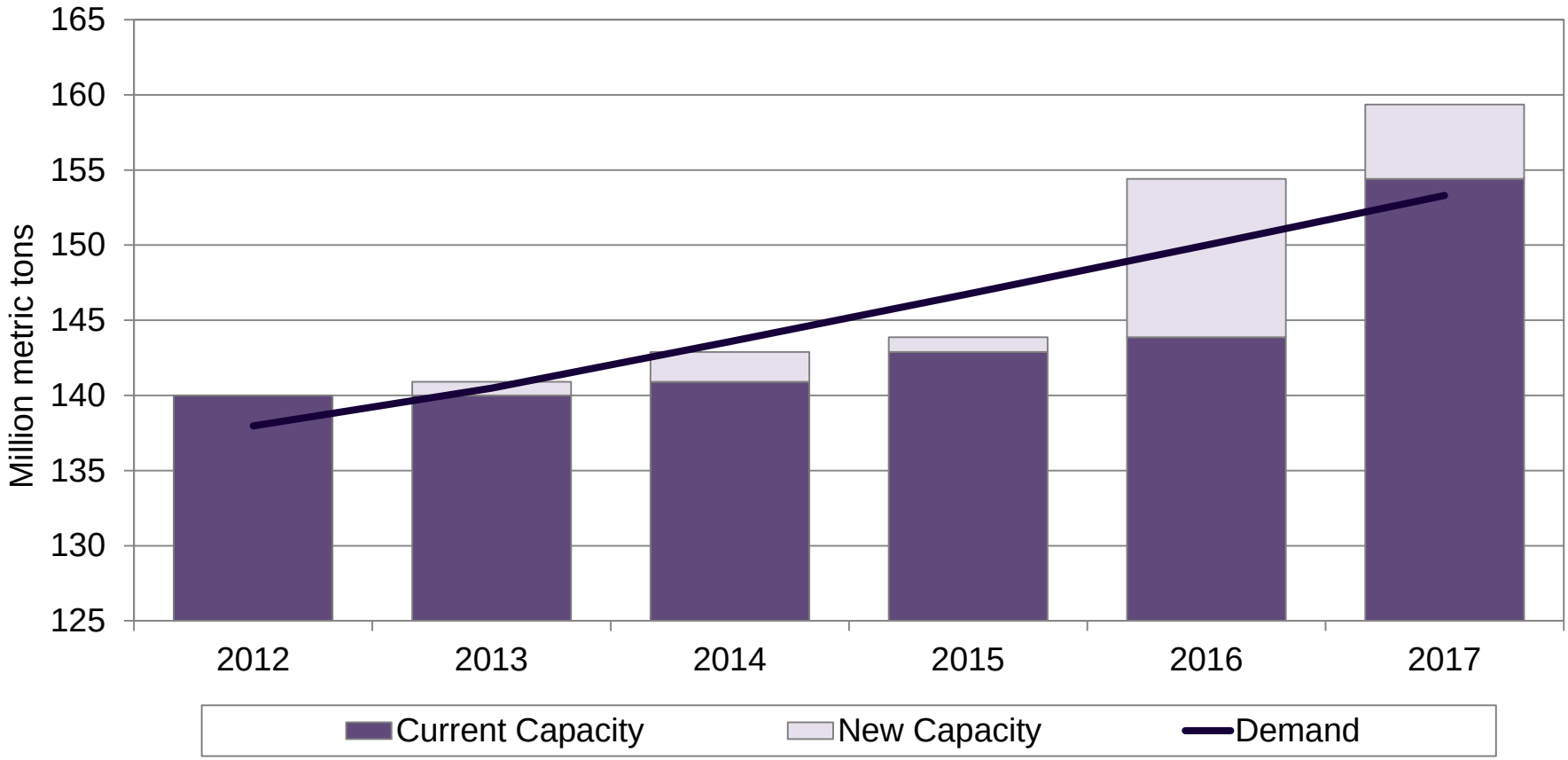
U.S. Imports are expected to drop by as much as 12 to 18 percent in 2016 and 2017 when new capacity comes online.



Note: Forecasts based on various industry sources.
Source: International Fertilizer Industry Association; Food and Agriculture Organization of the United Nations; and CF Industries.

Worldwide Ammonia Demand and Capacity

Excess global demand may start to erode in 2016. The degree to which the market potentially becomes over-supplied will be function of project cancellations (if any) and continued growth.

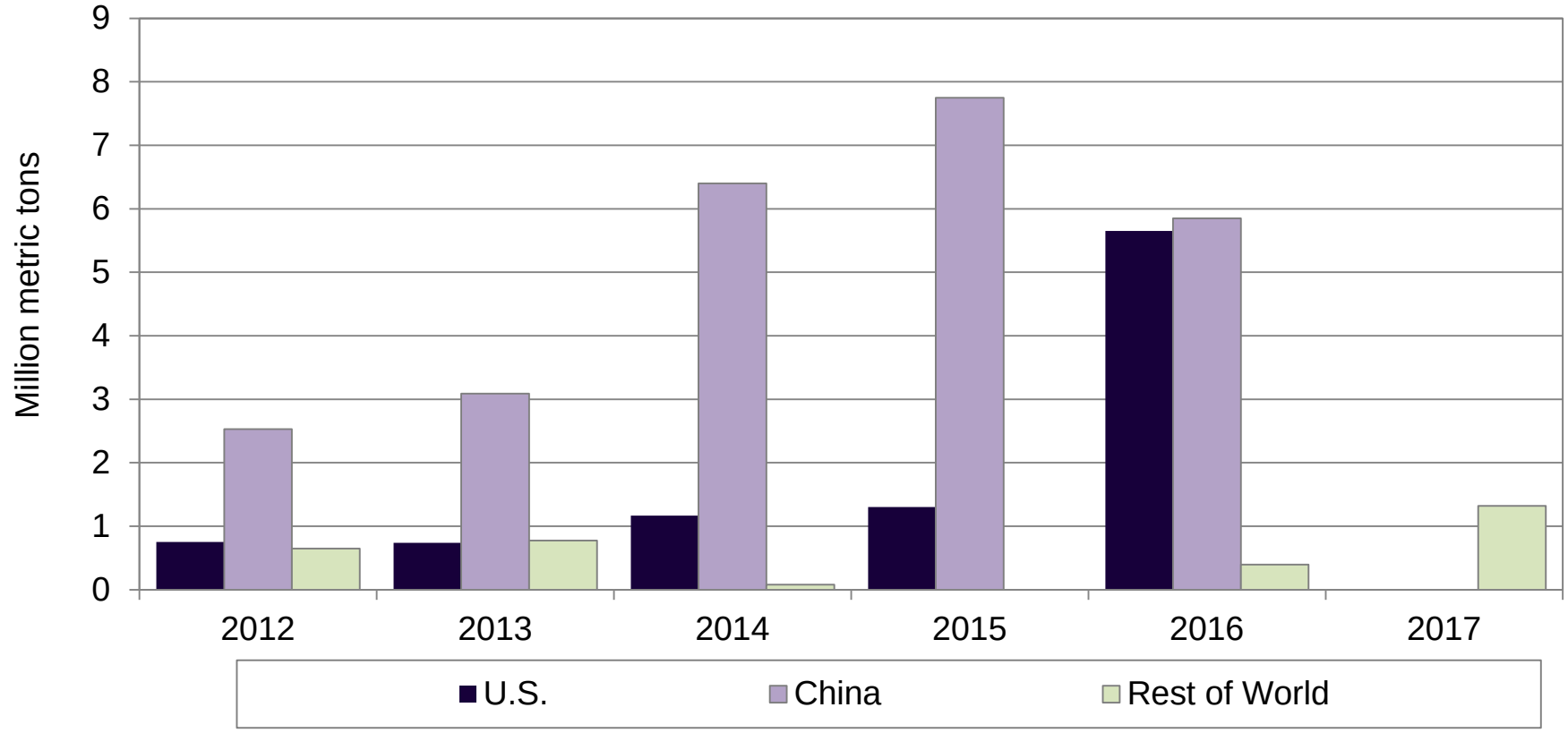


Source: Author's construct from previous slides.

Methanol Manufacturing

Existing U.S. Proposals as a Share of World

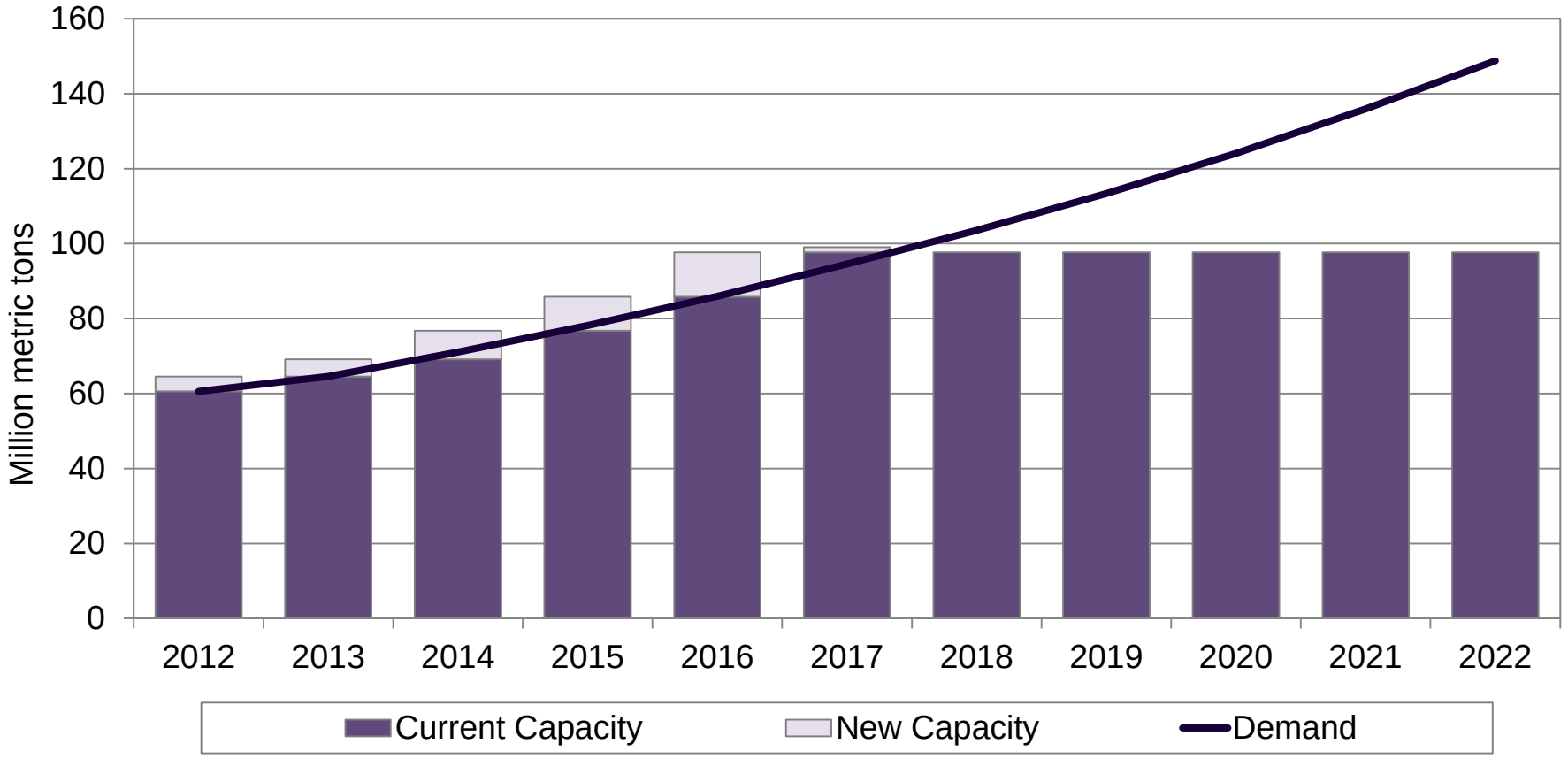
While U.S. based projects plan to add an impressive amount of methanol capacity, proposed projects in China will add almost three times as much, totaling 25 to 30 million metric tons. Projects in New Zealand, Brazil, Russia, Azerbaijan and India total 3.2 million metric tons. Still, U.S. projects account for 33 percent of worldwide projects.



Source: American Oil & Gas Reporter; Oil and Gas Journal.

Worldwide Methanol Demand and Capacity

While there may be some near term excess capacity, longer term, demand is expected to outpace methanol capacity development, particularly post-2018.



Source: Author's construct from previous slides.

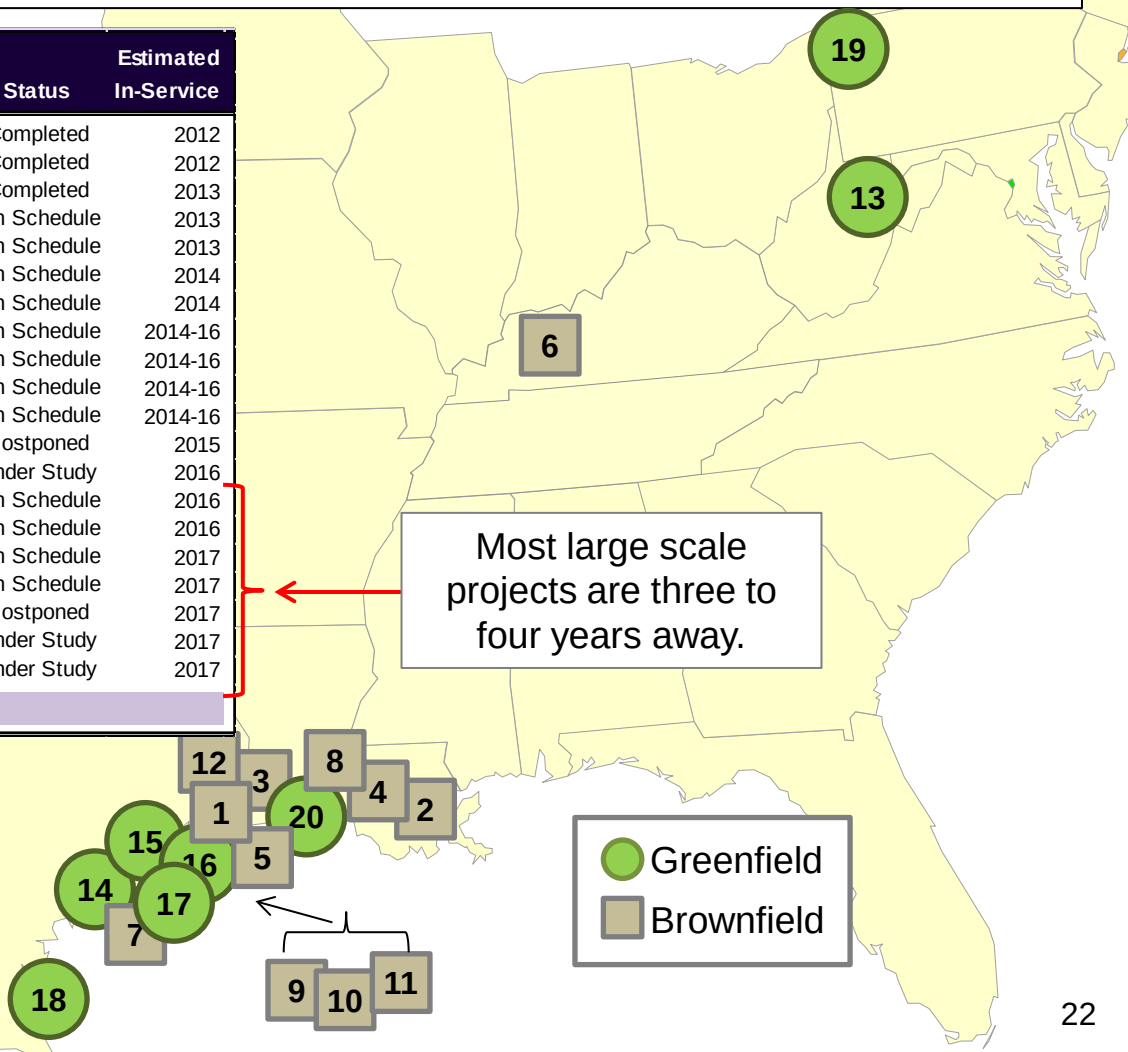
Ethylene Manufacturing

Recent and Proposed U.S. Ethylene Cracking Capacity Expansions

Over 10 million tons of ethylene cracking capacity is either under construction or has been proposed. This represents more than 35 percent of current ethylene capacity.

	Owner/Operator	Location	Capacity (tonnes/year)	Site Type	Status	Estimated In-Service
1.	BASF-Total	Port Arthur, TX	60,000	Brownfield	Completed	2012
2.	Dow Chemical	Hahnville, LA	400,000	Brownfield	Completed	2012
3.	Westlake Chemical	Lake Charles, LA	110,000	Brownfield	Completed	2013
4.	Williams	Geismar, LA	230,000	Brownfield	On Schedule	2013
5.	Ineos	Alvin, Tx	120,000	Brownfield	On Schedule	2013
6.	Westlake Chemical	Calvert City, KY	80,000	Brownfield	On Schedule	2014
7.	BASF-Total	Port Arthur, TX	100,000	Brownfield	On Schedule	2014
8.	Dow Chemical	Plaquemine, LA	200,000	Brownfield	On Schedule	2014-16
9.	Dow Chemical	Freeport, TX	200,000	Brownfield	On Schedule	2014-16
10.	LyondellBasell	Channelview, TX	230,000	Brownfield	On Schedule	2014-16
11.	LyondellBasell	La Porte, TX	390,000	Brownfield	On Schedule	2014-16
12.	Westlake Chemical	Lake Charles, LA	110,000	Brownfield	Postponed	2015
13.	Aither Chemical	Charleston, WV	n.a.	Greenfield	Under Study	2016
14.	Formosa Plastics	Point Comfort, TX	800,000	Greenfield	On Schedule	2016
15.	ExxonMobil Chemical	Baytown, TX	1,500,000	Greenfield	On Schedule	2016
16.	Chevron Phillips	Baytown, TX	1,500,000	Greenfield	On Schedule	2017
17.	Dow Chemical	Freeport, TX	1,500,000	Greenfield	On Schedule	2017
18.	OxyChem/Mexichem	Ingleside, TX	550,000	Greenfield	Postponed	2017
19.	Shell Chemical	Monaca, PA	1,000,000	Greenfield	Under Study	2017
20.	Sasol	Lake Charles, LA	1,000,000	Greenfield	Under Study	2017
	Total		**10,080,000**			

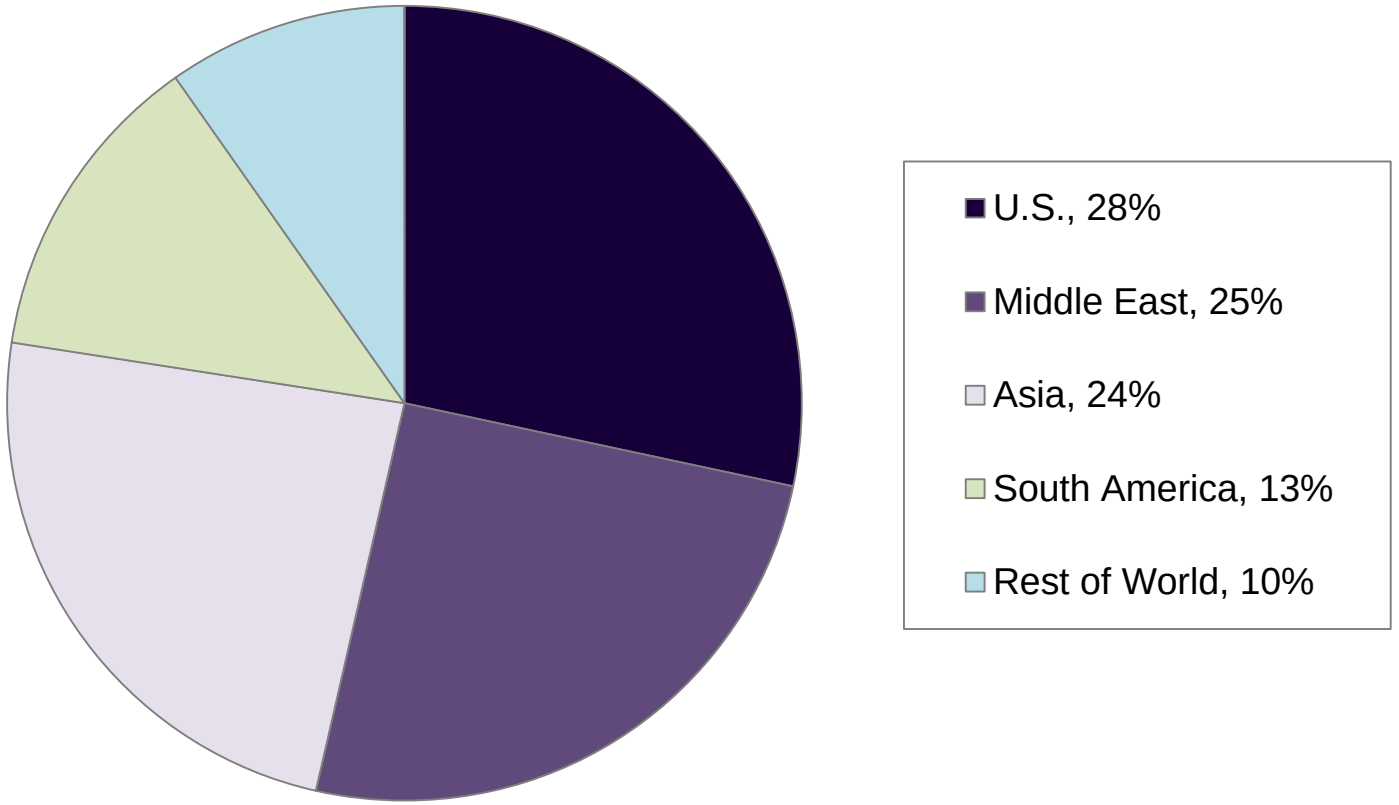
Most large scale projects are three to four years away.



Source: Platts, January 2013.

U.S. Proposals as a Share of World

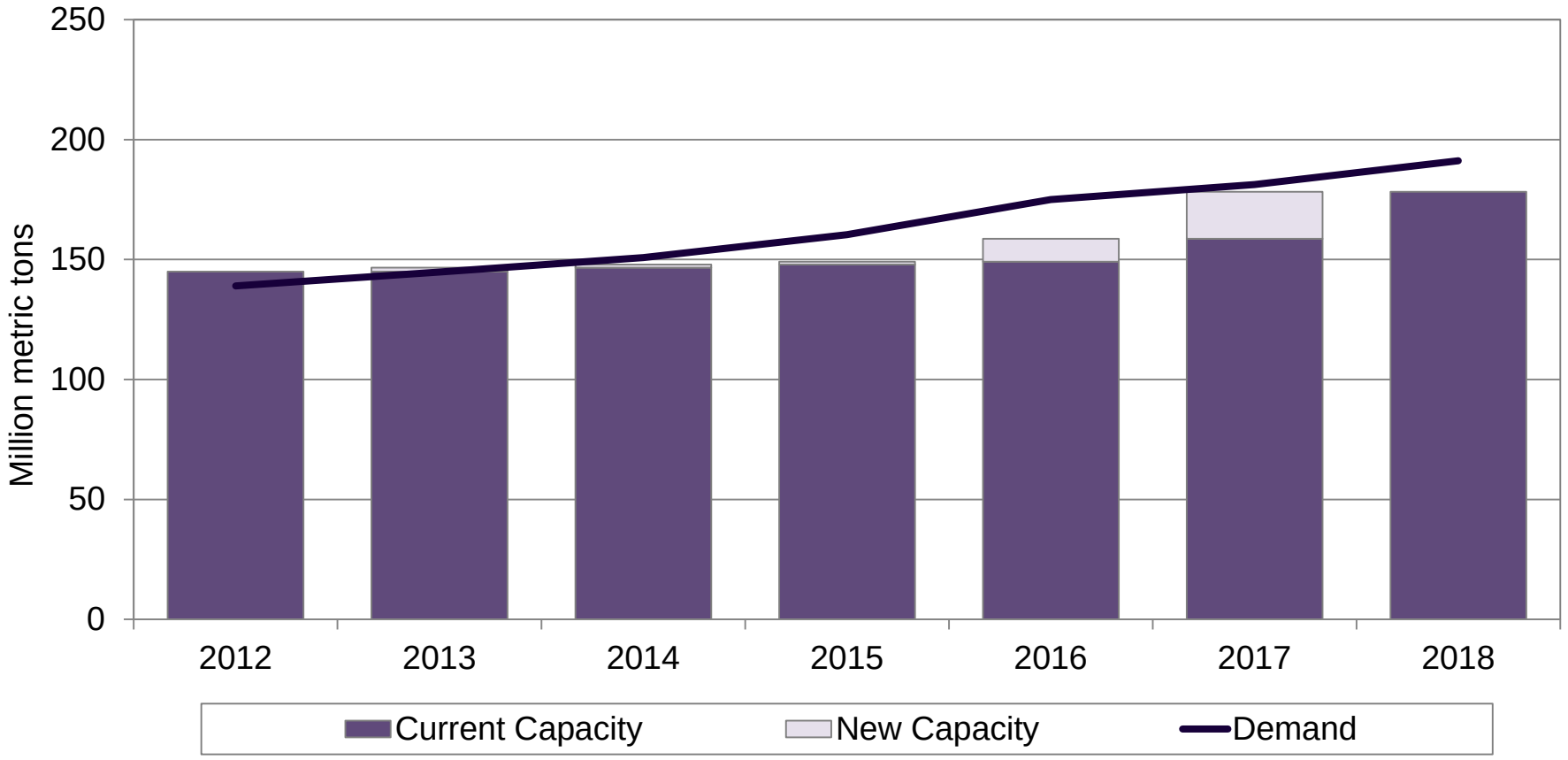
Ethylene projects in the U.S. account for almost 30 percent of projects worldwide.



Source: Platts, 2013; Oil and Gas Journal; Company websites; and recent tradepress.

Worldwide Ethylene Demand and Capacity

While there may be some near term excess capacity, longer term, demand is expected to outpace ethylene capacity development, particularly post 2015.

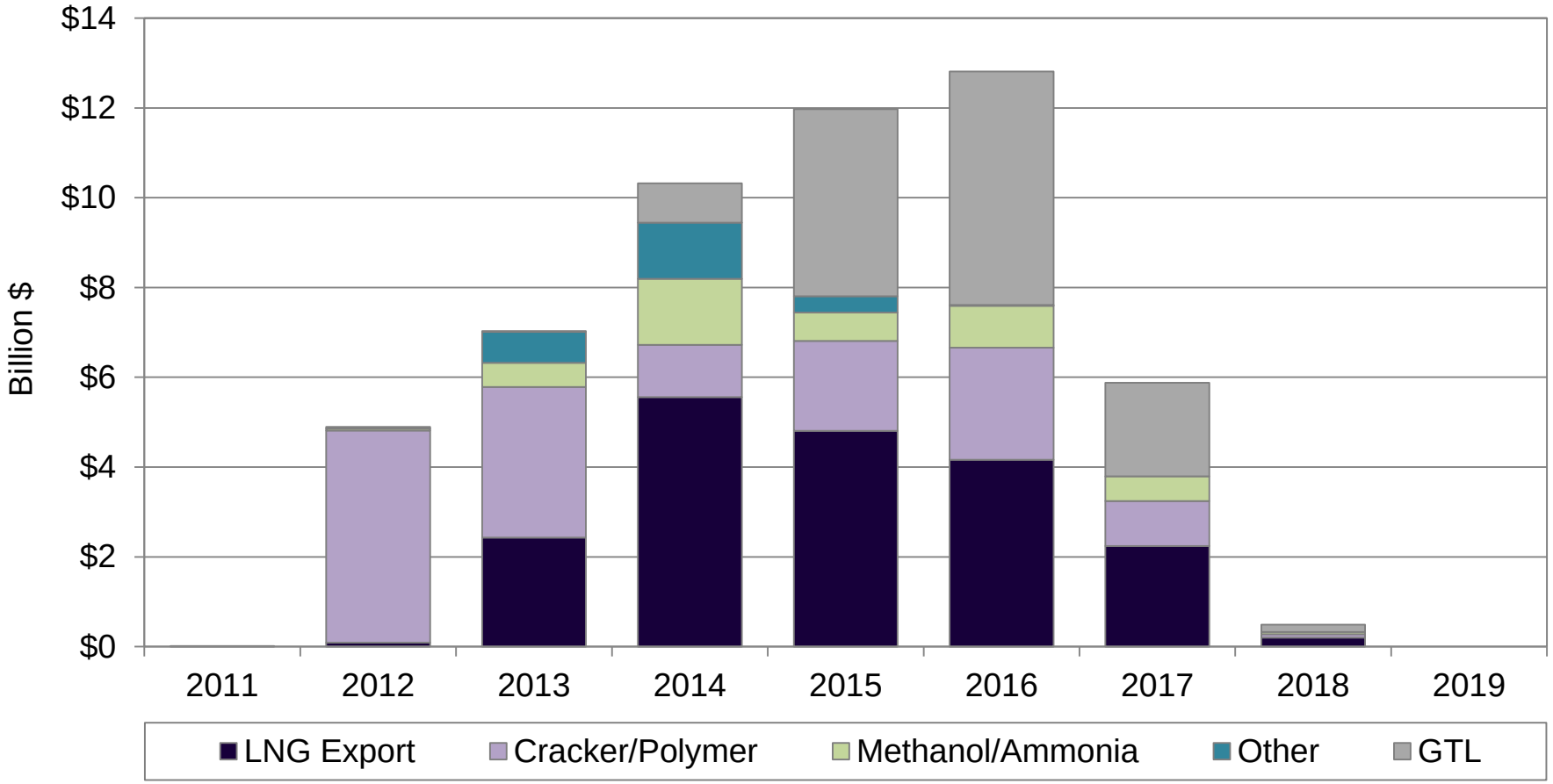


Source: Author's construct from previous slides.

Development Potential

LSU-CES Study (2013): Louisiana Total Capital Expenditures by Sector

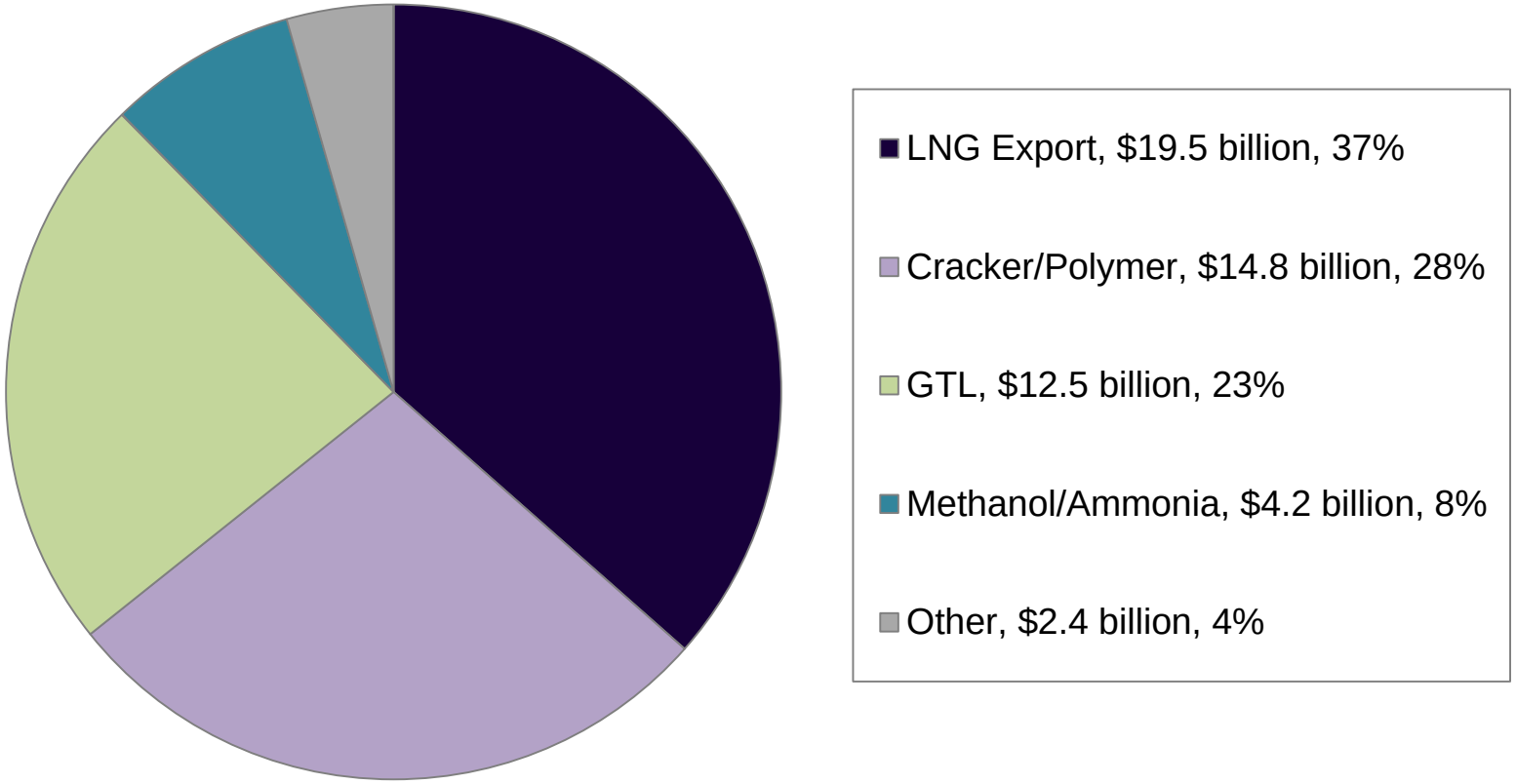
The LSU Center for Energy Studies (CES) reports an estimated $53.4 billion in new energy-based manufacturing development, most of which is anticipated to occur between 2014 and 2019.



Source: David E. Dismukes (2013). *Unconventional Resources and Louisiana's Manufacturing Development Renaissance*. Baton Rouge, LA: Louisiana State University, Center for Energy Studies.

Manufacturing Renaissance

Of the proposed facility expansions in Louisiana identified in the LSU-CES study, gas-to-liquids and LNG export comprise the majority of proposed capital spending.



Source: David E. Dismukes (2013). *Unconventional Resources and Louisiana's Manufacturing Development Renaissance*. Baton Rouge, LA: Louisiana State University, Center for Energy Studies.

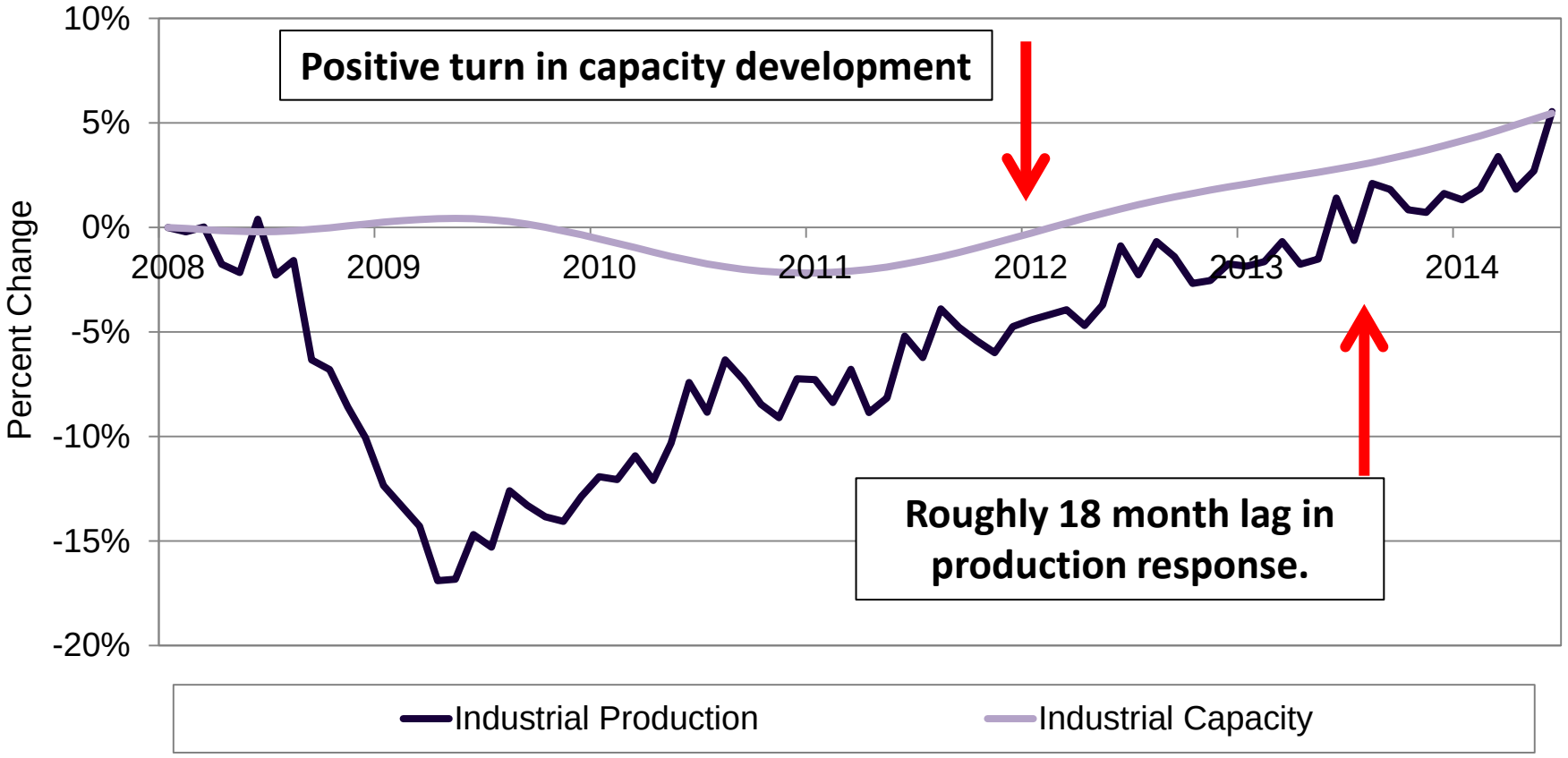
Potential Economic Impacts/Benefit: Construction, State

Not quiet as clear will be the additional power/gas requirements for all the new residential and commercial activities supporting development/operation. Should elevate regional usage trends relative to national averages.

	Construction Impacts									
	Total	2011	2012	2013	2014	2015	2016	2017	2018	2019
Output (million $)										
Direct	$ 17,727.7	$ 4.4	$ 1,715.4	$ 2,458.1	$ 3,538.2	$ 3,872.0	$ 4,091.7	$ 1,890.0	$ 157.9	$ -
Indirect	$ 2,846.2	$ 0.7	$ 275.4	$ 394.6	$ 568.1	$ 621.6	$ 656.9	$ 303.4	$ 25.4	$ -
Induced	$ 5,516.8	$ 1.4	$ 533.8	$ 765.0	$ 1,101.1	$ 1,204.9	$ 1,273.3	$ 588.2	$ 49.1	$ -
Total	**$ 26,090.6**	**$ 6.4**	**$ 2,524.6**	**$ 3,617.7**	**$ 5,207.3**	**$ 5,698.5**	**$ 6,021.9**	**$ 2,781.6**	**$ 232.4**	**$ -**
Employment (jobs)										
Direct	120,114	30	11,623	16,655	23,973	26,234	27,723	12,806	1,070	-
Indirect	19,201	5	1,858	2,662	3,832	4,194	4,432	2,047	171	-
Induced	49,032	12	4,745	6,799	9,786	10,709	11,317	5,227	437	-
Total	**188,347**	**47**	**18,225**	**26,116**	**37,591**	**41,138**	**43,472**	**20,080**	**1,678**	**-**
Wages (million $)										
Direct	$ 5,777.7	$ 1.4	$ 559.1	$ 801.1	$ 1,153.1	$ 1,261.9	$ 1,333.5	$ 616.0	$ 51.5	$ -
Indirect	$ 835.2	$ 0.2	$ 80.8	$ 115.8	$ 166.7	$ 182.4	$ 192.8	$ 89.0	$ 7.4	$ -
Induced	$ 1,549.7	$ 0.4	$ 150.0	$ 214.9	$ 309.3	$ 338.5	$ 357.7	$ 165.2	$ 13.8	$ -
Total	**$ 8,162.6**	**$ 2.0**	**$ 789.8**	**$ 1,131.8**	**$ 1,629.1**	**$ 1,782.8**	**$ 1,884.0**	**$ 870.2**	**$ 72.7**	**$ -**

Industrial Production and Capacity Indices

Industrial capacity development "leads" later production (and employment trends). Recent development announcements suggest a strong steady opportunity for U.S. manufacturing output and employment growth.



Source: Federal Reserve Bank.

Conclusions

Conclusions

- The unconventional energy production revolution is having considerable positive economic impacts on U.S. manufacturing/industrial development.
- However, policy needs to recognize that all of this development is **resource-specific** and **policy dependent**.
- The south-central region of the South will be **initial** p**rime beneficiaries** of the U.S. manufacturing renaissance, but this is not to suggest there are not opportunities for other places in the South.

Conclusions

- Development "congestion" could lead to the consideration of expanding the location of assets in neighboring states.
- Key to participation in this process:
  - Friendly business climate.
  - Policy stability/consistency.
  - Willingness to support infrastructure development to move energy resources to alternative locations.

Questions, Comments and Discussion

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