

Robinson Economic Forecasting Conference
27 August 2014

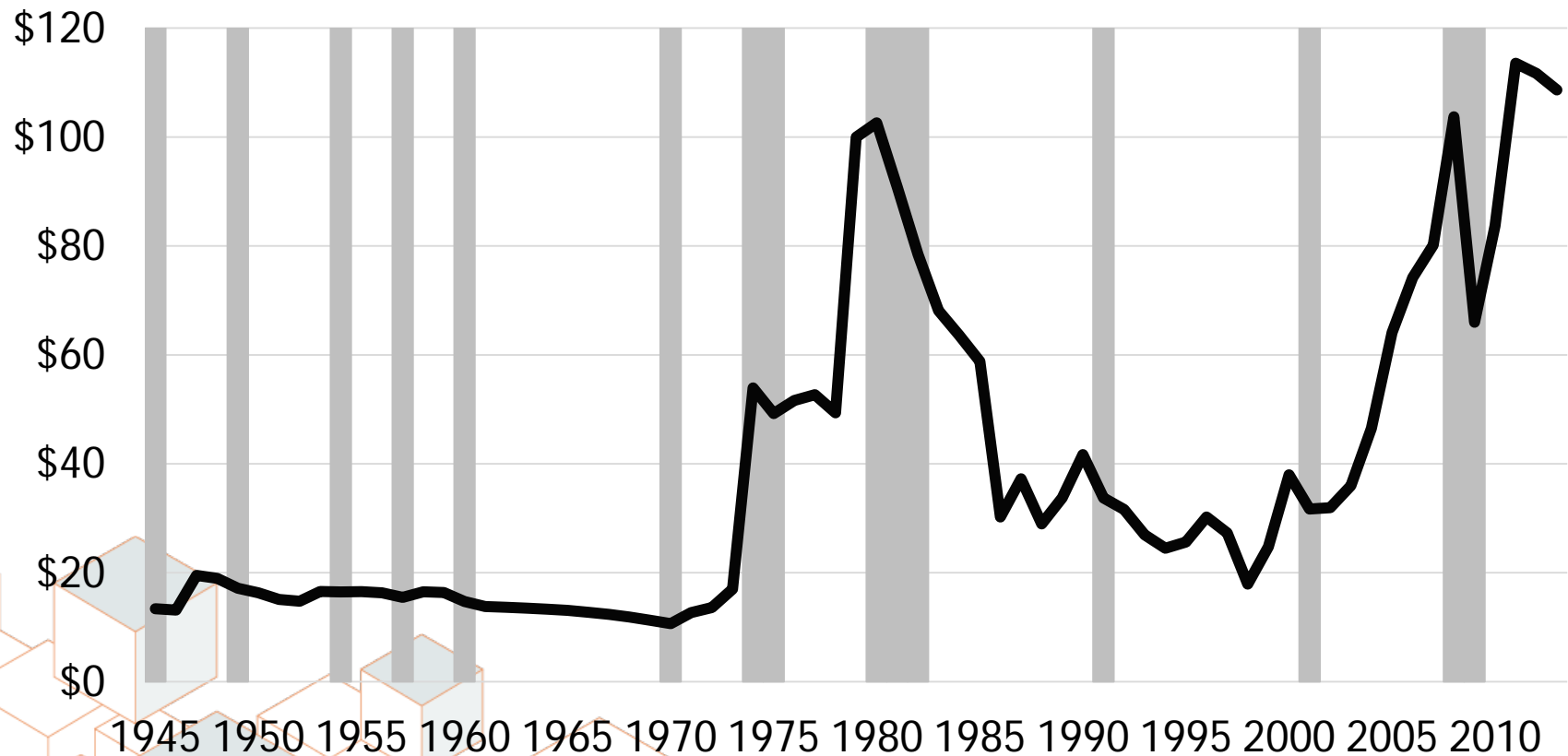
Will Unconventional Oil & Gas Reignite the Economy?

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Recessions Associated with Oil Price Spikes

\$ per Barrel of Oil (\$2013)



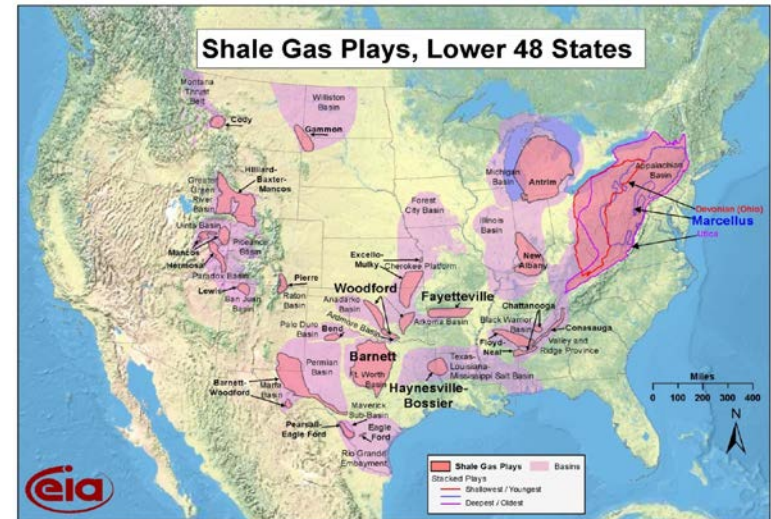
Source: BP

Shale Gas is Changing Everything

- Shale gas is possibly the most important energy development in the past 50 years
- Shale gas now accounts for more than a third of US natural gas production
- Abundant supplies of natural gas liquids are changing the economics of global petrochemical production patterns
- Lower natural gas costs are improving the competitiveness of not only chemical producers, but other gas-intensive manufacturers

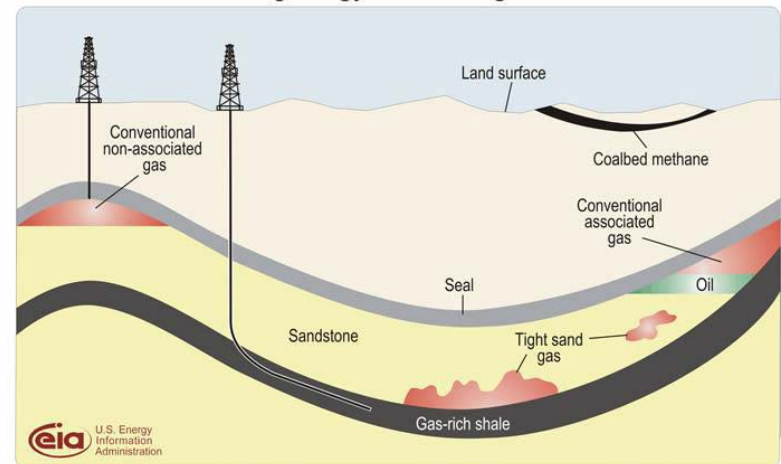
Shale Gas Resources and the Enabling Technologies

- New way of gathering natural gas from tight-rock deposits of organic shale
- Horizontal Drilling
 - Drill horizontal wells 1½ miles beneath the surface
 - And lateral lengths of 10,000 feet
- Hydraulic Fracturing
 - Fracture the rock by using water pressure aided by chemistry (polymers, gelling agents, foaming agents, etc.)
 - Typical well requires 2 to 3 million gallons of water and 1.5 million pounds of sand
 - About 99.5% of mixture is sand and water
- Computational modeling



Source: Energy Information Administration based on data from various published studies. Updated: March 10, 2010.

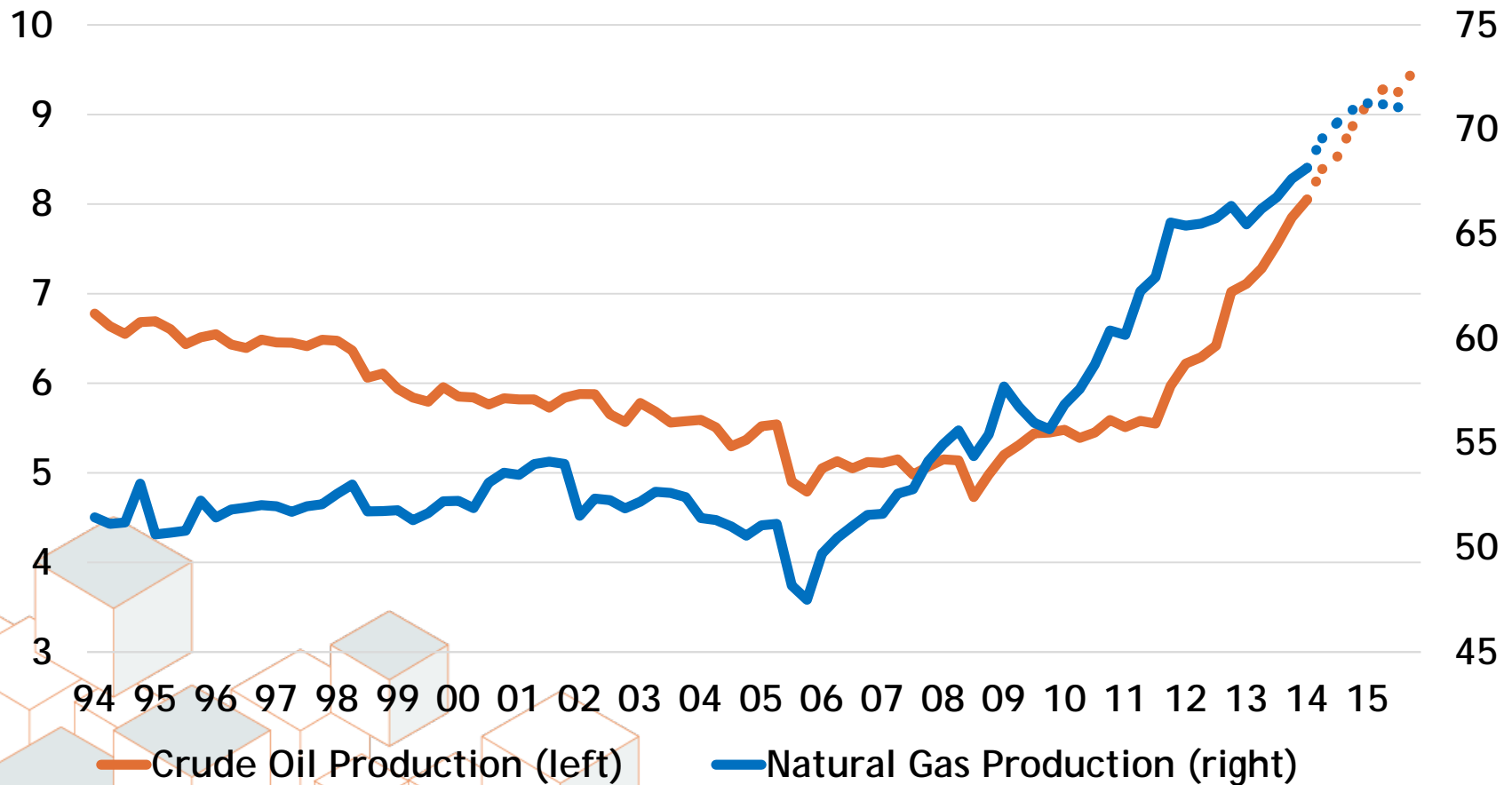
Schematic geology of natural gas resources



Surging US Oil & Gas Production

Million Barrels per Day (BPD)

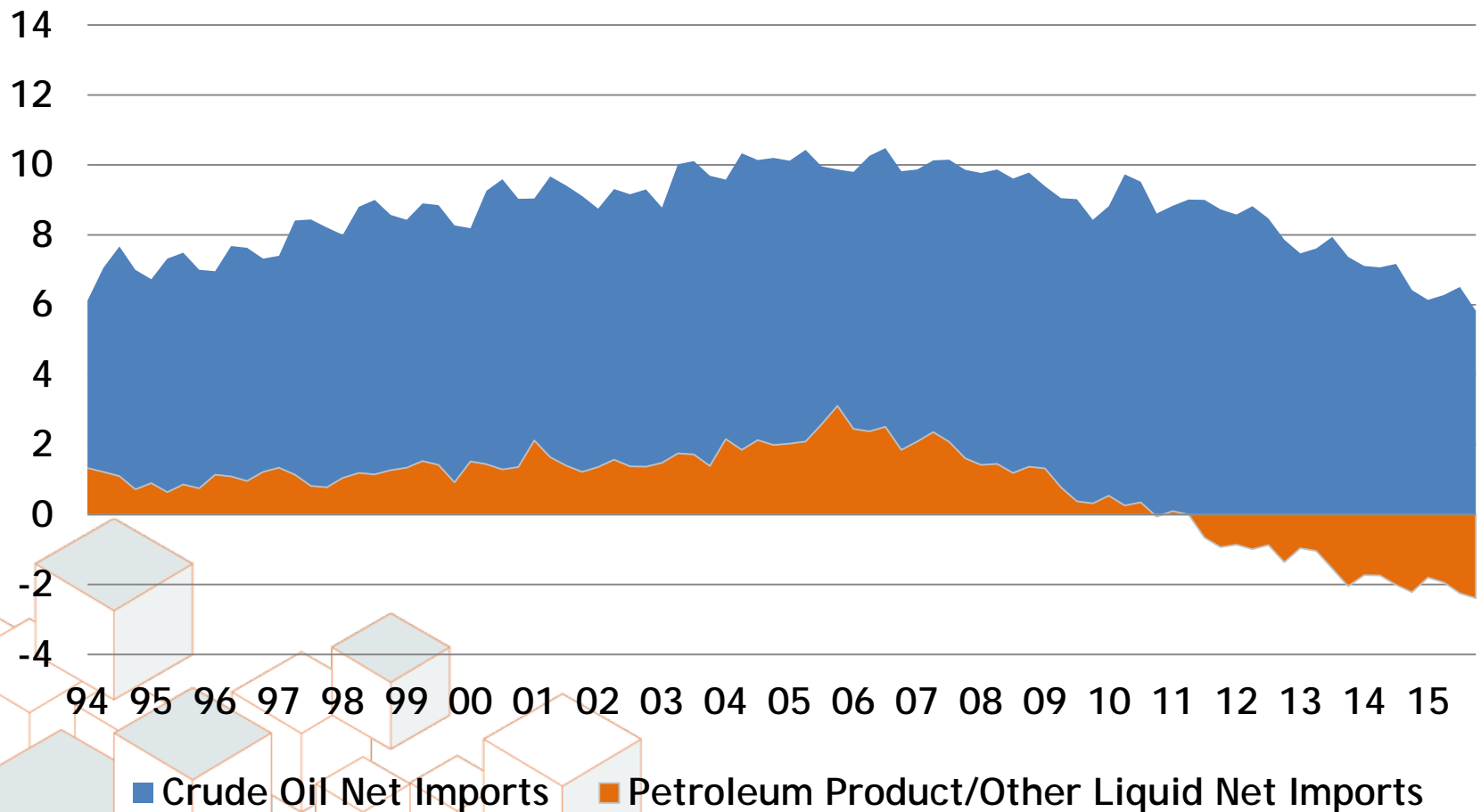
Billion Cubic Feet (BCF) per Day



Source: EIA Short-Term Energy Outlook (August 2014)

Resulting in Lower Crude Oil Imports and Finished Petroleum Product Exports

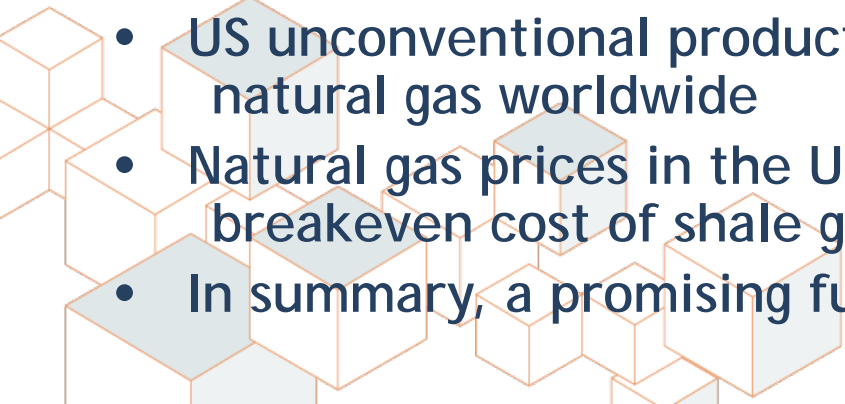
Net Imports - Million Barrels per Day (BPD)



Source: EIA Short-Term Energy Outlook

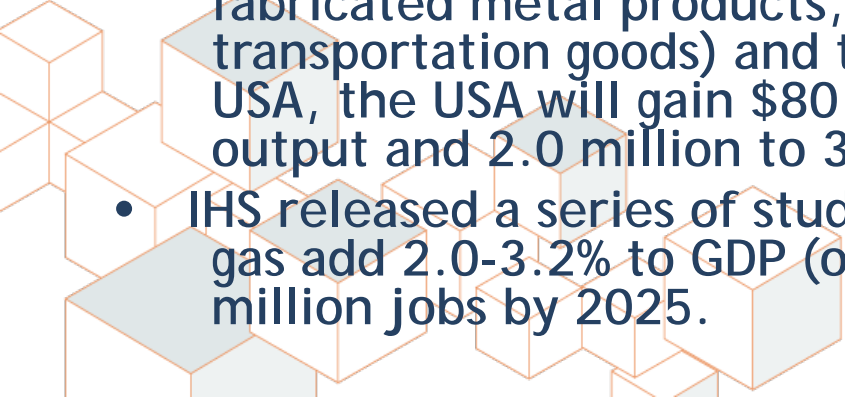
Summary of the Unconventional Oil & Gas Boom



- Production of oil in the United States is outpacing expectations thanks to growth in shale oil (where break-even costs of production have fallen on technological advances)
 - It's an unprecedented structural change
 - Leading to lower crude oil imports from the Middle East and the rise of finished petroleum product exports (US Gulf Coast light crude imports drop to zero by 2015)
 - Unconventional gas production has turned the United States from a net importer to self-sufficiency...
 - Changing the United States is a surplus natural gas producing nation - essentially forever
 - US unconventional production has boosted the availability of natural gas worldwide
 - Natural gas prices in the United States are trading along the breakeven cost of shale gas production
 - In summary, a promising future!
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Analyses Show Significant Macroeconomic Effects

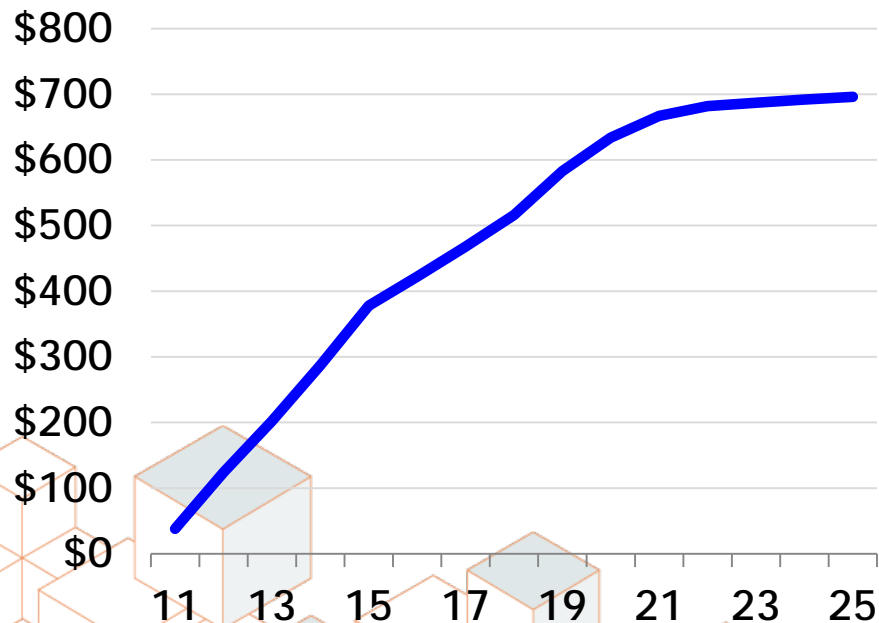


- An analysis by PWC found that US manufacturing companies could employ approximately one million more workers by 2025 due to benefits from affordable energy and demand for products used to extract natural gas.
 - Citigroup released a study which examined the effects of the domestic energy supply revolution and found new production and associated activity will accelerate economic growth by 30-40 basis points. By 2020, the cumulative impact will boost real GDP by 2.0% to 3.3%, creating from 2.7 million to as high as 3.6 million net new jobs, and reduce (by 60%) the current account deficit to 2.4% of GDP.
 - A Boston Consulting Group study uncovered a “tipping point” in cost-risk among seven key industries (computers and electronics, appliances and electrical equipment, machinery, furniture, fabricated metal products, plastic & rubber products, and transportation goods) and that as these industries “re-shore” to the USA, the USA will gain \$80 billion to \$120 billion in added annual output and 2.0 million to 3.0 million jobs.
 - IHS released a series of studies and finds that unconventional oil and gas add 2.0-3.2% to GDP (over \$3,500 per household) and nearly 4.0 million jobs by 2025.
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Unconventional Oil & Gas Favorably Impacts the Economy

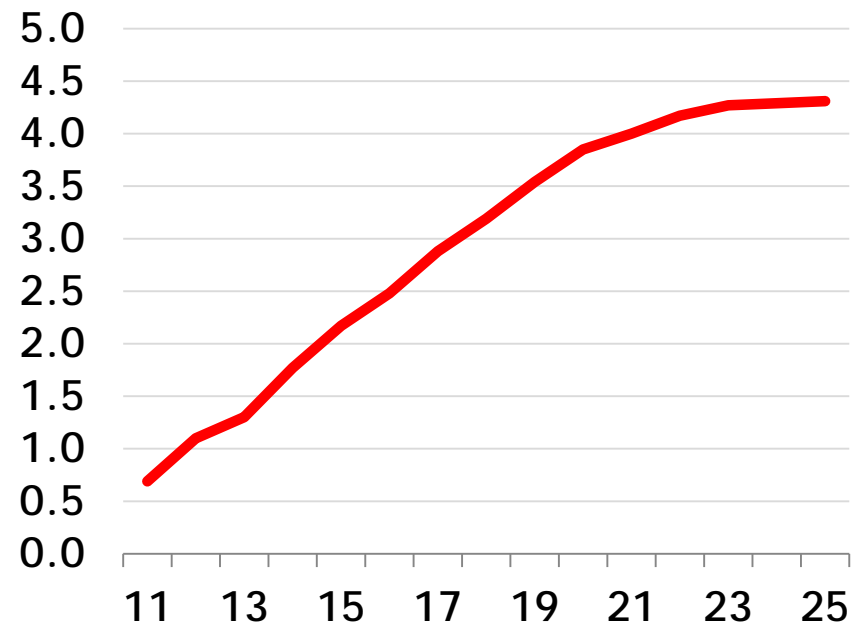
Incremental GDP due to Unconventional Oil & Gas

Billions of 2009\$



Incremental Employment due to Unconventional Oil & Gas

Millions of Jobs



Note: Based on an analysis of the published literature and expressed as incremental to a baseline.



Shale Gas

A Game Changer

"Manufacturing plants are returning to the US to take advantage of cheap natural gas, spurring major investments in petrochemical and steel production." -- [Wall Street Journal](#) February 2012

"We think lower natural gas price are creating a structural economic advantage for the US. It's a new competitive strength for US manufacturers." -- [Reynders McVeigh Capital Management](#) February 2012

"Big industry may be coming back to the northeast United States." -- [Associated Press](#) September 2011

"A renewed U.S. ethane advantage has lifted the fortunes of North American petrochemical makers. A surge in supply from unconventional gas sources has increased the availability and reduced the cost of ethane and other natural gas liquid (NGL) feedstocks." -- [Chemical Week Cover Story](#) March 18, 2011

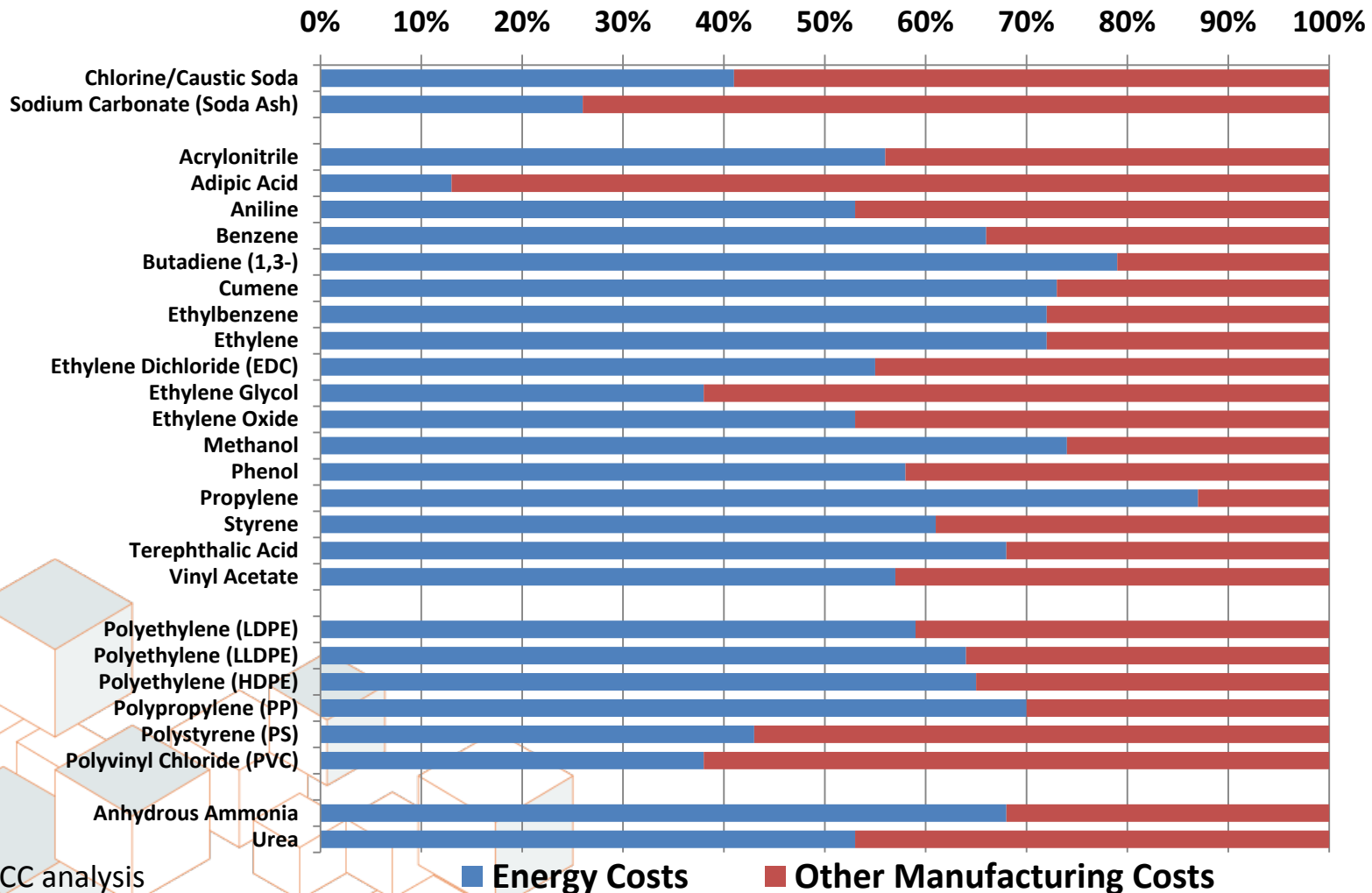
"Some believe the potentially tremendous economic impact of the Marcellus shale will be a 'game-changer' for a state long dependent on the coal industry." -- [Times-Herald](#), Charleston, WV, March 3, 2011

"Cheap U.S. shale gas production could deliver massive spill-over benefits to the U.S. chemicals industry. ... Cheap natural gas will make U.S. chemicals companies cost competitive against just about everyone except the Middle East."

--Citi, "Shale Gas: [A Game Changer](#) for the Chemical Industry?," P.J. Juvekar, March 11, 2010

The Chemical Industry is Energy-Intensive

Fuel, Power and Feedstock Costs as a Percent of Total Costs

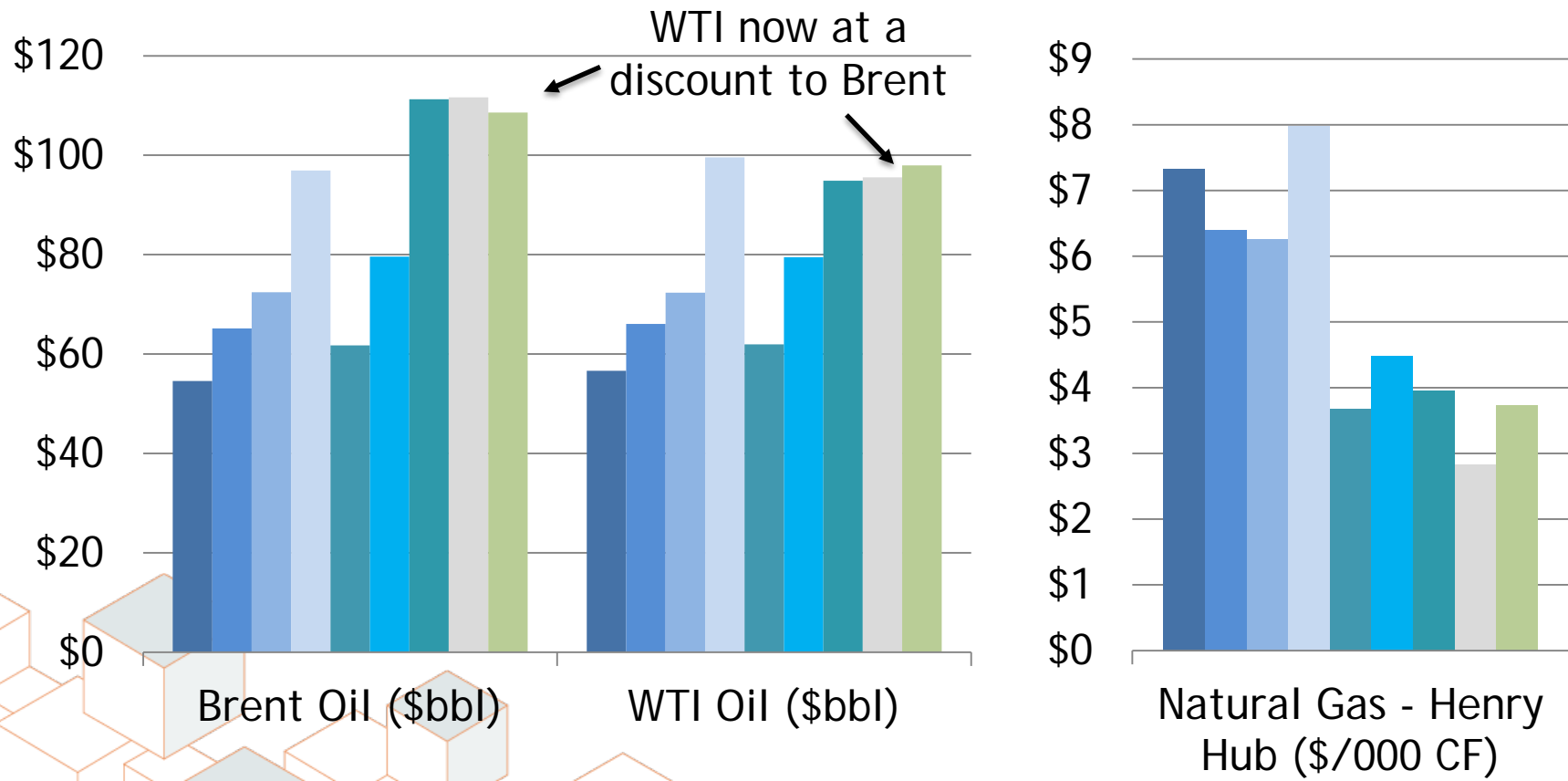


Source: ACC analysis

■ Energy Costs

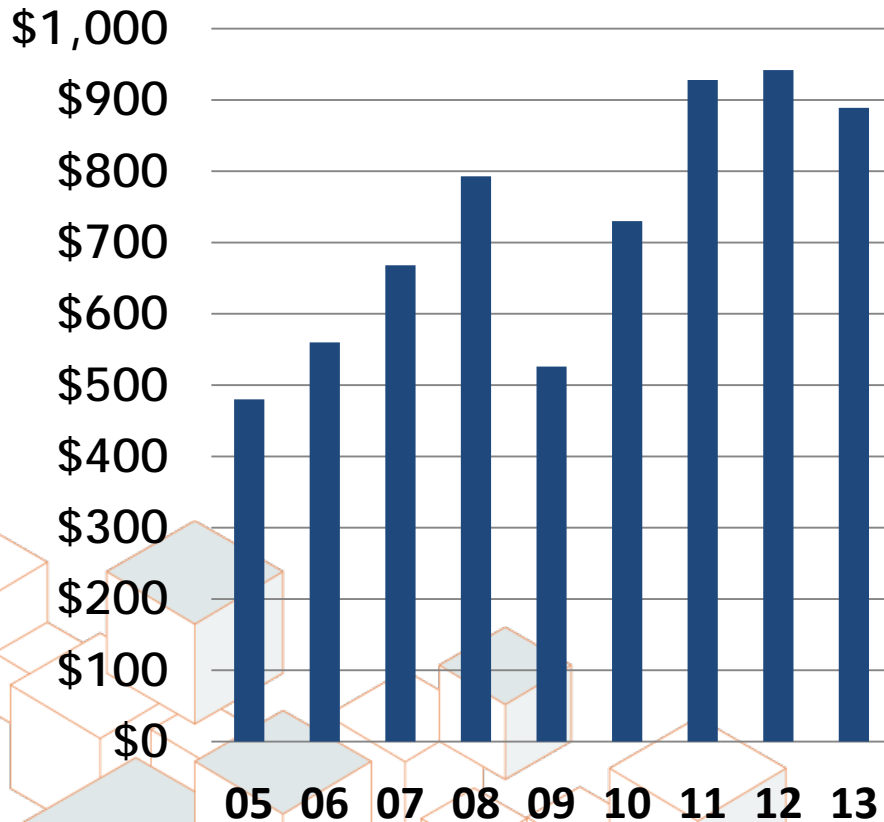
■ Other Manufacturing Costs

2005-13: US Energy Prices Falling in Either Absolute / Relative Terms

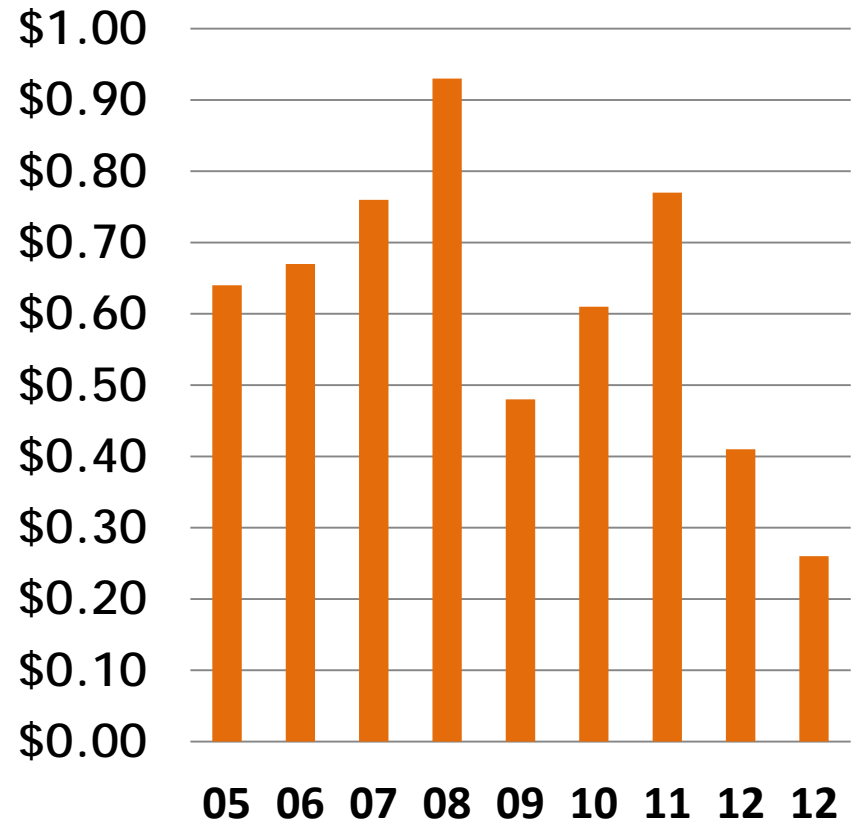


Leads to Falling US Feedstock Costs

Western European Naphtha
(\$/metric ton)



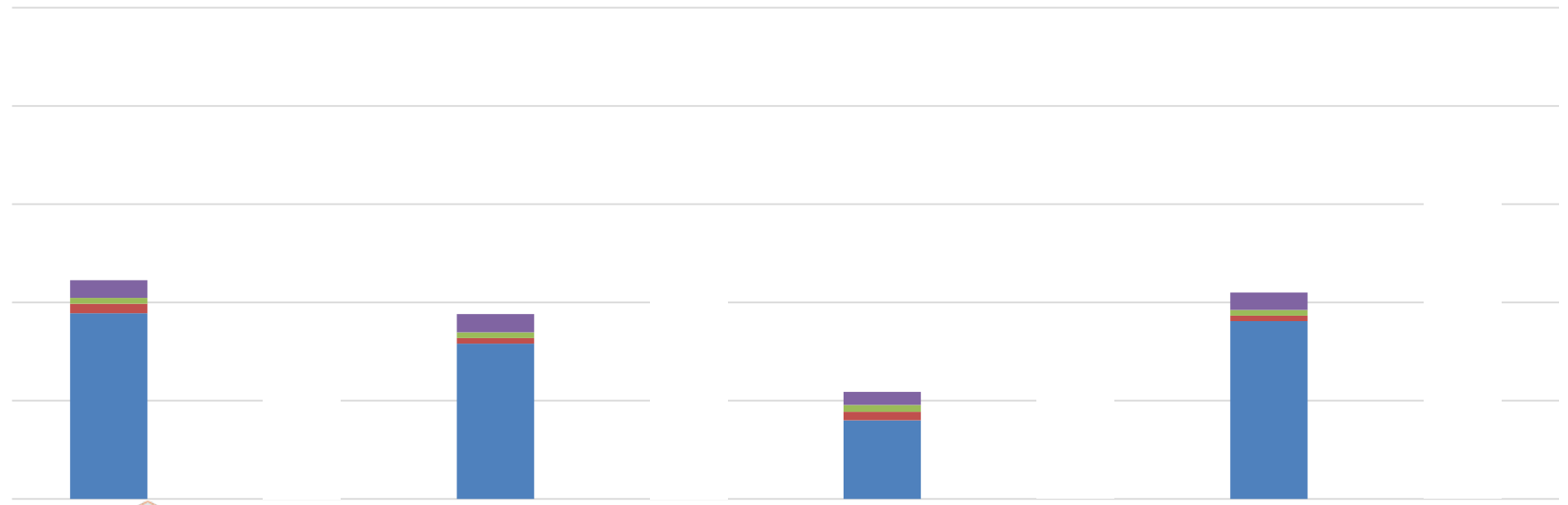
US Ethane
(\$/gallon)



Source: Chemical Week

...and Lower US Manufacturing Costs: Case of High Density Polyethylene (HDPE)

\$ per Metric Ton



US Gulf Coast (2005)

US Gulf Coast (2013)

Northwest Europe (2005)

Northwest Europe (2013)

Middle East (2005)

Middle East (2013)

Northeast Asia (2005)

Northeast Asia (2013)

Raw Materials

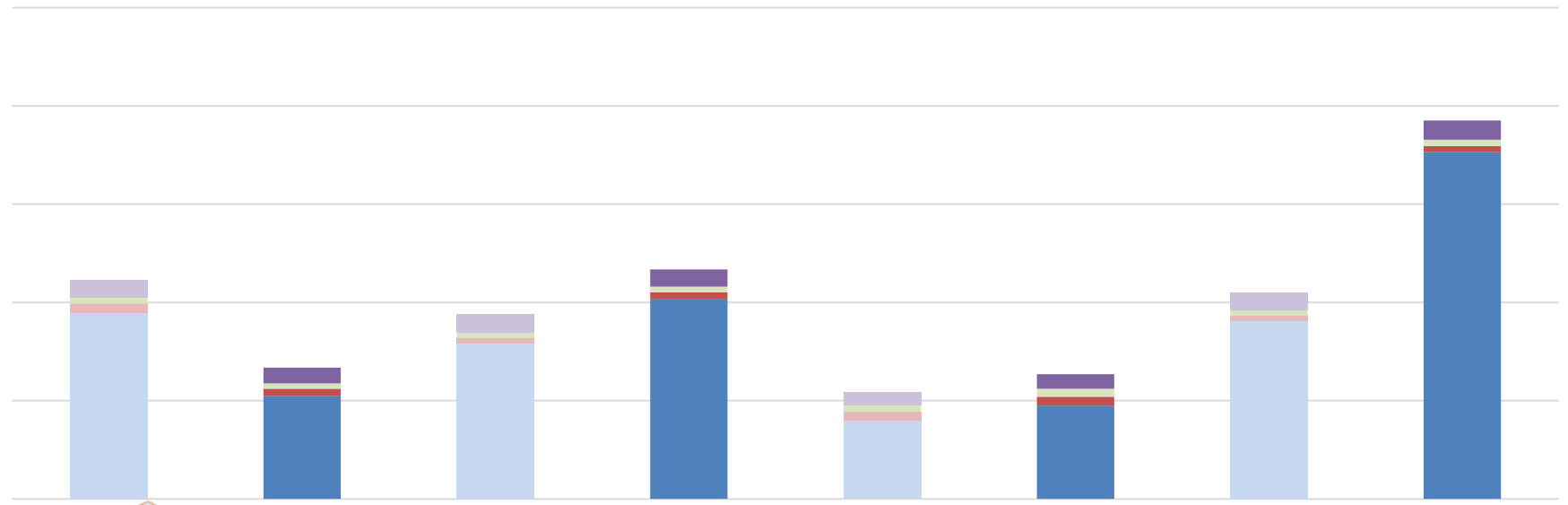
Utilities

Direct Costs

Other Costs

...and Lower US Manufacturing Costs: Case of High Density Polyethylene (HDPE)

\$ per Metric Ton



US Gulf Coast (2005)

US Gulf Coast (2013)

Northwest Europe (2005)

Northwest Europe (2013)

Middle East (2005)

Middle East (2013)

Northeast Asia (2005)

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Raw Materials

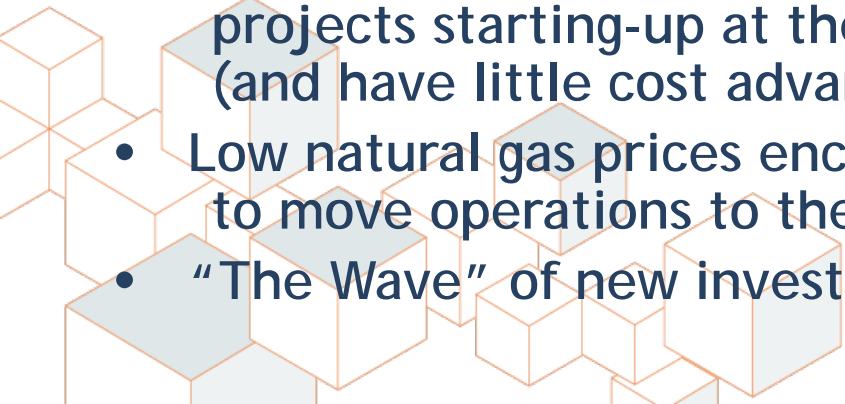
Utilities

Direct Costs

Other Costs

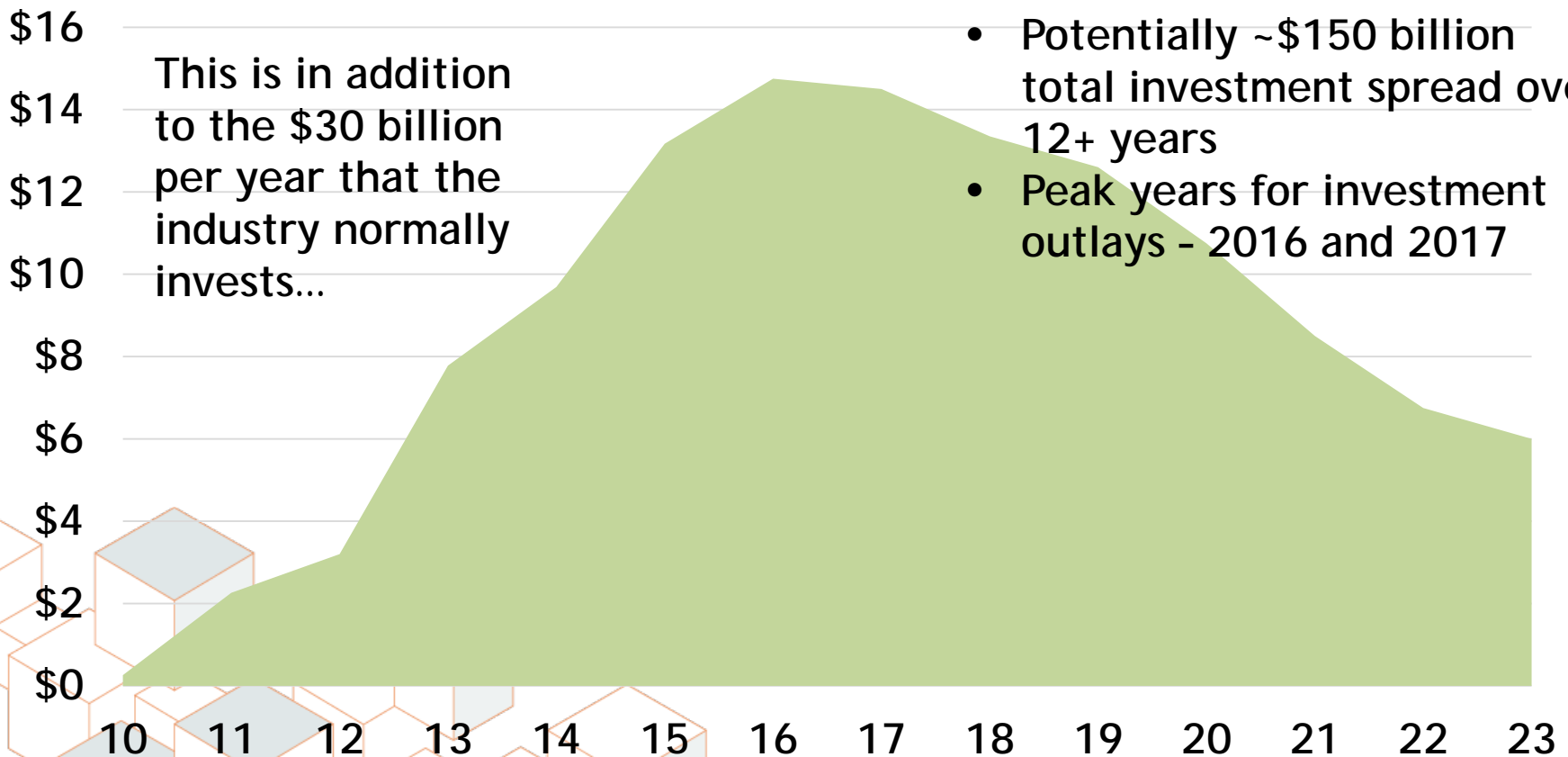
US Industry Benefitting from the Energy Revolution



- Revolution in unconventional gas is supporting the rebirth of US petrochemical and fertilizer production as well as steel, tires, and plastic products
 - North American ethylene producers have shifted to natural gas (ethane) from oil (naphtha) and dramatically reduced costs
 - North America's chemical sector is second lowest-cost ethylene producer after the Middle East with a 50-60% cost advantage over Western Europe and Asia
 - With Middle Eastern producers using blends of heavier liquids, the United States will be even more competitive
 - Limited ethane supplies in the Middle East suggest that new projects starting-up at the end of the decade will crack naphtha (and have little cost advantage)
 - Low natural gas prices encouraging large chemical multinationals to move operations to the United States
 - "The Wave" of new investment...64% of which is FDI
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US Chemical Industry Capital Investment: Incremental Due to Shale Gas

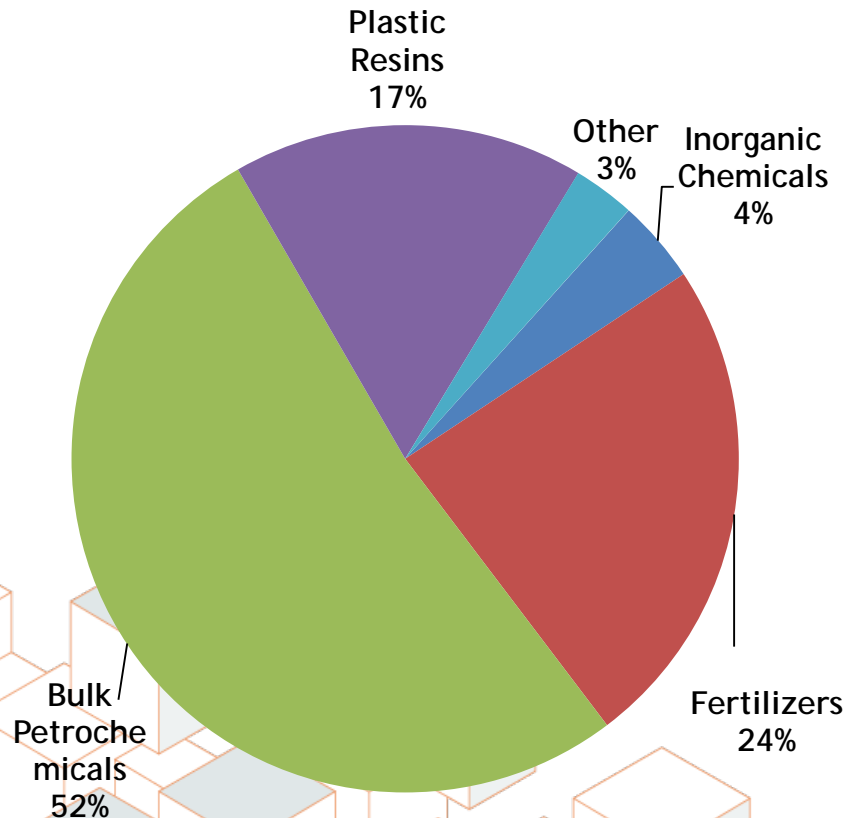
Billions of 2013 Dollars



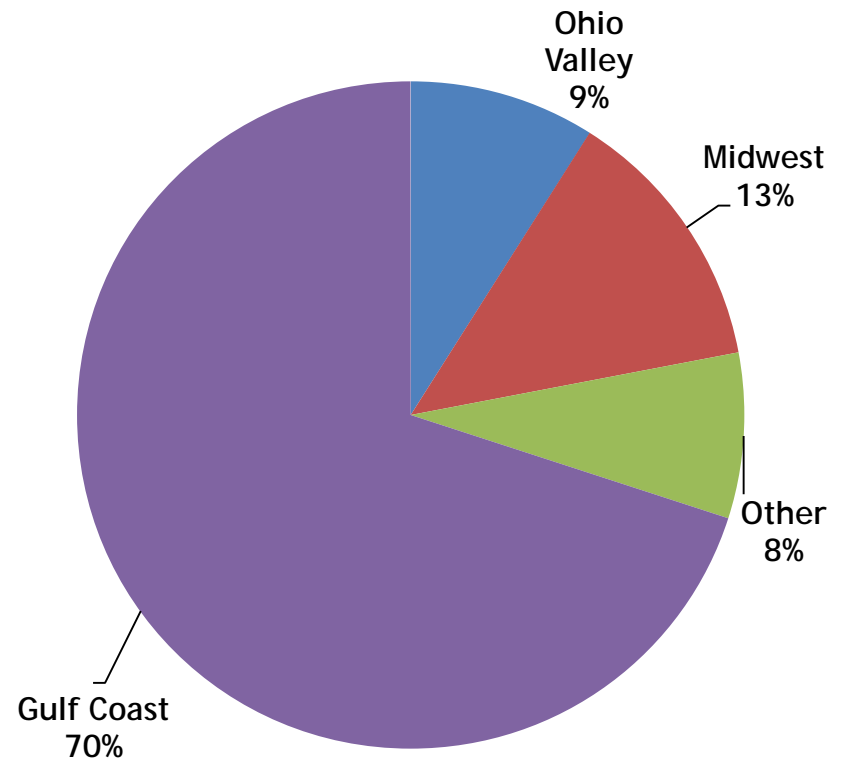
- More projects to be announced
- Potentially ~\$150 billion total investment spread over 12+ years
- Peak years for investment outlays - 2016 and 2017

Composition of Announced Projects

Investment by Industry Segment



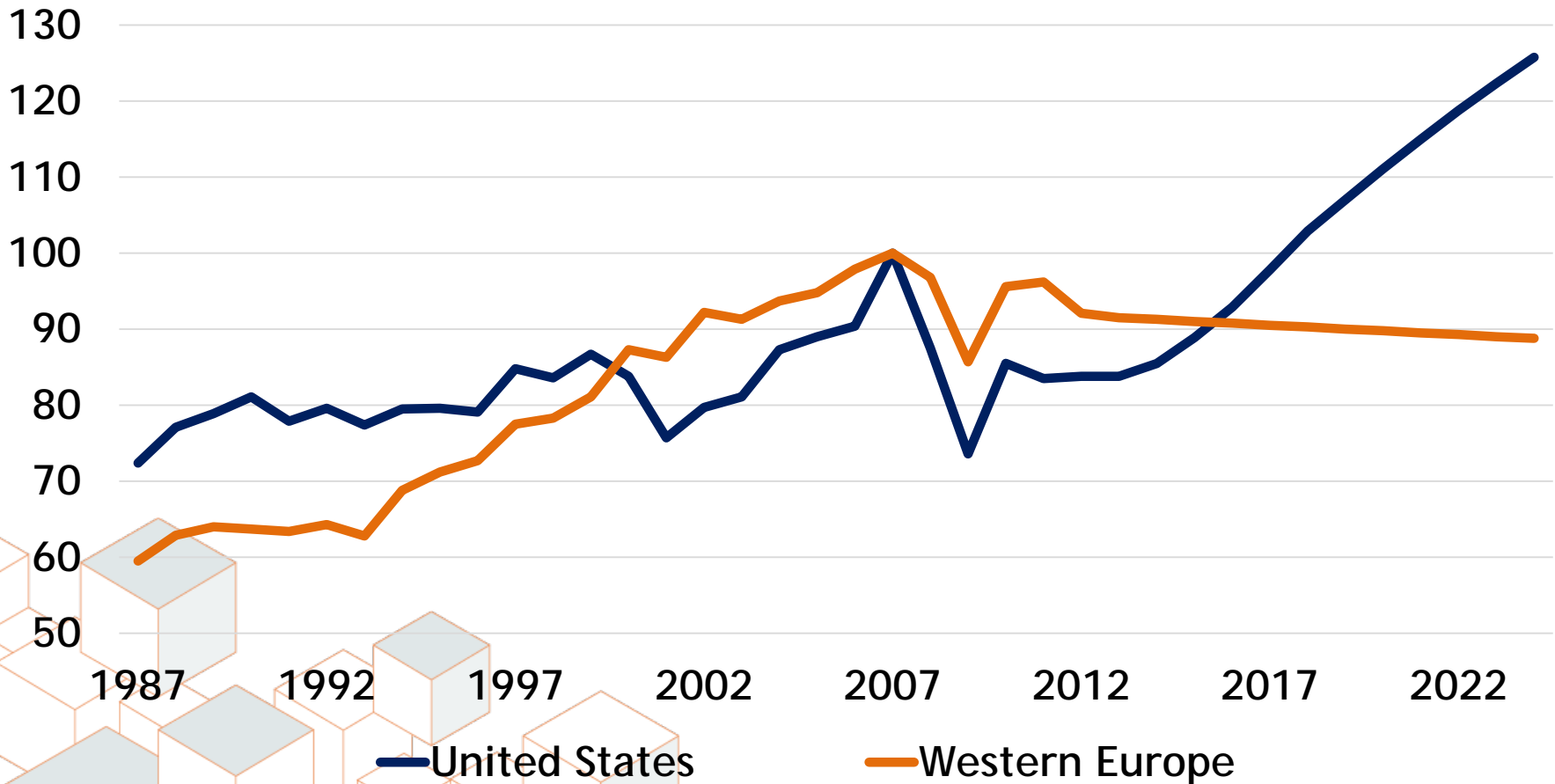
Investment by Region



Source: ACC analysis of 196 announced projects valued at \$124 billion

In All Scenarios, the US Captures Market Share Away From Western Europe...

Basic Chemicals - Volume Index of Production (2007=100)



Sources: Eurostat, Federal Reserve, ACC analysis

Concluding Thoughts



- Global chemistry gathers strength, rising at a premium to the global economy and with more rapid growth in China and other emerging markets
 - Shale gas has improved the competitiveness of the US manufacturing, especially chemicals
 - About 195 major chemical industry projects (valued at \$124 billion) have been announced (perhaps 250 and \$150 billion when it's all said and done)
 - Will generate new business, jobs, and tax revenues
 - With renewed competitiveness and new supply, US exports gain as share of output with reaccelerating growth and US capturing global market share
 - And tipping point in downstream customer industries points to strong domestic demand, which aids specialties (the next wave?)
 - In addition to shale gas and manufacturing renaissance, new materials (e.g., nanotechnology) and processes (e.g., bio-based chemistry) will also lead to enhanced growth
 - *In summary, a promising future!*
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Questions?

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