Unconventional Oil & Gas
Leading to Manufacturing Renaissance

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Surging US Oil & Gas Production

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

Crude Oil Production (left)  Natural Gas Production (right)
Shale Gas as a Manufacturing Game Changer

• Shale gas could also help revive American manufacturing and create hundreds of thousands of jobs, including some areas hardest hit by the recession, while strengthening national energy security.
• The new economics of shale gas create a competitive advantage for US manufacturers, which will lead to greater investment, job creation and industry (and economic) growth.
• Shale gas growth is helping to reduce natural gas and oil prices and create a more stable supply for fuel and power - this will allow US manufacturers to become more competitive than producers in the rest of the world.
• It is also reducing electricity costs.
• Should oil prices remain high, affordable natural gas will continue to provide US manufacturers with a competitive advantage over global competitors that use more expensive, oil-based feedstock and energy supplies.
• This oil and gas boom represents a positive shock to the US economy (much like the Internet), which should be able to capitalize on these developments. Long-term economic growth potential could be boosted by 0.3 to 0.8% per annum.

WTI now at a discount to Brent

Source: EIA
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)

Categories:
- Raw Materials
- Utilities
- Direct Costs
- Other Costs
...and Lower US Manufacturing Costs: Case of High Density Polyethylene (HDPE)

$ per Metric Ton

<table>
<thead>
<tr>
<th>Region</th>
<th>2005</th>
<th>2013</th>
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<tbody>
<tr>
<td>US Gulf Coast</td>
<td>$X</td>
<td>$X</td>
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<tr>
<td>Northwest Europe</td>
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<td>Northeast Asia</td>
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- **Raw Materials**: Blue
- **Utilities**: Red
- **Direct Costs**: Green
- **Other Costs**: Purple
Divide Brent oil price ($ per barrel) by Henry Hub natural gas price ($ per 1,000 cubic feet). When the ratio is above 7, US competitiveness vis-à-vis other major producing regions is enhanced. The current ratio is very favorable for US competitiveness and exports of petrochemicals, plastics and other derivatives.
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...60% of which is FDI
US Chemical Industry Capital Investment: Incremental Due to Shale Gas

- More projects to be announced
- Potentially >$150 billion total investment spread over 12+ years
- Peak year for investment outlays -2017

This is in addition to the $30 billion per year that the industry normally invests...

Source: ACC analysis
Composition of Announced Projects

Investment by Industry Segment
- Plastic Resins: 17%
- Fertilizers: 23%
- Inorganic Chemicals: 3%
- Other: 4%

Investment by Region
- Gulf Coast: 68%
- Midwest: 14%
- Ohio Valley: 12%
- Other: 6%

Source: ACC analysis of 215 announced projects valued at $133 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
Announced Plastics Processor Projects by State

Announcements since June 2012
Source: Plastics News, ACC analysis
Note: no projects have been announced in AK or HI (not shown)
Concluding Thoughts

• Shale gas has been a game changer in US natural gas markets with US first mover advantages
• Along with oil developments (and lower electricity costs) shale gas has improved the competitiveness of the US manufacturing, especially chemicals
  • Over 215 major chemical industry projects (valued at $133 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?) which will also be aided by competitiveness in raw materials
• 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!
Questions?

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Possible Workforce Development Solutions

- Sector councils to ensure critical needs and challenges are met
- Develop aggressive campaigns to change awareness and perception of manufacturing, trade and other middle-skill career opportunities (rethink “college for all” culture)
- Development of common tools and curricula to provide training and address weaknesses in basic skills and employability (need for a 21st century competency-based apprenticeship model and other models for working and learning)
- Coordination to facilitate connections between stakeholders
- Develop tools to collect better demand-side and supply-side data
- Work with education and training providers at all levels to establish networks to enable information sharing, sharing of best practices, and strengthening of industry partnerships

Sources: Greater Houston Partnership, National Network of Business and Industry Associations