Two Energy Trends: Threats or Opportunities?

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Transportation ~30%
Electricity ~40%
Industrial & Commercial ~30%

Important to differentiate between transportation issues from other energy users.
Differentiating Power Generation & Transportation

- US is energy independent in so far as power generation
- US imports 50% of its oil
  - energy security issue is coupled to transportation, oil imports
Topics

- Shale gas
- Cellulosic ethanol
Natural Gas Production Skyrocketing

- U.S. production up 25% over last 5 years
- 5% increase in 2012 followed by 1% in 2013
- Smaller increase due to Low Gas Prices & Active Drilling Rigs reduction by ~90%

Source: EIA, Annual Energy Outlook 2014 Early Release
Henry Hub Natural Gas Prices, 15 year history

Henry Hub Natural Gas Spot Price

Dollars per Million Btu

Source: U.S. Energy Information Administration
Natural Gas Prices Low Relative to Crude

Spread is driving lots of interest for using gas in transportation sector
Natural Gas Increasingly Fuel of Choice for Power Generation

- Current US power generation capacity ~25%
- Dominant source of new capacity additions over last decade

Figure 5: Share of US Power Generation
Historical and current EIA projections

Source: EIA and RHS estimates
Natural Gas Prices Fueling Interest in Exports

- Shale Gas projected to be relatively flat until 2016 when prices are expected to rise.

- Higher prices expected to increase drilling activity and increasing production
Natural Gas Prices Spurring New Growth in Petro-Chemical Industry

- Chemicals Industry in US: $720 Billion in 2010
  - Exports - $226B, 10% of US exports

- New NG-chemicals plants
  - Royal Dutch Shell - $2B plant near Pittsburgh
  - ConocoPhillips and VX - $5B plant outside Houston
  - Formosa Plastics - $1.7B on Texas gulf coast
  - Exxon Mobil - $1.3B plant

![Map showing locations of chemical plants](image)
Market Anticipation of Gas Prices

Henry Hub Natural Gas Future Prices

Natural Gas Future Prices ($/MMBTU)

- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020

Prices:
- $4.00
- $4.10
- $4.20
- $4.30
- $4.40
- $4.50
- $4.60
- $4.70
- $4.80
- $4.90
- $5.00
The Other Natural Gas Story: Natural Gas Liquids

U.S. Ave Yield by NGL | % of Total
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Ethane | 40%
Propane | 27%
Butane/Iso-Butane | 18%
Plant condensate | 15%

*Adapted from: Al Toner, Asia-Pacific Energy Consulting (APEC), 2013

Source: Chris Foster, Bentek, Energy, 2013
Example: Ethane

- Ethane price coupling to oil seems to be broken
- Price now comparable to that of natural gas
High Volumes of NGL are Driving interest in New Chemical Plants

Timing of announced US ethylene expansions

Source: Joseph Chang, ICIS, 2013
Feedstock Switching is Altering Co-Products

Shift from naphtha to NGL feedstocks significantly changes plant co-products

- Ethane gas produces primarily ethylene
- Shortages anticipated in, for example propylene, butadiene

U.S. cracker output of co-products – as % of total ethylene output

Source: ICIS, 2013
Cellulosic Ethanol
Renewable Fuel Standards

The chart illustrates the Renewable Fuel Standard (RFS) requirements from 2008 to 2022. The RFS mandates an increasing use of renewable fuels, categorized into three main types:

1. Advanced cellulosic biofuel (2008-2013)
3. Conventional renewable fuel (corn ethanol, 2018-2022)

The chart also includes GHG reduction targets:

- 50% GHG reduction
- 50% GHG reduction
- 60% GHG reduction
- 20% GHG reduction (for new construction only. Existing corn facilities grandfathered.)
Cellulosic Ethanol Production Facilities

Are these real or phantom capabilities?
Georgia Leads the Nation in Pulpwood Production

Figure 1—Pulpwood production by State and broad species, 2011.
Concluding Comments

- Threats, opportunities, or irrelevant?