14th Annual Tulane Engineering Forum
The U.S. Upstream Gas Supply Renaissance

April 4, 2014

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We are in the Early Days of a Tremendous U.S. Energy Supply Renaissance

- Shale and resource discoveries have grown supply massively
  - These type of plays became economic with combination of horizontal drilling and multi-stage fracking
  - U.S. leads the world in these technologies
  - Oil and gas business is prolific and widespread in U.S. and geology is favorable

- U.S. supply growth results in:
  - Sharp reduction in oil imports, great for economy and security
  - Cheap supply cost of natural gas, leading to manufacturing renaissance
  - Job creation in U.S., more that 1 million in this decade
  - Big debates on “fracking” and environment issues

- In the past decade, the U.S. natural gas reserves and resources have grown from 10 years of known supply to 100+ years of known supply

- I will discuss the upstream business (exploration and production), Steve will discuss midstream and Bob will discuss the downstream
Expanding Resource Development has Completely Changed the E&P Business

Good Shales are Prevalent in 17 States (and Western Canada)
Historical U.S. Crude Oil Production (MBbl/d)

Source: EIA production release, March 2014.
Shale Gas Leads Growth in Total Gas Production Through 2040

U.S. Dry Natural Gas Production (Bcf/d)

Domestic Production of Shale Gas Has Grown Dramatically

Shale Gas Production (Dry) (Bcf/d)

Total current US gas production is approximately 71 Bcf/d

Source: EIA Outlook for U.S. Shale Oil and Gas, January 2014.
Establishing the ARC of Energy Sources

- Best way to properly consider energy choices is the “ARC test”:
  
  Affordable  Reliable  Clean  ARC

- Not sensible to have one without the other two
  - We don’t want to pay multiples of current costs for uneconomic technologies
  - We won’t accept “Venezuelan Reliability” (blackouts 4-6 hours per day)
  - We all want cleaner sources that are environmentally positive

- This is the appropriate way to consider energy choices with the growing need for energy worldwide

- It is not a healthy energy policy to exclude viable choices

- Natural gas fits this model well
Significant Measures Taken to Prevent Groundwater Contamination

- Surface casing is cemented into place at the uppermost portion of a well for the purpose of protecting the groundwater.

- As the well is drilled deeper, additional casing is installed to isolate the formations.

- Casing and cementing are critical parts of the well construction that not only protect water zones but are also important to successful oil or natural gas production.

- Bad idea to reenter old well bores.

Source: API Hydraulic Fracturing 2010.
Changing the Conversation from “I Don’t Like Fracking” to Constructive Discussion of These Issues

- Continued education on the fracking process and sound regulations
  - “No proven cases of fresh water contamination due to fracking”

- We have to have sound wellbore design and installation to protect drinking water supplies

- Appropriate water supply and disposal
  - Emerging supply issues in western U.S.
  - Water recycling to address both supply and disposal

- Emissions management
  - Natural gas has 50% less CO₂ than coal for electricity generation
  - Natural gas has 60% less CO₂ than diesel for heavy duty transportation
  - Methane pollution in atmosphere much more harmful than CO₂

- NIMBY (Not-in-my-backyard) issues
  - Many of these developments are in sparsely populated areas
  - Being good neighbors in townships, near housing
  - Pipeline rights-of-way
Fracking a Well is Equipment Intensive for 1-2 Weeks
The Well Then Produces for 50 Years

- 6-20 wells can be drilled from this “pad” to lesson the footprint of activity
Natural Gas Spot Price vs. Forward Expectations

Spot Price vs. 5-Year Forward (Henry Hub)

Source: Bloomberg Financial and CapIQ.
Current Uses of Natural Gas

Natural Gas Use by Sector in the U.S. (2012)

- Electric Power: 36%
- Industrial: 34%
- Commercial: 11%
- Residential: 16%
- Transportation: 3%

Energy Consumption by Fuel (2012)

- Natural Gas: 27%
- Oil and Other Liquids: 37%
- Coal: 18%
- Renewable Energy: 8%
- Nuclear Power: 8%
- BioFuels: 1%

Closing Comments

- People want energy supply for improved quality of living
- 3-pronged ARC test should guide energy discussions
  -- Affordable
  -- Reliable
  -- Clean
- Natural gas is abundant in the U.S.
  -- Now have 100+ year supply
  -- Lowest cost of supply in the world
- Exciting new markets in natural gas are emerging
  -- Cleaner substitute for coal
  -- Heavy duty transportation fuel (trucks, trains, ships)
  -- Manufacturing feedstock
  -- LNG export
- Natural gas is perfect partner for wind and solar applications
  -- Back up power when the wind doesn’t blow or the sun doesn’t shine
  -- Easy to power up quickly
- Developing gas technology in U.S. will benefit worldwide gas business
  -- Shale/resource potential in China, Argentina, Russia, Eastern Europe and Australia
  -- This ultimately is helpful for cleaner energy supply for all these countries