Permian Goes Global
How to leverage USA LNG in a changing global market?

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Jackson School of Geosciences

- Jackson School of Geoscience - $300 million endowment, and the largest university-based geoscience program in US
- One of three Jackson School of Geosciences - $30 - 35 million/year budget, 90% grants & contracts
- Established in 1909, 2nd largest research unit at UT
- 250 researchers, staff & students
- Assets include 3 core facilities, labs, field test sites.
Roadmap

• Research Scope and Methodology
• Regional Natural Gas and LNG Point of View
• What matters to USA LNG?
  • Supply
  • Cost positions
  • Demand shocks
Research on Natural Gas Value Chain

Upstream:
- Geologic and Reservoir Analysis
- Recovery and Productivity
- Waste and Water Management
- Production Outlook
  - Drilling Patterns
  - Well Economics

Midstream:
- North America Market Simulator
- Global Gas and LNG Analysis

Downstream:
- Flaring and CCUS
- Gas to Power Integration
- Hydrogen and other new markets
- Infrastructure Support
  - Electricity, Water and Processing
- Energy Transition Policies and Economic Impacts
Upstream Resource Assessment

Geology

Stratigraphic Framework

Petrophysics

3D Models

History Matching

Statistical Modeling

Production Outlook

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Production Outlook
Profitability and well inventory maps are used to create expected drilling maps:

1. Depending on previous year’s drilling and expected prices & costs we derive a projection for the drilling portfolio.
2. Profitability map reveals which locations are likely to be drilled.
3. Probability of drilling is assigned based on the inventory of wells available and drilling expected according to the portfolio.
Workflow of Natural Gas Market Simulators

Model Inputs

North America – GPCM
- 245 Pipelines
- +440 Storage areas
- LNG Exports / Imports
- 100 Market Points
- Import and Exports

Global Gas Market – G2M2
- Sectoral(5) Demand of 100+ countries
- LNG Contracts and Infrastructure
- Pipeline (400+) and Storage (600+)
- Multi-tanker classes
- Source and Destination Flows

(TORA)
Bottom-up resource evaluation

Customized assumptions to focus on specific projects or markets

Supply Builder

Infrastructure Builder

Demand Builder

Supply Flows

LNG Contract Flows

Graphic Display of Flows

Demand and Supply Balance

Courtesy of RBAC, Inc.
From left to right, countries have increasing dependency on imported gas.
Regional LNG Production versus Capacity
North America – LNG as an outlet not a driver

• With upcoming projects, capacity constraints are not a major concern, except localized areas.

• Upstream gas procurement and facility utilization should be the focus, and

• What to monitor in the market:
  • upstream supply outlooks
  • supply region market basis
Asia - Still a growth story despite of short disruptions
Long term need for LNG remains, while US becomes a major competitor to Australia and Qatar.

Anticipated lower winter peak for upcoming winter due to improved infrastructure support
Development of regional index and trading platform, supported by government
Europe – Uncertainty increases gas dependency

- Uncertainty of Climate Change Policies adds dependency to gas fired generations.
- Infrastructure interruption from Russia via Ukraine
- Potential hydrogen in the mix and integration of hydrogen into gas infrastructure and value chain.
Production outlook is a function of expected drilling, well economics and market and price conditions.
Decline Rate is one of the most critical factors, for determining the future price and Gulf LNG production. An alternative case which only includes an adjusted supply profile USA West South Central (including Permian as well as Barnett and Hayesville)
LNG Cost Stack 2020 – 2025

- Demand is coming - By 2025, there is a fast growth of LNG demand, about 30% growth in 5 years, 120 Million tons, (16 bcf/d).

- In past 5 years, US added about 12 bcf/d of liquefaction capacity, and there is another 6 bcf/d for next 5 years.
Competition of LNG after 2025

- Demand increase slows down after 2025, it takes 15 years for another 100 million tons (13 bcfd)
- With the decline rate projected here, would US lose the competition? What are the caveats?
  - Overestimating of decline rates elsewhere, and Uncertainty around shale production development in many developing countries.
  - US have the best experience in shale production and cost reduction of the world
Short Term Demand Shocks

- 15% down in Asia demand in 2020, 5% in 2021
- Warm winter for Europe in 2020-2021
- Price differential:
  - Henry Hub $\geq -0.10$/mmbtu
  - Asia -$1.44$/mmbtu
  - NBP -$0.25$/mmbtu
  - TTF - $0.50$/mmbtu
Summary - Permian Gas Goes Global

Upstream
- Disciplined operation is key for upstream success.
- Ongoing study on shale production outside US

Midstream
- Sufficient domestic takeaway to LNG terminals; USA LNG Terminals' utilization rate average above 70% before 2030

Downstream
- Downstream potential is robust for the medium to long term.
- Greater demand potential in Asia and Europe for LNG as moves into energy transition, like H2.
- Additional cross-product monetization options for oil and gas industry in Texas
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