

Permian Goes Global

How to leverage USA LNG in a changing global market?

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Bureau of Economic Geology



The University of Texas at Austin

Jackson School of Geosciences

Department of
Geological Sciences

Bureau of
Economic Geology

Institute for
Geophysics

- 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.

Industry Consortium Sponsors



Roadmap

- **Research Scope and Methodology**
- **Regional Natural Gas and LNG Point of View**
- **What matters to USA LNG?**
 - **Supply**
 - **Cost positions**
 - **Demand shocks**

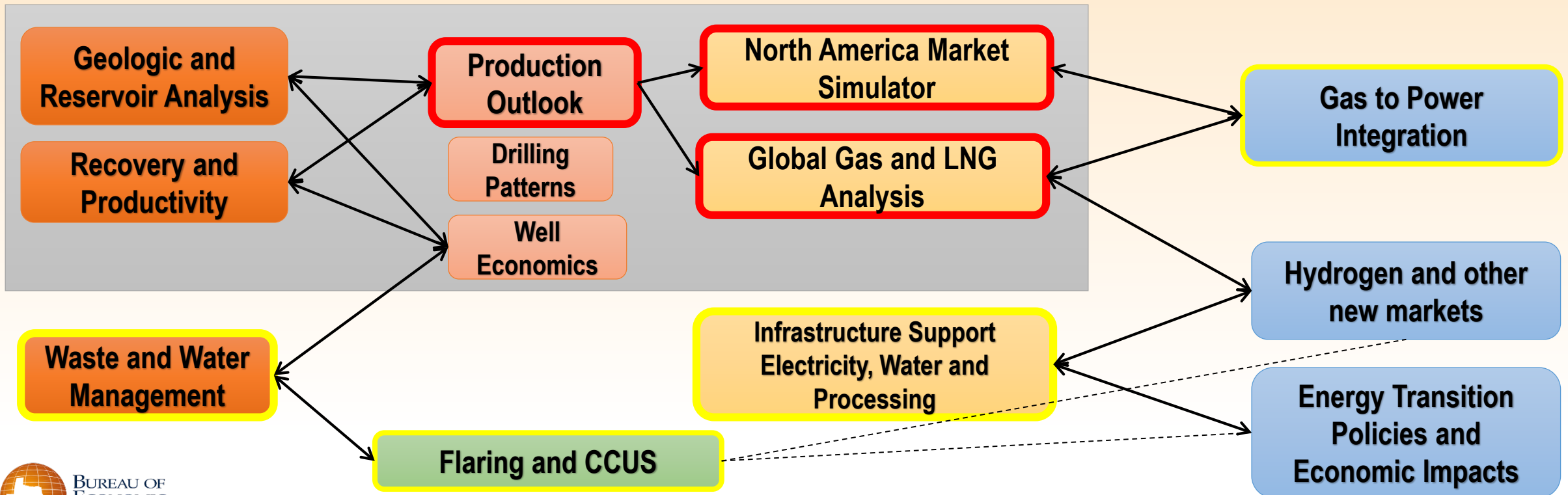
Research on Natural Gas Value Chain



Upstream

Midstream

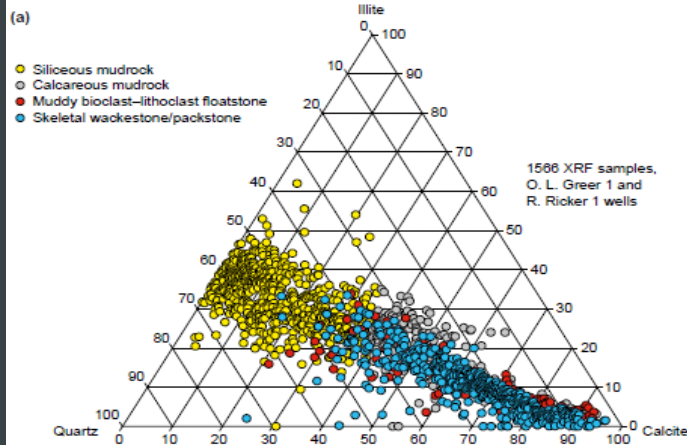
Downstream



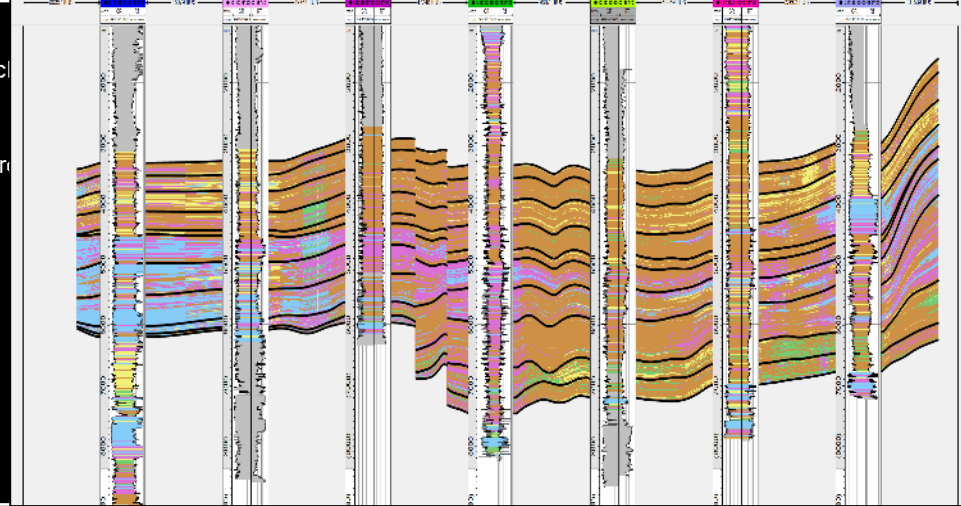
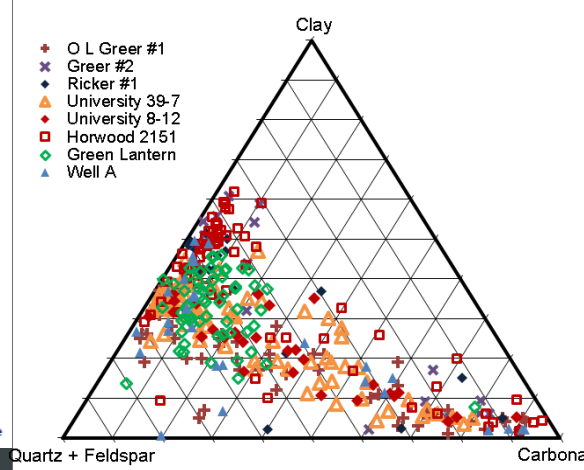
Geology

Upstream Resource Assessment

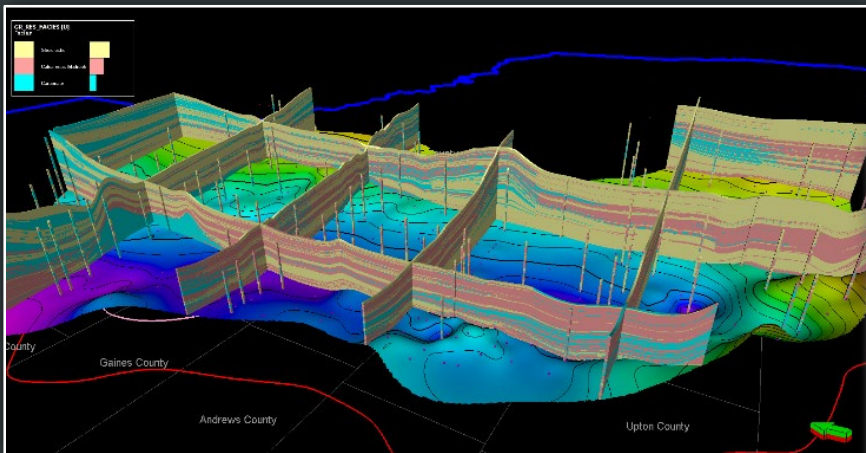
Stratigraphic Framework Petrophysics



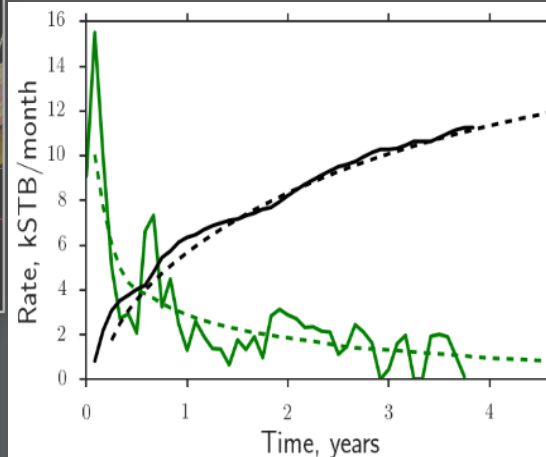
(from Baumgardner, Hamlin and Rowe, 2016; computed from XRF data)



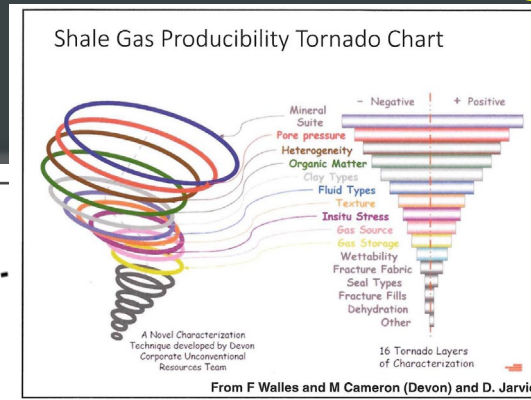
3D Models



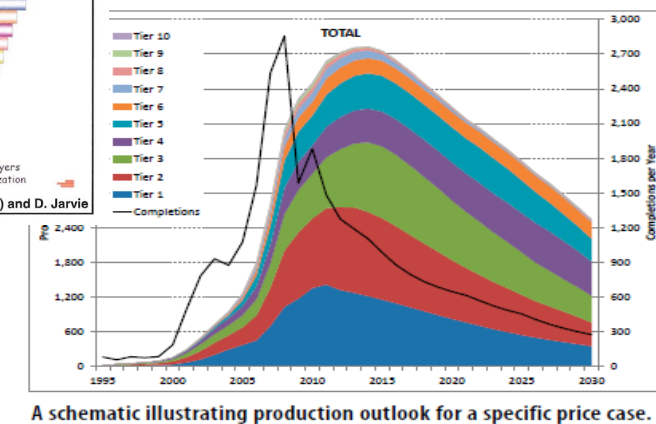
History Matching

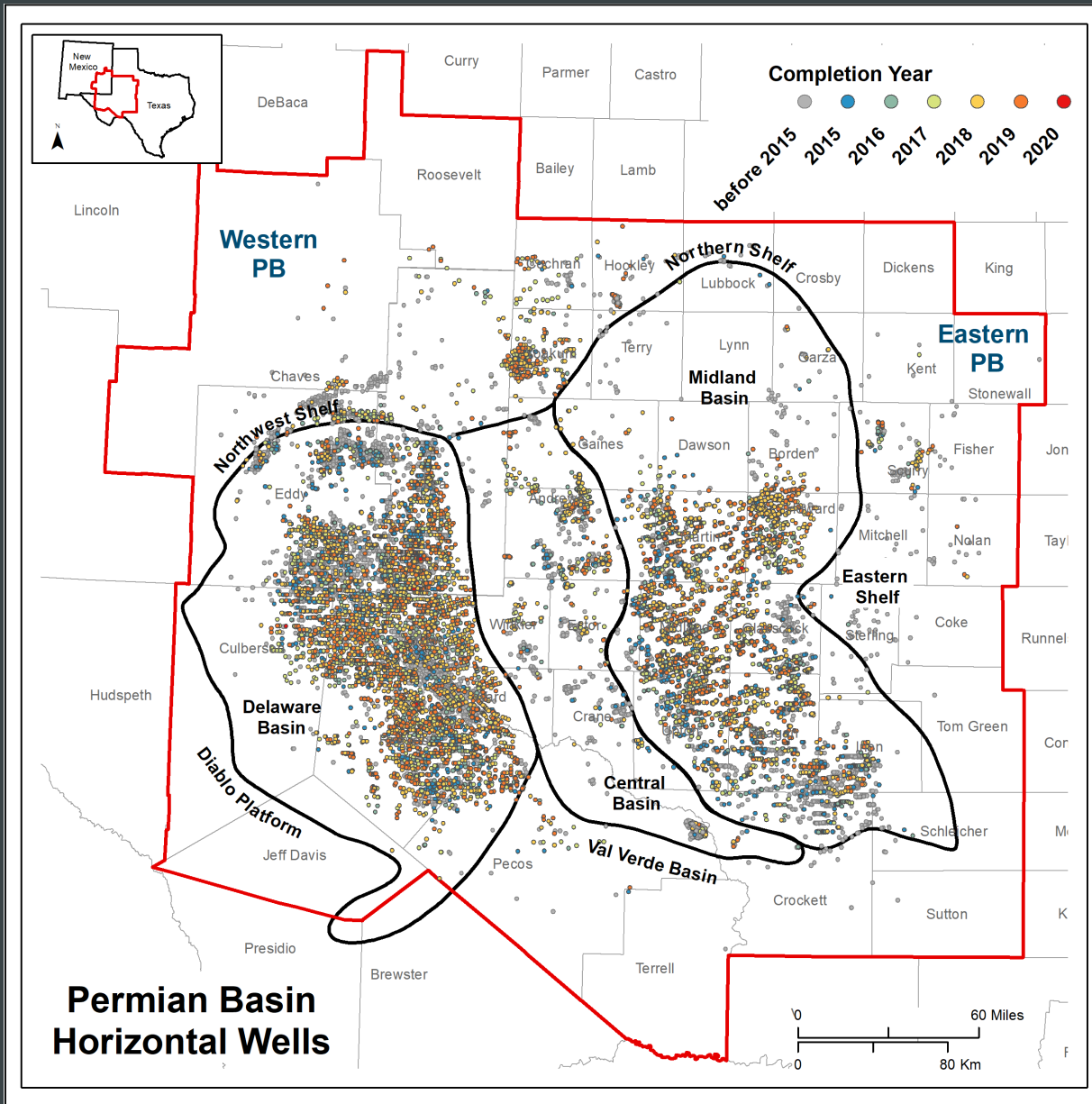


Statistical Modeling



Production Outlook





Expected Drilling

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

(TORA)
Bottom-up
resource
evaluation

Supply
Builder



North America – GPCM

- 245 Pipelines
- +440 Storage areas
- LNG Exports / Imports
- 100 Market Points)
- Import and Exports

Customized
assumptions to
focus on
specific
projects or
markets

Infrastructure
Builder



Global Gas Market – G2M2

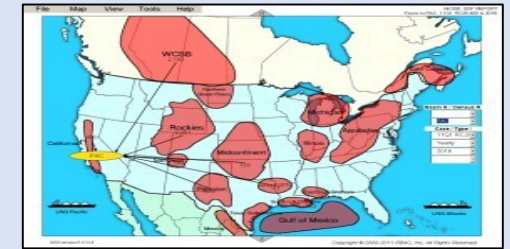
- Sectoral(5) Demand of 100+ countries
- LNG Contracts and Infrastructure
- Pipeline (400+) and Storage (600+)
- Multi-tanker classes
- Source and Destination Flows

Demand
Builder

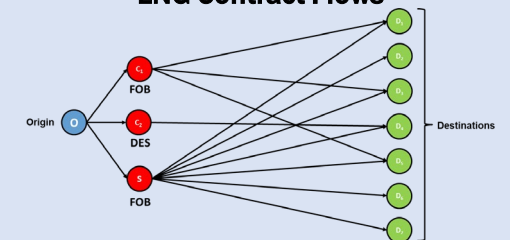
Demand and Supply Balance



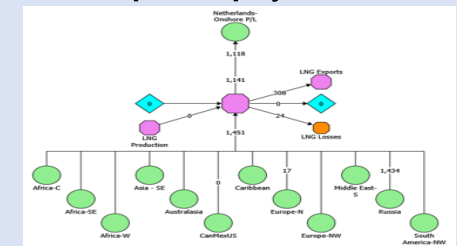
Supply Flows



LNG Contract Flows

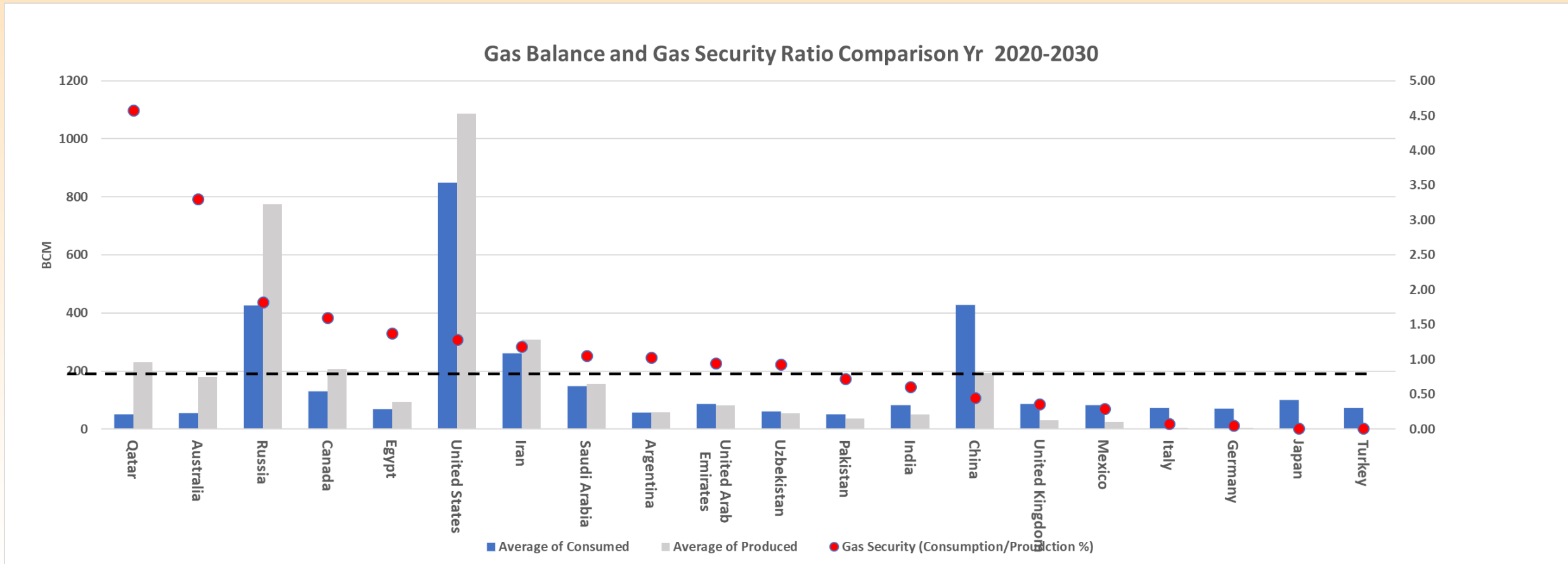


Graphic Display of Flows



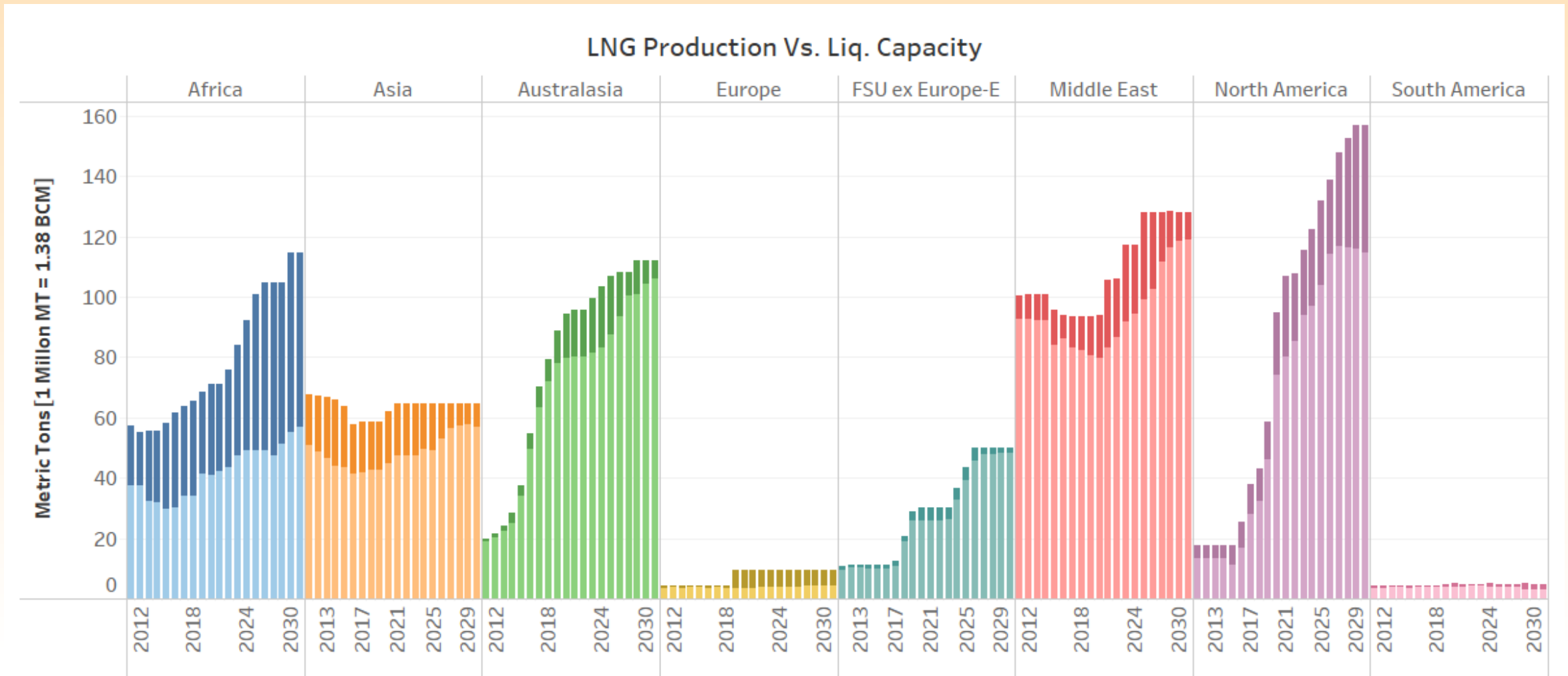
Courtesy of RBAC, Inc.

Gas Security Ratio – Production/Consumption By Country

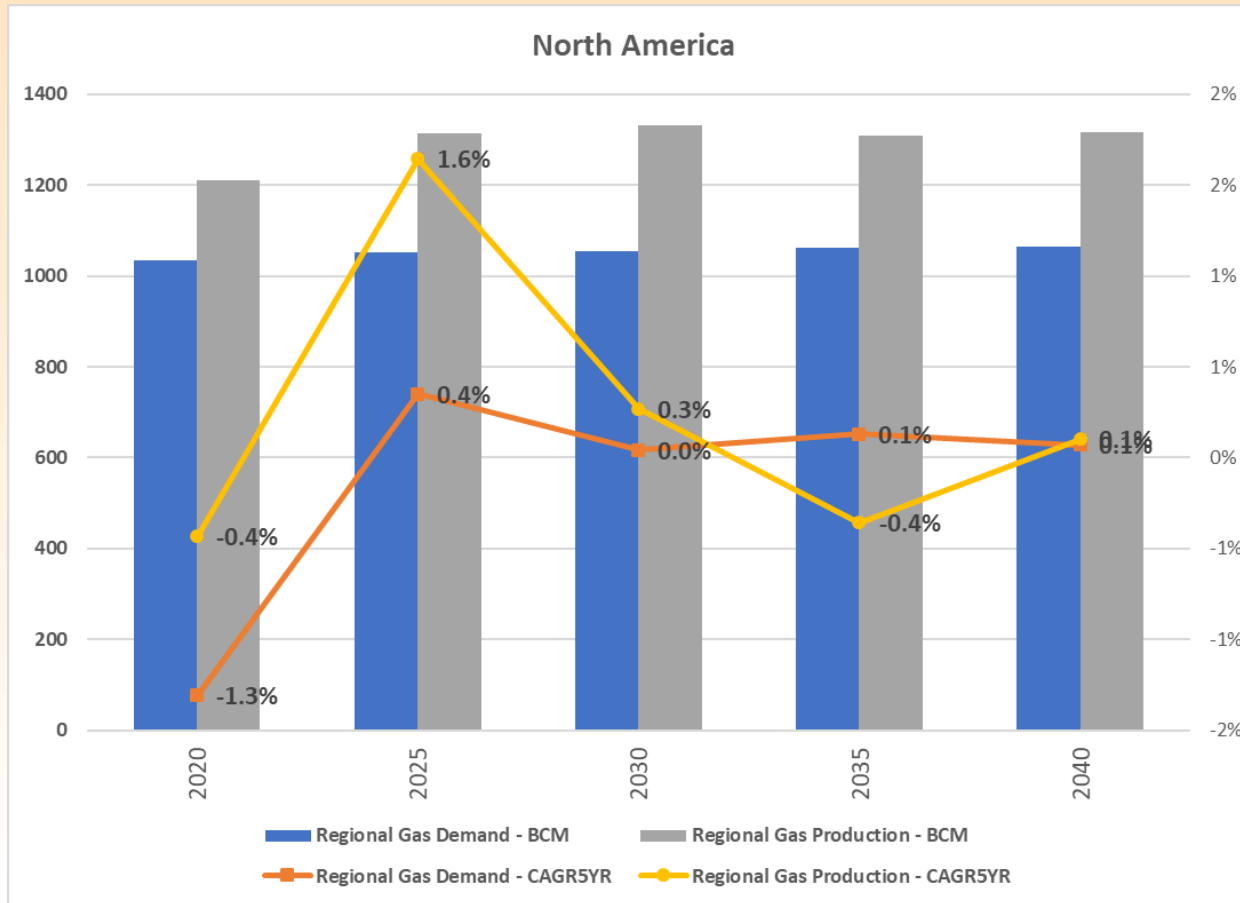


From left to right, countries have increasing dependency on imported gas.

Regional LNG Production versus Capacity

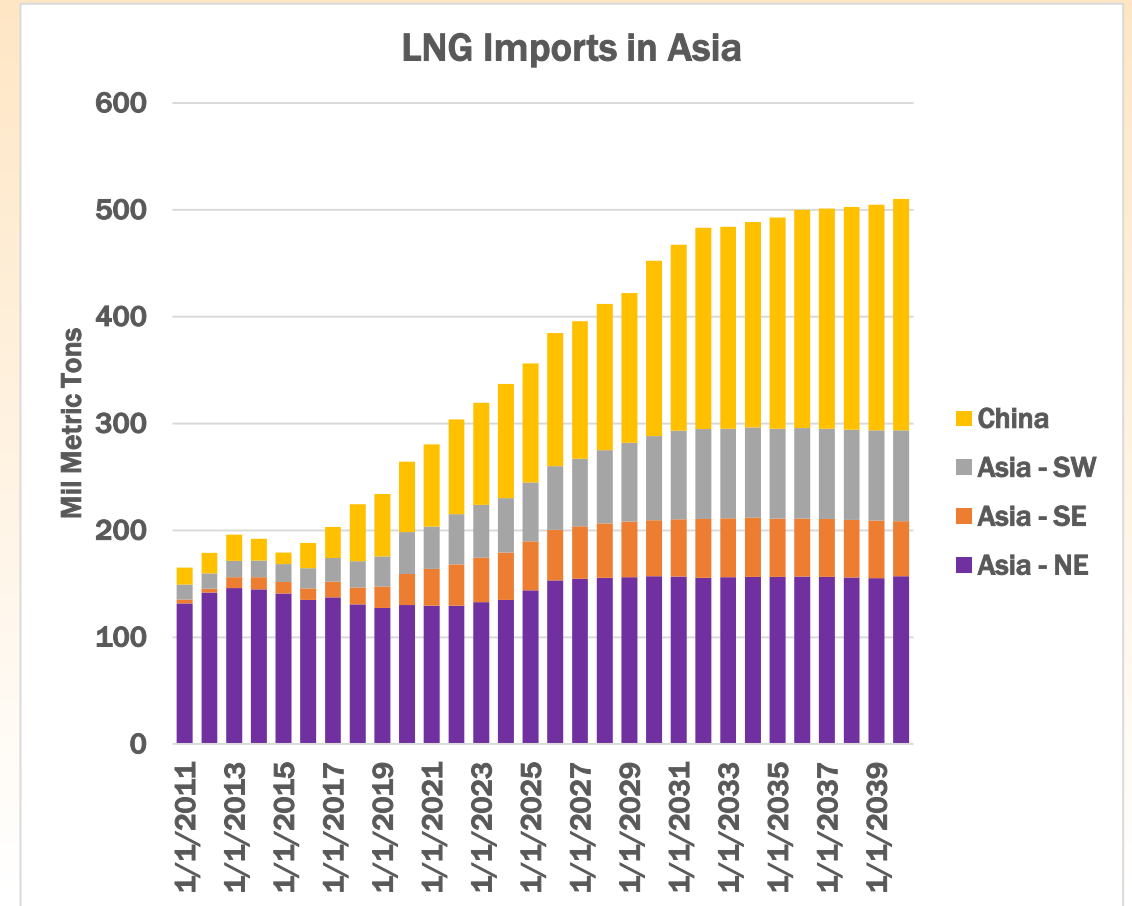
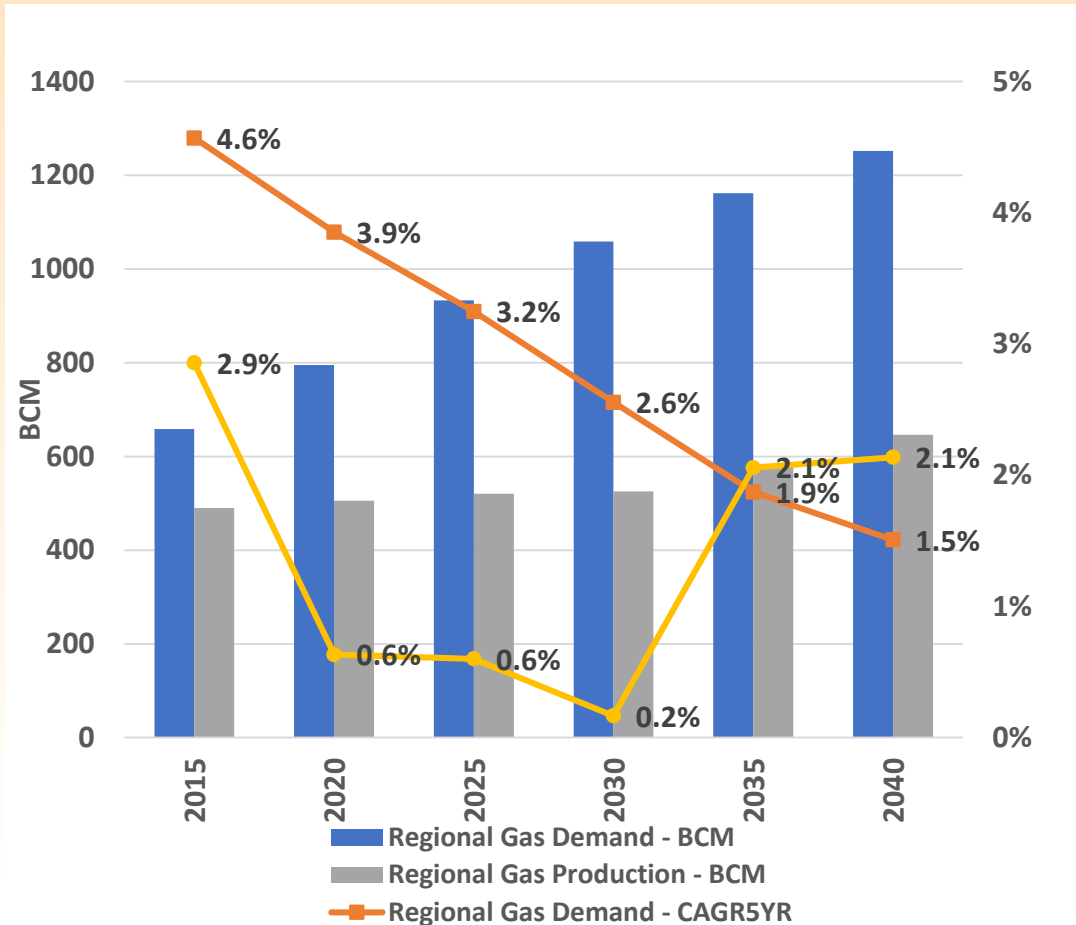


North America – LNG as an outlet not a driver

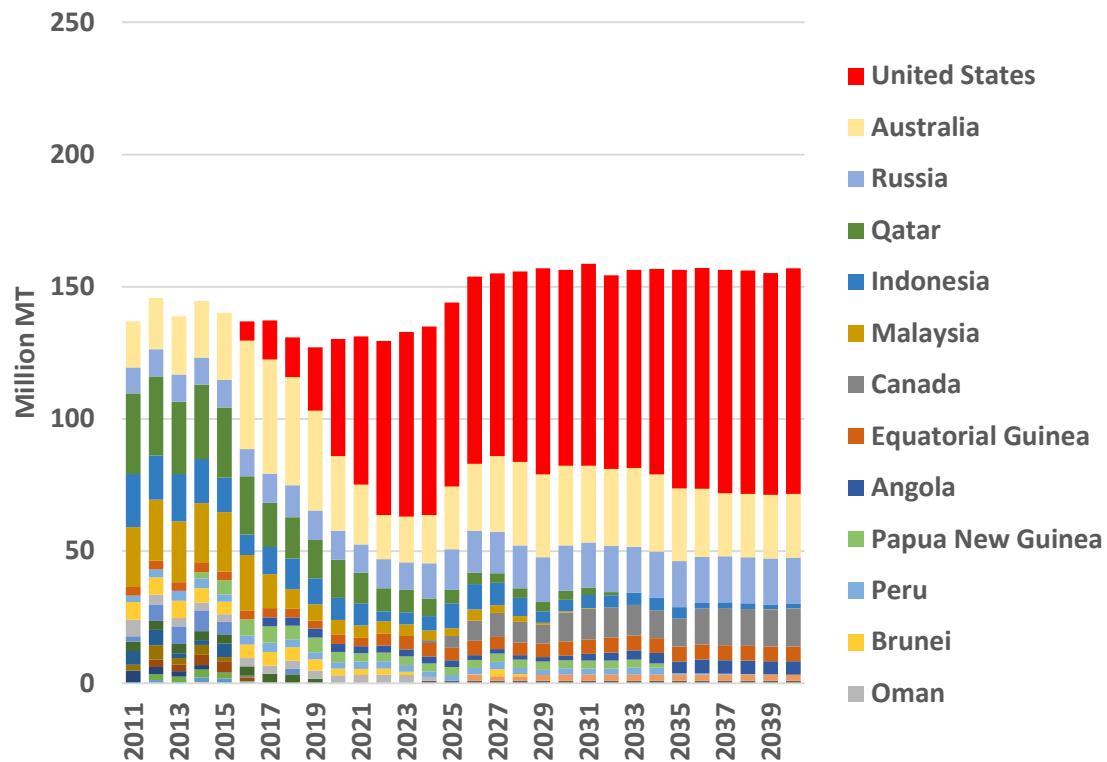


- With upcoming projects, capacity constraints are not a major concern, except localized areas.
- Upstream gas procurement and facility utilization should be the focus, and
- What to monitor in the market:
 - upstream supply outlooks
 - supply region market basis

Asia - Still a growth story despite of short disruptions

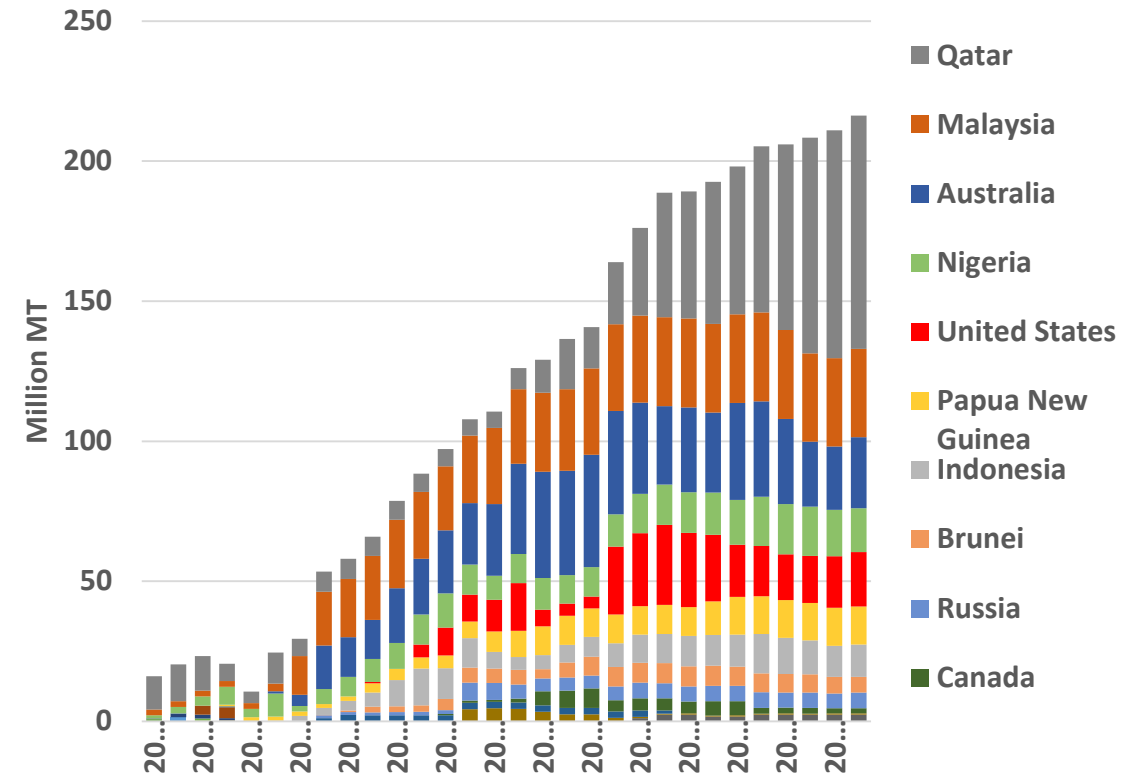


North East Asia



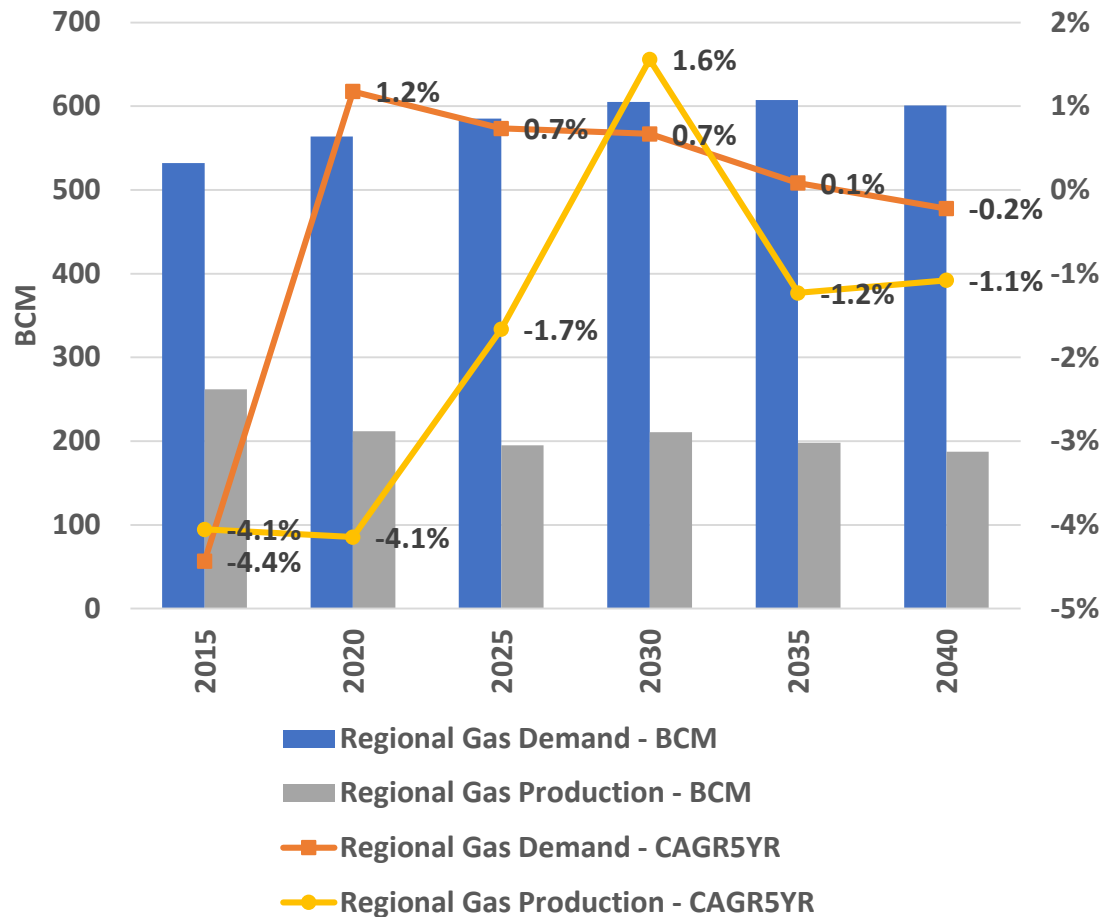
Long term need for LNG remains, while US becomes a major competitor to Australia and Qatar.

China



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.

Upstream - Be Aware of Decline Rates

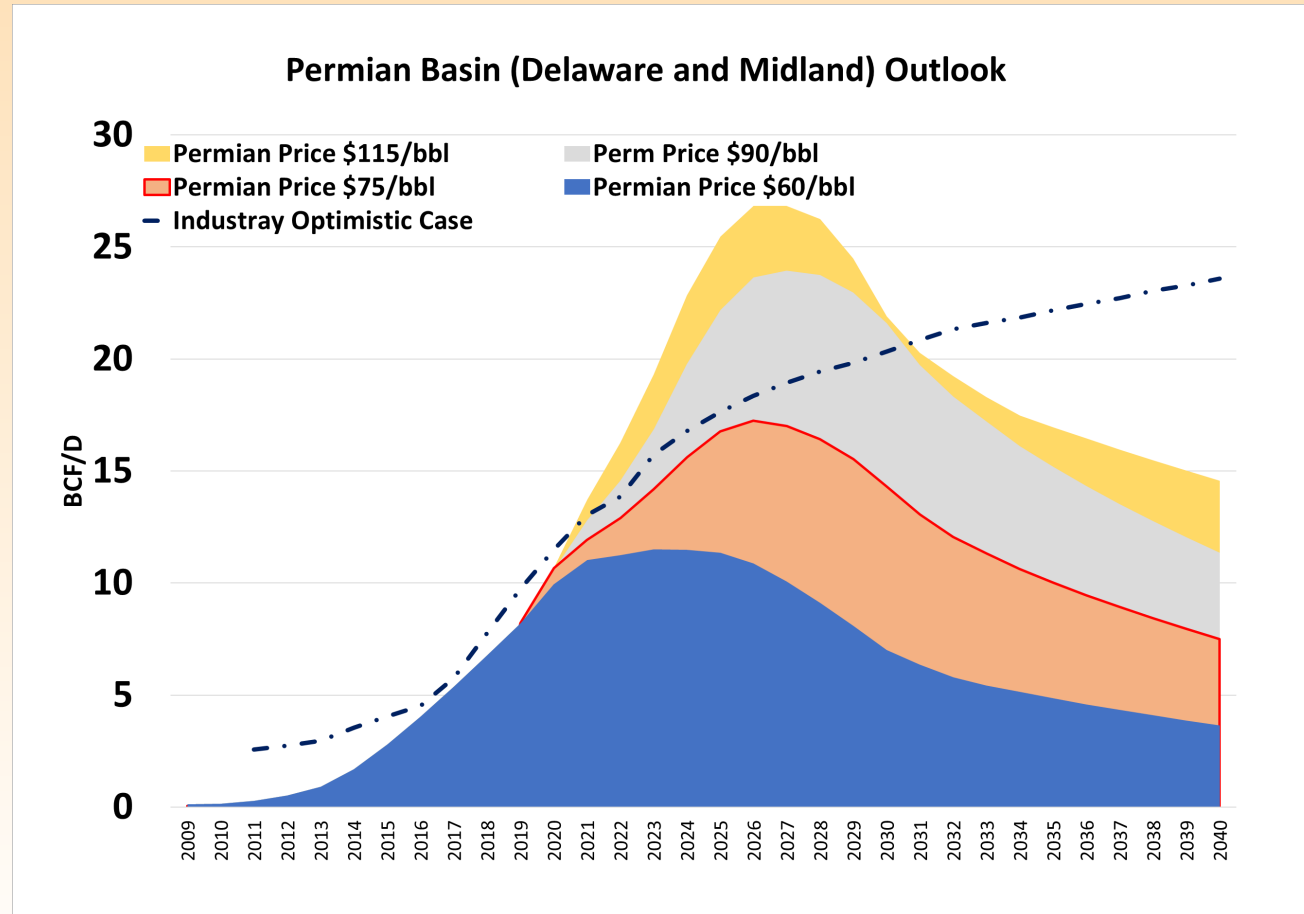
Geologic and
Reservoir Analysis

Recovery and
Productivity

Well
Economics

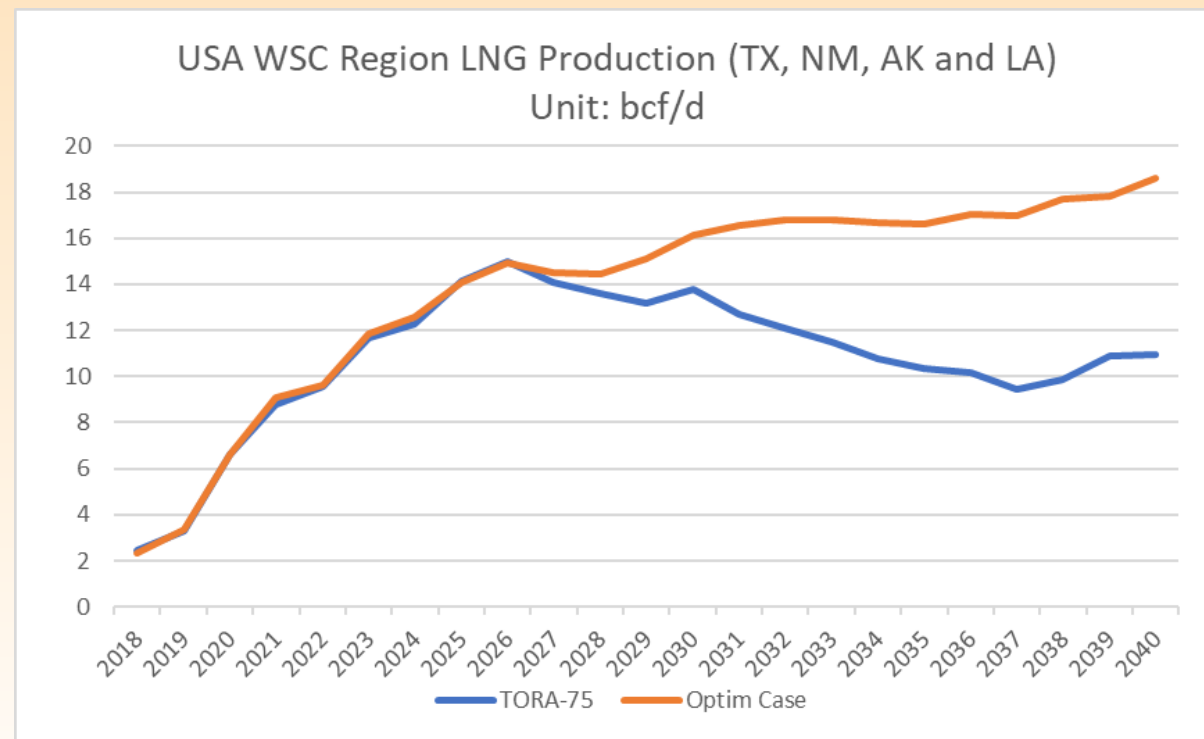
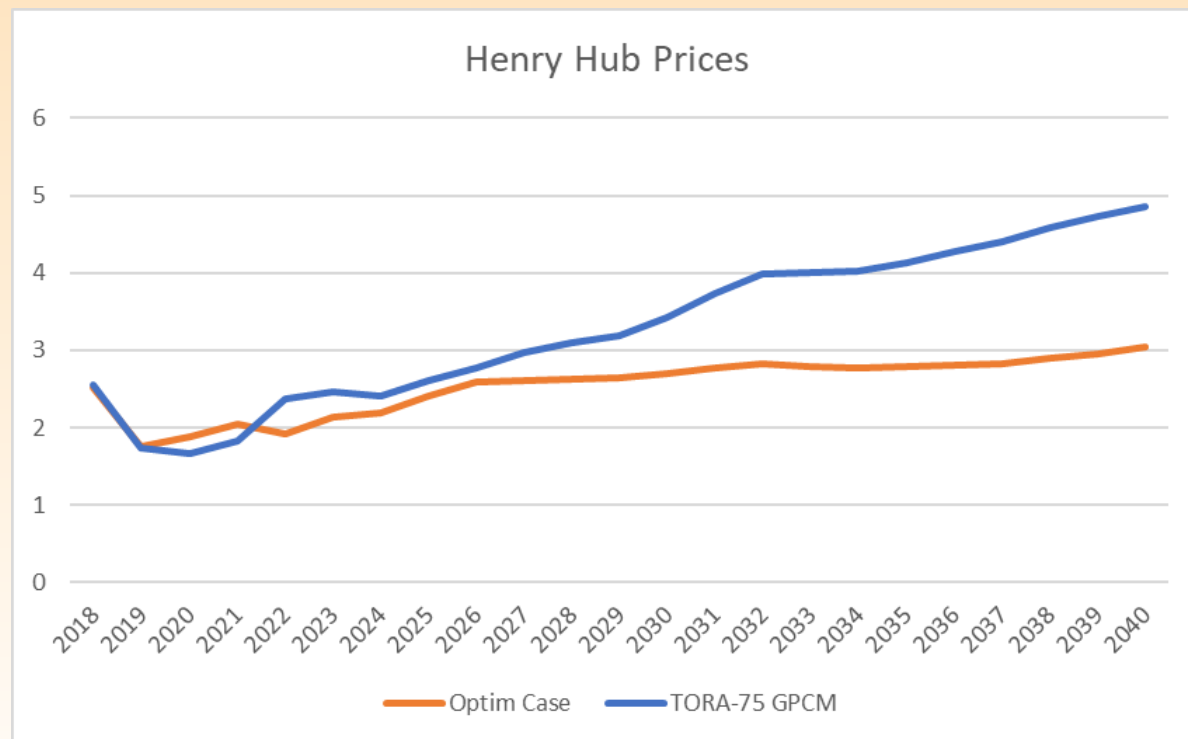
Drilling
Patterns

Production
Outlook



Production outlook is a function of expected drilling, well economics and market and price conditions.

Alternative Case – Faster Decline Rate

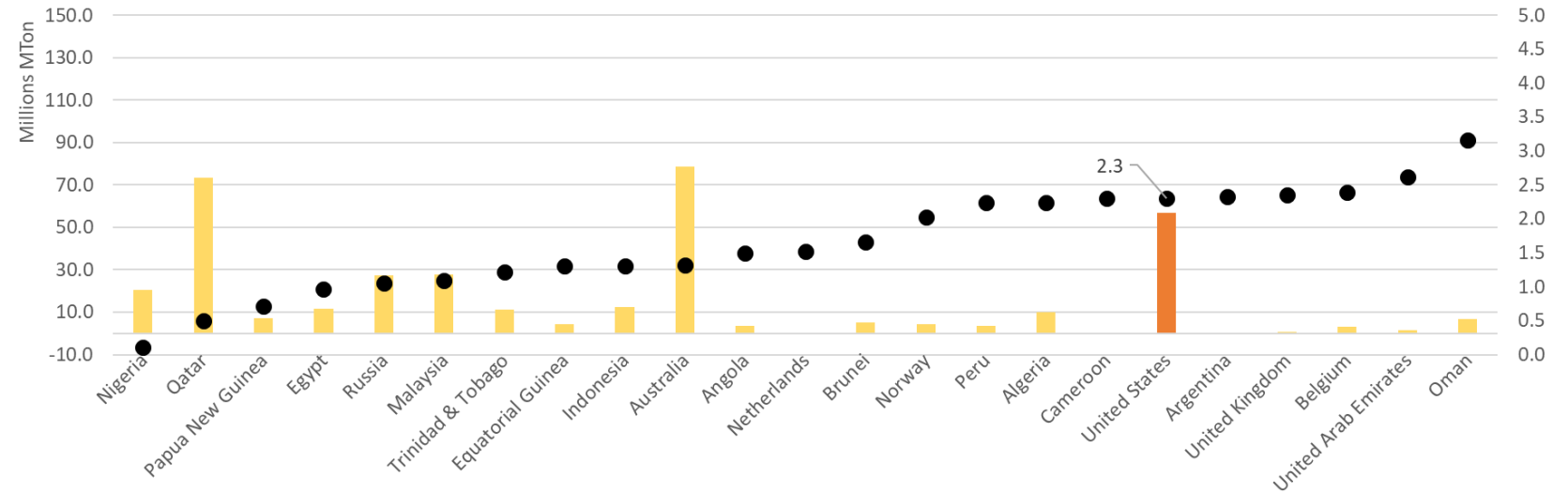


Decline Rate is one of the most critical factors, for determining the future price and Gulf LNG production. An alternative case which only includes an adjusted supply profile USA West South Central (including Permian as well as Barnett and Hayesville)

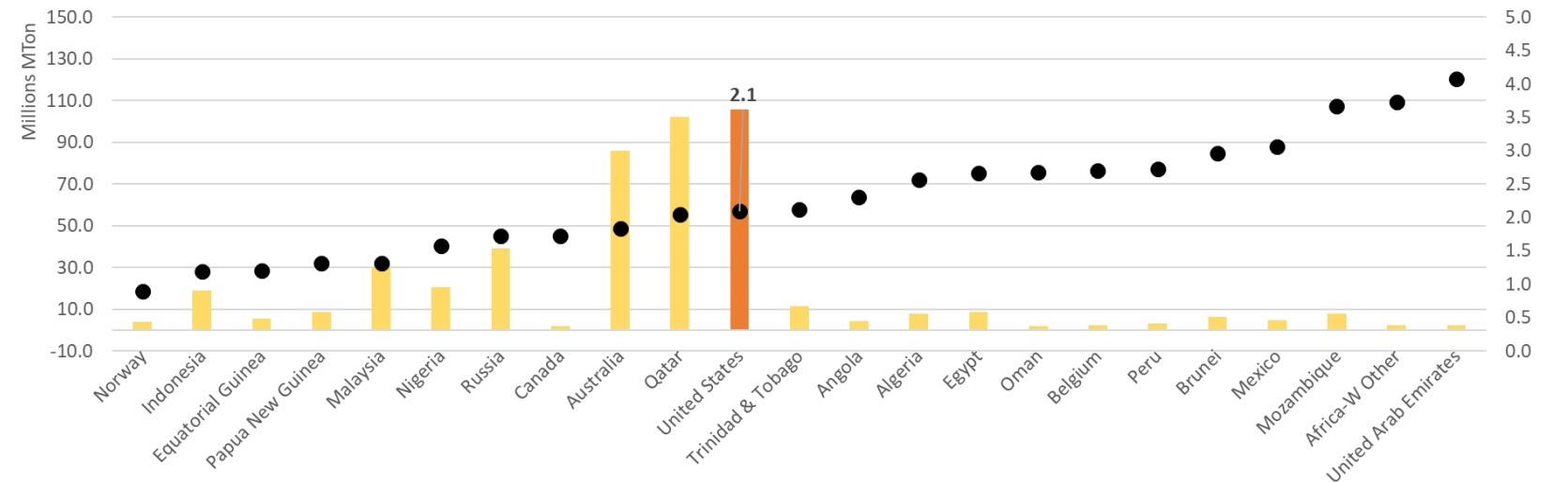
LNG Cost Stack 2020 – 2025

- 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.

Yr 2020 Global total of 370 Mil tons with wt ave Price \$ 1.28/mmbtu

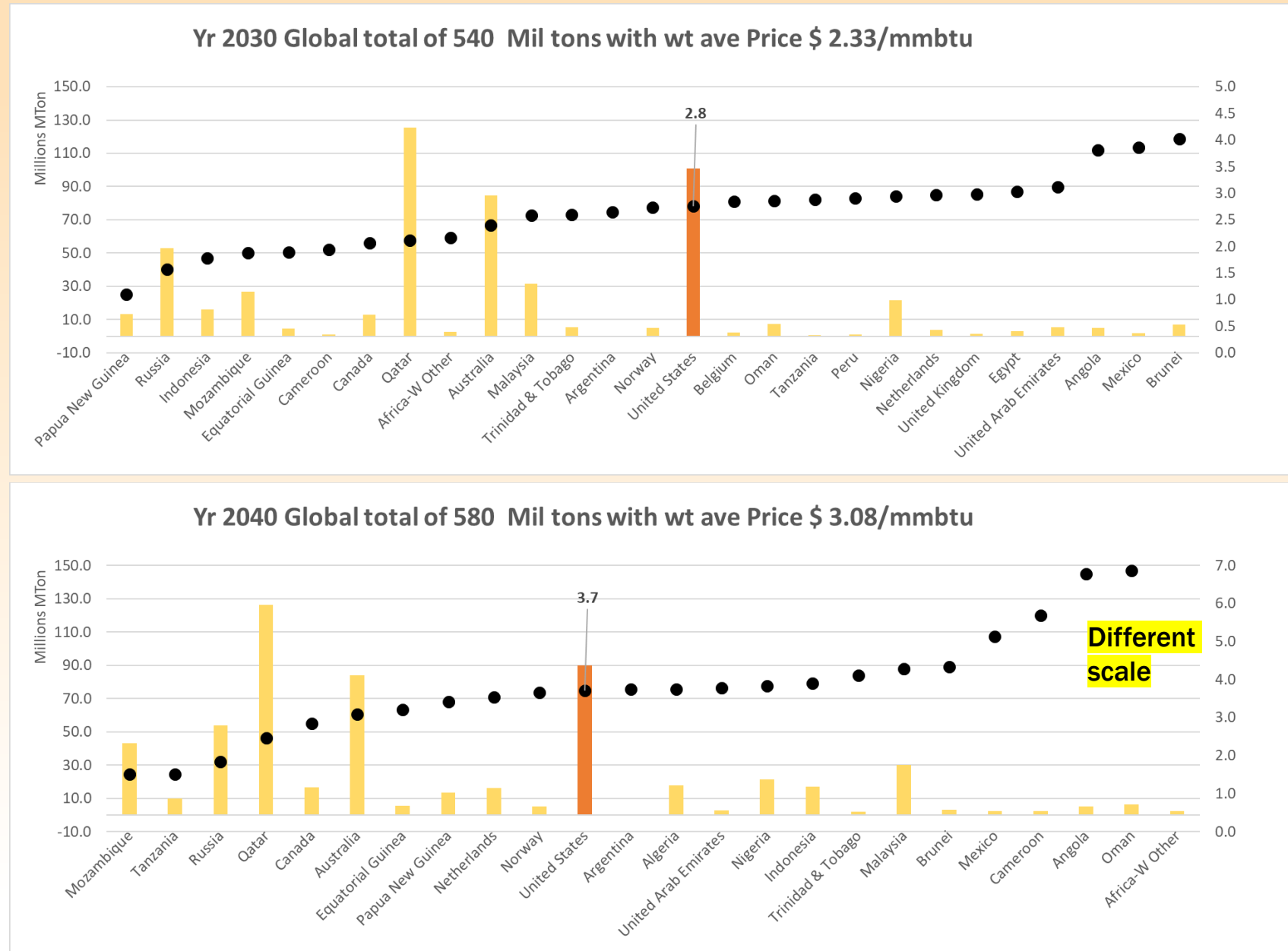


Yr 2025 Global total of 490 Mil tons with wt ave Price \$ 1.96/mmbtu



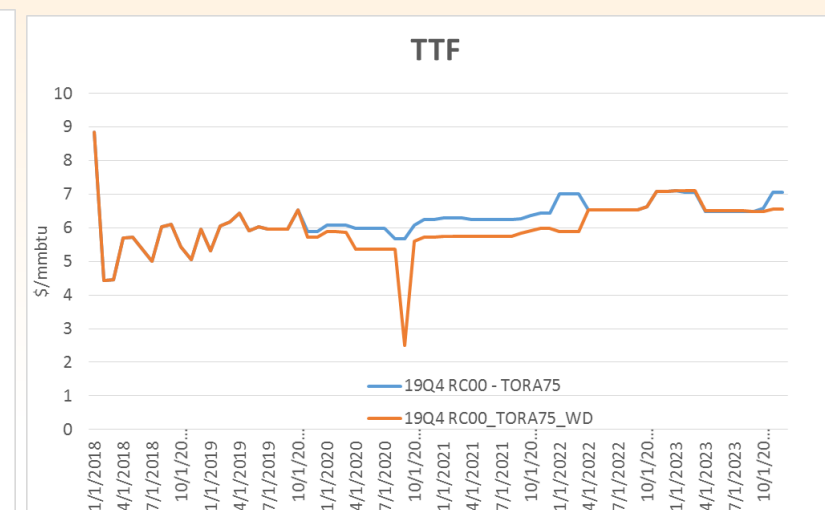
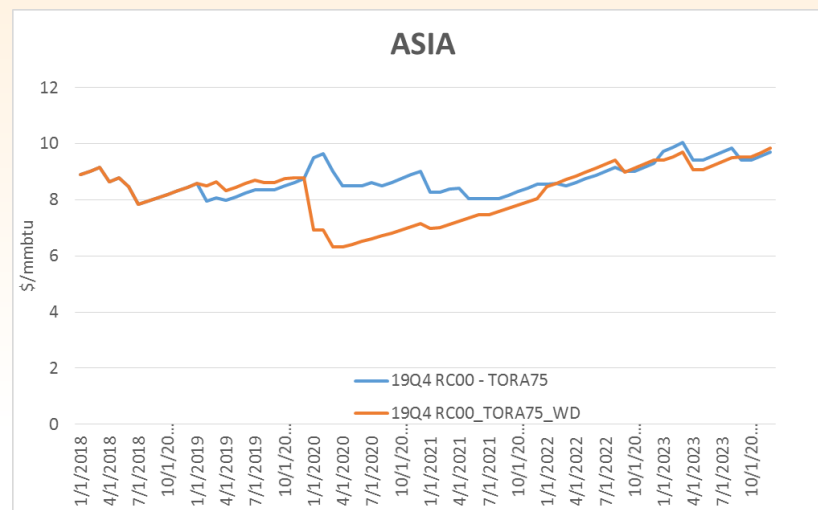
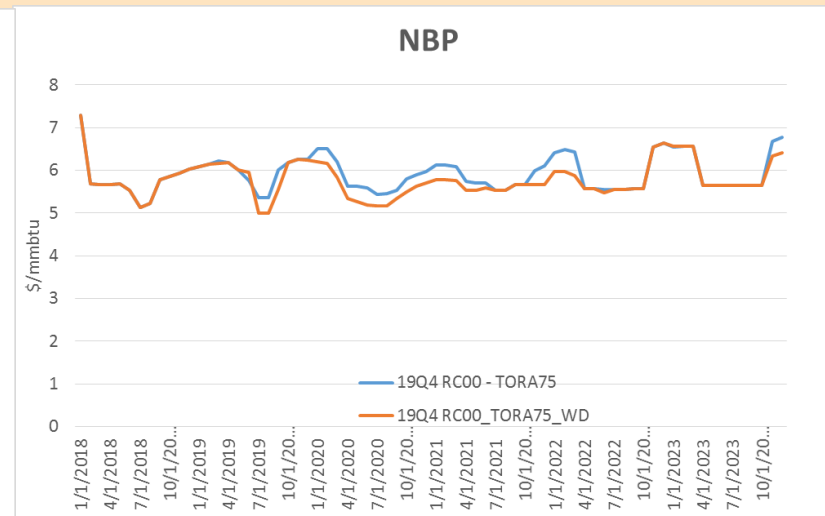
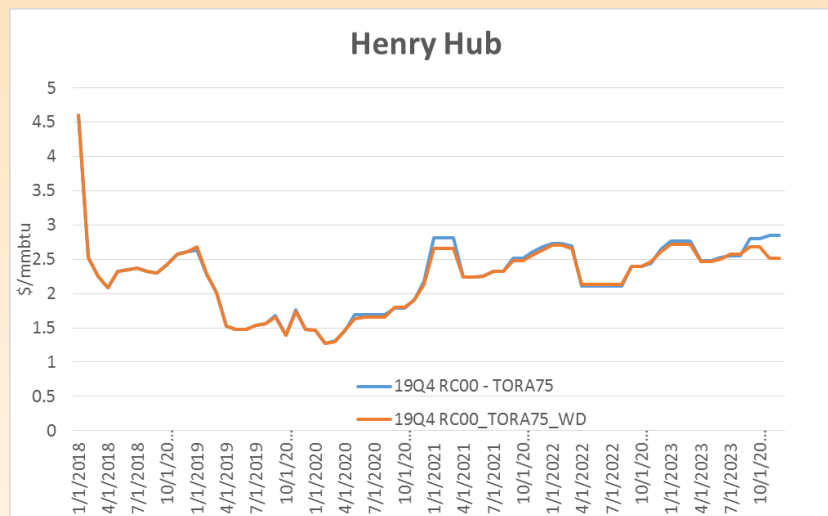
Competition of LNG after 2025

- 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 ≥ -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



Thanks!

The Center for Energy Economics (CEE) performs research and provides training and outreach on energy economics, markets, and frameworks for commercial and strategic investment. CEE is externally funded through research grants and contracts, corporate and government partnerships, and our training programs.