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North American Natural Gas Macro

California Energy Commissioner Workshop on Natural Gas Market Trends and Outlook
October 9th, 2017
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Agenda

- North American Overview
- Power Generation & Renewables
- Impacts to Pipeline Deliverability
Largest natural gas network in North America
- Own or operate ~70,000 miles of natural gas pipeline
- Connected to every important natural gas resource play in the U.S.

Largest independent transporter of petroleum products in North America
- Transport ~2.1 MMBbl/d (a)

Largest transporter of CO2 in North America
- Transport ~1.3 Bcf/d of CO2 (a)

Largest independent terminal operator in North America
- Own or operate ~155 terminals
- ~152 MMBbls liquids capacity
- Handle ~53 MMtons of dry bulk products (a)
- Own 16 Jones Act vessels (including 2 under construction)

Only Oilsands pipeline serving the West Coast
- Transports ~300 MBbl/d to Vancouver / Washington State; planned expansion takes capacity to 890 MBbl/d

(a) 2017 Budget
Current Key Trends

- U.S. becomes net exporter
- Industrial demand growth
- Gas-fired generation increases
- Less Canadian Exports to U.S.
- Continued supply increases
- More U.S. Exports to Mexico

Source: ICF International and Kinder Morgan Analysis
Supply
(Dry Gas – Bcf/d)

L48 Production

2016  72.1
2026  100.9
2016-2026 CAGR  3.4%
Flow Changes
(Dry Gas)

Changes 2016-2026 (Bcf/d)

- Jordan Cove 1.0
- 0.4
- 0.3
- 0.0
- -0.6
- 0.2
- 0.3
- 1.3
- 2.0
- 1.9
- 1.1
- 0.1
- -0.1
- 0.1
- 0.2
- 0.3
- 0.1
- -0.1
- 1.0
- 1.4
- 0.6
- 3.3
- 3.1
- 2.5
- -1.1
- -2.0
- 8.6
- GULF COAST LNG EXPORT
- EAST COAST LNG EXPORT
Power Generation
Given the projections for existing and new renewable power, the West Region may see a maximum demand destruction in power gen of 3.2 Bcfd (1.8 winter to 4.5 summer) by 2025.

Source: Existing to planned capacity from Velocity Suite; Gas demand impacts derived from ICF International generation forecast data

CA natural gas intensity is decreasing while overall U.S. is increasing
The EIM seeks to optimize generation resources across a broad power market region to reduce costs and emissions:

- Minimizes sub-hourly dispatch
- Reduces reserve capacity requirements
- Reduces renewable generation curtailments

Seattle City Light, Portland General Electric, Idaho Power, and Salt River Project will also join the EIM

100-200 MMcfd net reduction to WECC region gas demand

Since its inception, EIM has saved $146 MM and averaged 5 MMcfd of reduced gas-fired generation demand in 2016

Source: CAISO
California ISO “Duck Curve”

Net load - March 31

Ramp need
~13,000 MW in three hours

Potential over generation

Source: CAISO
In 2012, renewable impact was small. Large percentage of generation was baseload.

Renewables displacing ~870 MMcfd (gas equiv.) in 2017.

Gas deliverability needs increased due to hourly changes caused by renewables.
CAISO Future Generation

Higher solar generation pushes out more baseload generation leading to a reduction of ~300 MMcfd in gas equivalent generation compared to 2017 (1.2 Bcfd reduction compared to no renewables case).

Gas-fired hourly peaking grows by 7 GW\(^1\) or a 70 MDth/hr increase\(^1\); 19 GW total or 190 MDth/hr during peak. 190 MDth/hr \(\times \) 24 = 4.6 Bcfd

Assumes 200\% of 2017 solar, 115\% of 2017 wind, and 95\% of 2017 load; charts based on an average March day

\(^1\)Peak day compared to 2017
Historical average and peak storage withdrawal demand has been within California’s storage withdrawal capability. Future storage limitations may impact peak day deliverability.

Hourly deliverability needs based on renewable firming may put pressure on overall California deliverability, requiring greater pipeline delivery flexibility.

Increasing renewables and DOGGR storage rules reduce the deliverability margin in California.

More detailed in-state deliverability analysis is needed as power generation peaking needs could disrupt the current allocation of storage and pipeline capacity.
Load variability versus rates of delivery is a major issue for all pipelines
  - Rates of receipt and delivery rarely equal

Pipelines must manage linepack to achieve delivery flexibility
  - Achieve *daily* and *hourly* quantities AND
  - Meet all contractual pressure requirements

Linepack is derived from pipes and compression
  - Linepack Function of: pipe size (length, diameter) and operating pressures
  - Useable linepack is also a function of pipeline capacity load factor
    - Higher load factors equals less useable linepack
North American demand growth continues

- LNG exports and Power Generation are primary sources of demand growth
- Low gas prices incentivize Industrial and Residential growth

Renewables (wind and solar), because of their intermittent nature, are impacting gross natural gas demand and deliverability needs.

- Less gas-fired generation for baseload in regions with growing renewables
- More gas-fired generation will be required for renewable firming
- Growing demand for hourly natural gas deliverability

Pipelines must manage linepack to achieve scheduled daily and *hourly* quantities AND meet all contractual pressure requirements.

- In certain regions or market areas, this may require more pipe, compression, pipeline or storage services.