| **Docket Number:** | 17-IEPR-04 |
| **Project Title:** | Natural Gas Outlook |
| **TN #:** | 221391 |
| **Document Title:** | Presentation - North American Natural Gas Macro |
| **Description:** | Presentation by George Wayne of Kinder Morgan |
| **Filer:** | Raquel Kravitz |
| **Organization:** | Kinder Morgan |
| **Submitter Role:** | Public |
| **Submission Date:** | 10/5/2017 1:34:09 PM |
| **Docketed Date:** | 10/5/2017 |
North American Natural Gas Macro
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Agenda

- North American Overview
- Regional Supply and Demand
- Power Generation
- Mexico
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
Demand (Not Including Exports)

2016-2026 Volumes in Bcf/d

North America Total
2016  92.6
2026  111.7
2016-2026 CAGR 1.9%

PNW  1.6  2.4  4.1%
WESTERN CANADA  6.8  8.3  1.9%
6.4  6.3  -0.2%
5.1  5.9  1.4%

EASTERN CANADA  3.4  4.4  2.5%
12.5  16.1  2.5%
12.0  13.9  1.5%
15.5  18.8  1.9%
5.6  6.8  2.0%
Flow Changes

Changes 2016-2026 (Bcf/d)
Power Generation
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 impact 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
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.
CAISO Renewables 2012 to 2017

### CAISO Avg. Load & Generation (2012)

- **Large percentage of generation was baseload**

### CAISO Avg. Load Following (2012)

- **In 2012, renewable impact was small**

### CAISO Avg. Load & Generation (2017)

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

### CAISO Avg. Load Following (2017)

- **Gas deliverability needs increased due to hourly changes caused by renewables**
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)

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

Gas-fired hourly peaking grows by 7 GW¹ (2 Bcfd increase¹, 5 Bcfd total)²

¹Peak day compared to 2017, ²Daily equivalent hourly flow rate
Renewable Implications to Natural Gas

On average, without energy storage gas-fired renewable firming is higher by 70 MMcfd

In a higher solar generation scenario, renewable firming increases by 1.1 Bcfd compared to 2017

Rapid hourly changes in solar generation result in need for substantial hourly gas capacity to support gas-fired renewable firming generation

Without energy storage, peaking need is higher by 1 GW (1 Bcfd)¹

“Future,” assumes 200% of 2017 solar, 115% of 2017 wind, and 95% of 2017 load, 13 GW x 5 hour energy storage discharge

¹Daily equivalent hourly flow rate
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.
Appendix
Energy storage increases total gas-fired generation by 200 MMcfd\(^1\) but reduces renewable firming by 70 MMcfd. Hourly peaking growth is limited to 2 GW\(^2\) (1 Bcfd increase\(^2\), 4 Bcfd total\(^3\)).

\(^1\)Compared to future case with no energy storage; gas-fired generation increases because over-generation of baseload is needed to enable charging of energy storage. \(^2\)Compared to 2017. \(^3\)Daily equivalent hourly flow rate.