Committee on Gas
Committee on Gas and Committee on Energy Resources and the Environment

How Clear is the Crystal Ball? Planning for the Future of Natural Gas
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Planning for the Future of Natural Gas

NARUC Summer Policy Summit
Joint Session with Committee on Energy Resources and the Environment and Committee on Gas

San Diego, California | July 17, 2017

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Early Stages of Explosive Growth in U.S. Demand for Natural Gas

Potential Demand Increase in Demand for U.S. Production, 2017–2020 (Bcf/d)

Source: EBW Analytics
Power Sector Consumption Growing Rapidly

Combined-Cycle Generating Capacity Additions by Year, 2011–2020 (MW)

Source: EBW Analytics, Ventyx
Could Continue Even Without Clean Power Plan

Scenarios for Natural Gas Combined-Cycle Capacity Growth, 2016–2030 (MW)

Source: API
Mexican Exports Growing Rapidly

U.S. Natural Gas Pipeline Exports to Mexico, 2014–2024 (Bcf/d)

Source: EBW Analytics, EIA Annual Energy Outlook
LNG Exports Most Important Driver

Projected Cumulative Growth in Natural Gas Demand Attributed to LNG, 2016–2019 (Bcf/d)

Cumulative Natural Gas Demand for LNG Operations Including Potential Projects, 2016–2022 (Bcf/d)

Source: Simmons, EBW AnalyticsGroup

Source: EBW Analytics
U.S. Now Linked to Global Market

World LNG Exports by Region, 2012–2022

Source: IEA
Supply Surging

Global LNG Export Capacity, 2012–2022

Source: IEA
Space Heating Demand (Bcf) and Average Henry Hub Price ($/MMBtu), Last Five Winters

Source: EBW AnalyticsGroup
Climate Crisis

Average Global Sea Surface Temperature, 1880-2015

Temperatures Worldwide, 1901-2015

Source: NOAA
EIA Least Cost of Energy (LCOE) Comparisons Misleading

EIA LCOE Calculations for Onshore Wind, Solar PV, NGCC and NGCT ($/MWh)

Adjusted Levelized Cost of Energy Metrics

Source: EIA

Source: EBW Analytics Group
Average and Marginal PV Curtailment and Net LCOE in Base Scenario

Growth in Electricity Storage

U.S. Energy Storage Annual Deployments Will Reach 2.6 GW by 2022

Source: GTM
What Might the Future Look Like with a Large Share of State-Supported Clean Energy?

Source: Brattle Group
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Thank you for your time.
Future Use of Natural Gas
July 17, 2017

Steven Weissman, Lecturer
UC Berkeley Goldman School of Public Policy
U.S. Energy Supply Since 1850

Source: EIA
Natural Gas Electricity Generation

Figure 2: Natural Gas Electricity Generation: EIA AEO2015 Reference Case, 2000–2040

Projected Total U.S. Natural Gas Consumption

Figure 5: Total Natural Gas Consumption (in quadrillion Btu), 2012–2040

Result: Three Pillars Required In All Deep Decarbonization Scenarios

- Energy Efficiency
- Decarbonization of Electricity
- End Use Fuel Switching to Electric Sources

Key Metric of Transformation:
- Electricity Emissions Intensity (gCO2/kWh)
- Share of Electricity and Electric Fuels in Total Final Energy (%)
Total $\text{CO}_2^e$ from Natural Gas

Figure 8: $\text{CO}_2^e$ from Natural Gas vs. Total Greenhouse Gas Allowances*

*The total natural gas consumption rate ($\text{CO}_2^e$) is derived from EIA data for National Energy Consumption by Sector and Source. The conversion factor used to determine MMT is 0.1 mmBtu/1 therm $\times$ 14.46 kg C/mmBtu $\times$ 44 kg CO$_2$/12 kg C $\times$ 1 metric ton/1,000 kg = 0.005302 metric tons CO$_2$/therm. The excel data is provided by the EIA Annual Energy Outlook 2015: Website access: [http://www.eia.gov/forecasts/aeo/](http://www.eia.gov/forecasts/aeo/).
Figure 6: Age and Capacity of Operating U.S. Coal and Gas-fired Generators, Fall 2011

- **Coal** (brown circles)
- **Gas** (blue circles)

- Assumed coal and gas combustion turbine retirement age: 60 years
- Assumed gas combined cycle retirement age: 25 years

Source: Rocky Mountain Institute © 2011. For more information see www.RMI.org/ReinventingFire.
Timeline for New Gas-fired Power Plants

Figure 7: Typical Timelines for Natural Gas Power Plants

Application Filed in 2016

Low
- 2016
- 2020
- 2050

Average
- 2016
- 2022
- 2057

High
- 2016
- 2029

Application Filed in 2020

Low
- 2020
- 2024
- 2054

Average
- 2020
- 2026
- 2061

High
- 2020
- 2033
- 2081
Critical Steps and Legal Pathways to Phasing Out Fossil Fuel

1. Planning is key
2. State limits on coal and gas(?) use
3. Banning the use of fossil fuels
4. Limiting GHG emissions
5. Setting an effective price on carbon
6. Internalizing cost through environ. compliance
7. Closing or divesting government-owned plants
Starting to Plan

NATURAL GAS GHG EMISSIONS

Tons Of CO$_{2e}$

Year

2017  2050

80% Below 1990 Level
Potential Alternatives may Include…

- Repowering of OTC Units at a Reduced or Requisite Capacity
- Renewable Energy Resources with Energy Storage System
- Transmission Line(s) Improvement Only
- Repowering of OTC Units as Originally Planned
- Transmission Line(s) Improvement with Energy Storage System
- Deployment of Distributed Energy Resources
  (Energy Efficiency, Demand Response, PV solar, Electric Vehicle Charging, Energy Storage)
- Combination of Any of the Above or Any Other Viable Alternatives
Objective of this Moorpark Subarea Local Capacity Alternative Study

- Objective of this ISO study is to identify and evaluate potential resource portfolio alternatives to the Puente Project to meet the local resource adequacy need in the Moorpark area.

- The study is performed for the purpose of informing the CEC’s proceeding regarding NRG’s application to construct the Puente Project.

- The study will be based on the parameters and assumptions stipulated in the CEC order regarding the study.

- The study does not assess the cost, timing or feasibility of procurement of the alternative resources.
### Resource portfolio options

<table>
<thead>
<tr>
<th>Resource</th>
<th>Maximum capacity (MW)</th>
<th>Output Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE (with new measures; includes permanent load shift products)</td>
<td>15 MW (see Note 1)</td>
<td>constant</td>
</tr>
<tr>
<td>Demand response (load reduction/behind the meter energy storage)</td>
<td>80 MW</td>
<td>4-hour</td>
</tr>
<tr>
<td>PV solar/energy storage hybrid</td>
<td>25 MW</td>
<td>7-hour</td>
</tr>
<tr>
<td>Storage enabled existing slow-responding demand response</td>
<td>~ 30 MW</td>
<td>6-hour</td>
</tr>
<tr>
<td>Preferred resources total</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Battery storage</td>
<td>≥ 114 MW *</td>
<td>Minimum 4-hour</td>
</tr>
</tbody>
</table>

* 150+114=264

**Notes:**

1. As ~111 MW (2026) of additional achievable energy efficiency in the Moorpark area is already included in ISO studies based on information provided by the CEC, this 15 MW is assumed to contribute towards that additional achievable energy and not modeled in addition to the 111 MW.

2. The procurement viability, timing and cost of developing these resources is not part of the scope of this study.
Committee on Gas