Natural Gas Demand for the U.S. Power Sector

Forum on Global Energy, Economy, and Security

Michael E. Webber
Aspen Institute, Aspen, CO
July 25, 2017
The Power Sector Is Changing: Market

• Old products:
  – Power: kW
  – Electricity: kWh

• Markets use an auction
  – Bid stacks arrange power cheapest to most expensive

• New services:
  – Fast ramping
  – Contingency/Supplemental reserves
  – Non-spinning reserves
  – Spinning reserves
  – Regulation up/down
  – Fast responding regulation up/down
  – Primary frequency response
  – Fast frequency response
  – Reactive power management
  – Synchronous inertial response
Prices change with demand
Prices change with demand

Generator Type
- Biomass
- Coal
- NG CC
- NG Other
- Nuclear
- Renewable

Renewables Online: 0 GW
Demand: 46 GW
Gas Price: $3.50
Elec. Price: $32.69

Marginal Cost ($/MWh)

ERCOT Load (GW)

Time: 0:00
Electricity prices change with natgas prices

![Graph showing the relationship between electricity prices and natgas prices. The graph illustrates how electricity prices change with different levels of natural gas prices and corresponding load demands.]
Electricity prices change with natgas prices
Increasing Renewables Lowers Electricity Prices

Renewables Online: 2 GW
Demand: 40 GW
Gas Price: $3.50
Elec. Price: $31.24
Increasing Renewables Lowers Electricity Prices

- **Generator Types**:
  - Biomass
  - Coal
  - NG CC
  - NG Other
  - Nuclear
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- **Renewables Online**: 2 GW
- **Demand**: 40 GW
- **Gas Price**: $3.50
- **Electric Price**: $31.24

**Marginal Cost ($/MWh)**

**ERCOT Load (GW)**
The Power Sector Is Changing: Environment

• Regulations seek to reduce environmental impact
  – Emissions: CO₂, NOₓ, SOₓ, Hg, PM₂.₅, PM₁₀,...
  – Water: fuel production, power plant cooling,...
• Winners: wind, solar, natural gas
Despite Water Needs of Hydraulic Fracturing, Switching From Coal to Natural Gas Combined Cycle Saves Water

Texas Fleet Average Water Consumption per kWh

Source: Grubert, Beach and Webber • Graphic: Michael E. Webber, The University of Texas at Austin
There is Tension Between CO\textsubscript{2} and H\textsubscript{2}O in the Power Sector

CO\textsubscript{2} Emissions vs. Water Consumption

Graphic: Michael E. Webber, The University of Texas at Austin

[Source: NETL, DoE, Webber]

Dr. Michael Webber
Aspen Institute Global Energy Forum
July 25, 2017
There is Tension Between CO\textsubscript{2} and H\textsubscript{2}O in the Power Sector

**CO\textsubscript{2} Emissions vs. Water Consumption**

(Graphic: Michael E. Webber, The University of Texas at Austin)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Technology</th>
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<tr>
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<tr>
<td>2</td>
<td>Coal, IGCC</td>
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<td>Natural Gas Combustion Turbine</td>
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[Source: NETL, DoE, Webber]
There is Tension Between CO\textsubscript{2} and H\textsubscript{2}O in the Power Sector

**CO\textsubscript{2} Emissions vs. Water Consumption**

Graphic: Michael E. Webber, The University of Texas at Austin

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[Source: NETL, DoE, Webber]
Market winners: solar, wind and natural gas

• Low marginal price: solar, wind
  – Cheap wind and solar beat everything
  – Cheap gas beats coal, nuclear

• Ancillary services: natural gas

• Environmental impact: wind, solar, natural gas
  – Nuclear good for emissions, bad for water
In 2016, natural gas exceeded coal for the first time in the U.S. electricity generation mix.
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Source: U.S. Energy Information Administration / January 2017 Monthly Energy Review (7.2a) • Graphic: Michael E. Webber, The University of Texas at Austin
Natural Gas Faces Headwinds to Further Adoption In the U.S. Power Sector

• Renewables will get cheaper
• Leak at Aliso Canyon
• Gas is low carbon but it is not zero carbon
• Public resistance to fracking is not declining
• Demand from other sectors such as chemicals or exports give upward price pressure
• Price volatility
  – Lack of long-term fixed price contract
  – Oscar Wyatt
Michael E. Webber, Ph.D.

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