Informing the Debate

Natural Gas and the Cost Implications of Residential Electrification

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US experienced the single-largest gas consuming day in history January 1, 2018.

Peak Day Natural Gas Consumption (Bcf per day)
January 2018
What was the Test this Time?


Mid-Atlantic (Washington, DC) – as of January 7, 2018 had experienced the longest consecutive day period of high temperatures below 32 degrees Fahrenheit since 1961, surpassing 11 days.

Domestic Consumption – 14 straight days of consumer demand (less exports) in excess of 100 Bcf.

The average daily temperature in the Lower 48 from Dec. 24, 2017, through Jan. 3 was 27 degrees Fahrenheit, 9 degrees lower than average for 1981 to 2010, according to the U.S. Energy Information Administration.

Sustained pipeline and LNG exports at 5-7 Bcf per day.
Ten Largest weekly storage withdrawals (1994-2018)
billion cubic feet (Bcf)

Report week

1/5/2018
1/10/2014
12/13/2013
1/25/2008
1/8/2010
1/31/2014
1/17/1997
2/9/2007
1/28/2000
2/14/2014

Source: U.S. Energy Information Administration, Weekly Natural Gas Storage Report
Natural gas exports continue to grow, now 8% of total US demand.

US Pipeline Exports to Mexico & Feedgas for LNG, 2017
(Bcf per day)

Data: S&P Global
### Year-end 2016 assessment results

<table>
<thead>
<tr>
<th>Type of Gas Resource</th>
<th>Mean Technically Recoverable Volumes (trillion cubic feet or Tcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional gas resources (conventional, tight and shale reservoirs)</td>
<td>2,658.3</td>
</tr>
<tr>
<td>Coalbed gas resources</td>
<td>158.7</td>
</tr>
<tr>
<td>Total gas resources</td>
<td>2,817.0</td>
</tr>
<tr>
<td>Proved gas reserves (EIA, year-end 2015)</td>
<td>324.3</td>
</tr>
<tr>
<td>Future gas supply in the U.S.</td>
<td>3,141.3</td>
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</tbody>
</table>
The potential natural gas resource in the US at a record high.

- Continuous growth of gas resources.
- Shale gas is responsible for recent increase in gas resources.
Where is domestic gas production headed?

Natural Gas Production, US Lower-48 (Bcfd)

- **History**
  - June-17: 65 Bcfd
  - August-17: 70 Bcfd
  - October-17: 75 Bcfd
  - December-17: 80 Bcfd
  - February-18: 85 Bcfd
  - April-18: 90 Bcfd
  - June-18: 95 Bcfd
  - August-18: 100 Bcfd
  - October-18: 105 Bcfd
  - December-18: 110 Bcfd

- **S&P Global Forecast**
  - December-18: 81.4 Bcfd
  - August-19: 85.0 Bcfd

- **Dec’19 Forecast**
  - Dec’19: 85.0 Bcfd
Appalachia Drives Domestic Production Growth since 2012

**U.S. gross withdrawals of natural gas (Jan 2012 - Aug 2017)**

- **billion cubic feet per day**

![Chart showing U.S. gross withdrawals of natural gas from Jan 2012 to Aug 2017. The chart highlights the significant increase in production from Appalachia.](chart_image)

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**Key Points**

- **Appalachia** has driven domestic production growth since 2012.
- The chart illustrates the rise in natural gas withdrawals from Appalachia compared to other regions such as Permian, Haynesville, Eagle Ford, Anadarko, Niobrara, and Bakken.

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**American Gas Association**
Natural gas prices have remained low compared to recent history for the past three years.
However, there are different visions for domestic energy policy.

“It is very clear that we cannot afford to expand infrastructure and reliance on fossil fuels, including gas.”

“At the same time, we do need to ensure that coal energy is not backfilled with gas.”

Natural Gas in the Crosshairs
From Studies to Policy

Who is Pushing the Agenda?

Under discussion anywhere natural gas infrastructure being considered
Local Commitments to “Clean Energy”

Map of Cities that Signed the Commitment

190 Mayors have signed the Sierra Club 100% renewable energy pledge.
Residential gas use is a small part of the US GHG Inventory

- Electricity generation and transportation are the two largest GHG sources.
- Residential gas use is 4% of total GHG emissions.
- Commercial gas use is 3%.
As the grid decarbonizes, the calls to “electrify everything” grow.
What happens when you electrify residential space and water heat?
Winter requires more energy than summer. Impacts of electrification must evaluate peak requirements.

**US Residential Monthly Winter & Summer Energy Consumption, Top Months 2010-2016**

- **Winter (January 2014)**: 1,739 TBtu
- **Summer (July 2011)**: 766 TBtu

Source: EIA Monthly Energy Review
The US electric grid is becoming less carbon intensive.

Electric Power Carbon Emissions Projected
EIA Annual Energy Outlook 2017, Reference Case*

*Includes the Clean Power Plan
A “Generational” Challenge

The Cal-ISO generation stack has experienced a major swing from last March (2017) as lower output from hydro, nuclear, and solar has been offset by greater reliance on gas-fired generation and power imports. Hydro generation is averaging 55 GWh/d MTD, accounting for 10% of the generation stack, down from 19% in March 2017. Hydro output fell to near minimum levels at the start of the month before rebounding in line with the five-year average in the second half. Solar generation is averaging just 64 GWh/d, a 6 GWh/d year-on-year fall despite a continued build-out in utility-scale solar capacity. The fall in solar can largely be attributed to a string of cloudy days earlier in March. Filling in for lost hydro and solar, gas-fired generation is averaging 28% of the generation stack so far this month, up from just 20% in March 2017. Power imports are also up year on year, accounting for 32% of total supply in the state.

What has been overlooked?

U.S. Peak Month Energy Use 2014 - 2016

Electric Infrastructure Costs Required To Serve the Incremental Peak Load

- Residential: 531 Trillion BTU
- Commercial: 441 Trillion BTU
- Industrial: 272 Trillion BTU

Equipment Cost Differentials

Natural Gas Furnace

Electric Heat Pump

Operating Cost Differentials

Electricity

Natural Gas
AGA/ICF Study

- Will residential electrification actually reduce emissions?
- How will residential electrification impact natural gas utility customers?
- What are the impacts on the Power Sector and Transmission infrastructure?
- What is the overall cost of residential electrification?
Electric infrastructure investments are already significant.

Electric power requirements grow in the Base Case.
Electrification will drive investments higher.

US Electricity Generation Capacity (GW)

Electric power requirements grow in the Base Case

Additional capacity due to residential electrification

2023

2035
Three Modeling Cases

• 2017 AEO Reference Case

• Econometric selection of incremental power needs

• Forced renewables for incremental power
Key Data Used in Study

• Energy Information Administration (EIA) 2035 Projections for:
  o Electric grid mix
  o Energy demand and price
  o Energy efficiency advancements
• Equipment and operating cost differentials
• Emissions differentials
• Incremental peak day load associated with electrification
• Incremental electric infrastructure required
• Electric capital investments
Initial Findings from Study
Electrification of residential space and water heating will have significant impacts

- Consumer costs
- Infrastructure requirements
- Emissions
- Natural gas demand
- Regional differences
Questions?

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