Demand Response for Natural Gas Distribution

Opportunities and Challenges

PRESENTED BY

Léa Grausz

CO-AUTHORED BY

Jurgen Weiss
Steve Levine
Sanem Sergici
Anul Thapa

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THE Brattle GROUP

Agenda

- **Setting the Stage**
- The Natural Gas DR Value Proposition
- Challenges of Natural Gas DR
- Is there a Future for Natural Gas DR?

What is natural gas demand response?

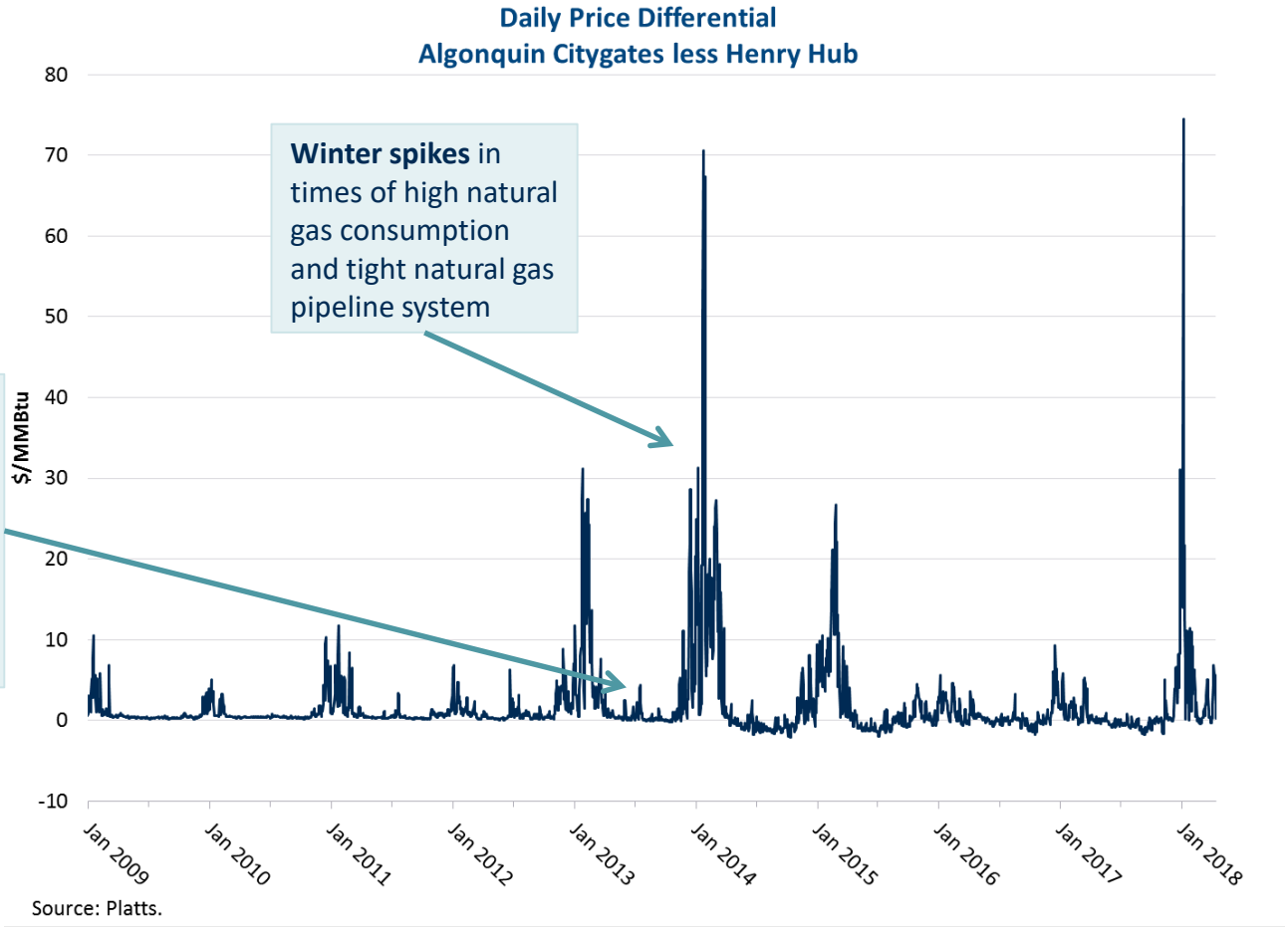
A natural gas demand response (DR) program is meant to trigger a change in natural gas customers' demand during peak period, in response to messaging, prices or direct load control by the utility

- Res/com: heating demand reduction (e.g., via thermostat control, via water heater temperature settings)
- Com/Ind: interruptible service/fuel switching

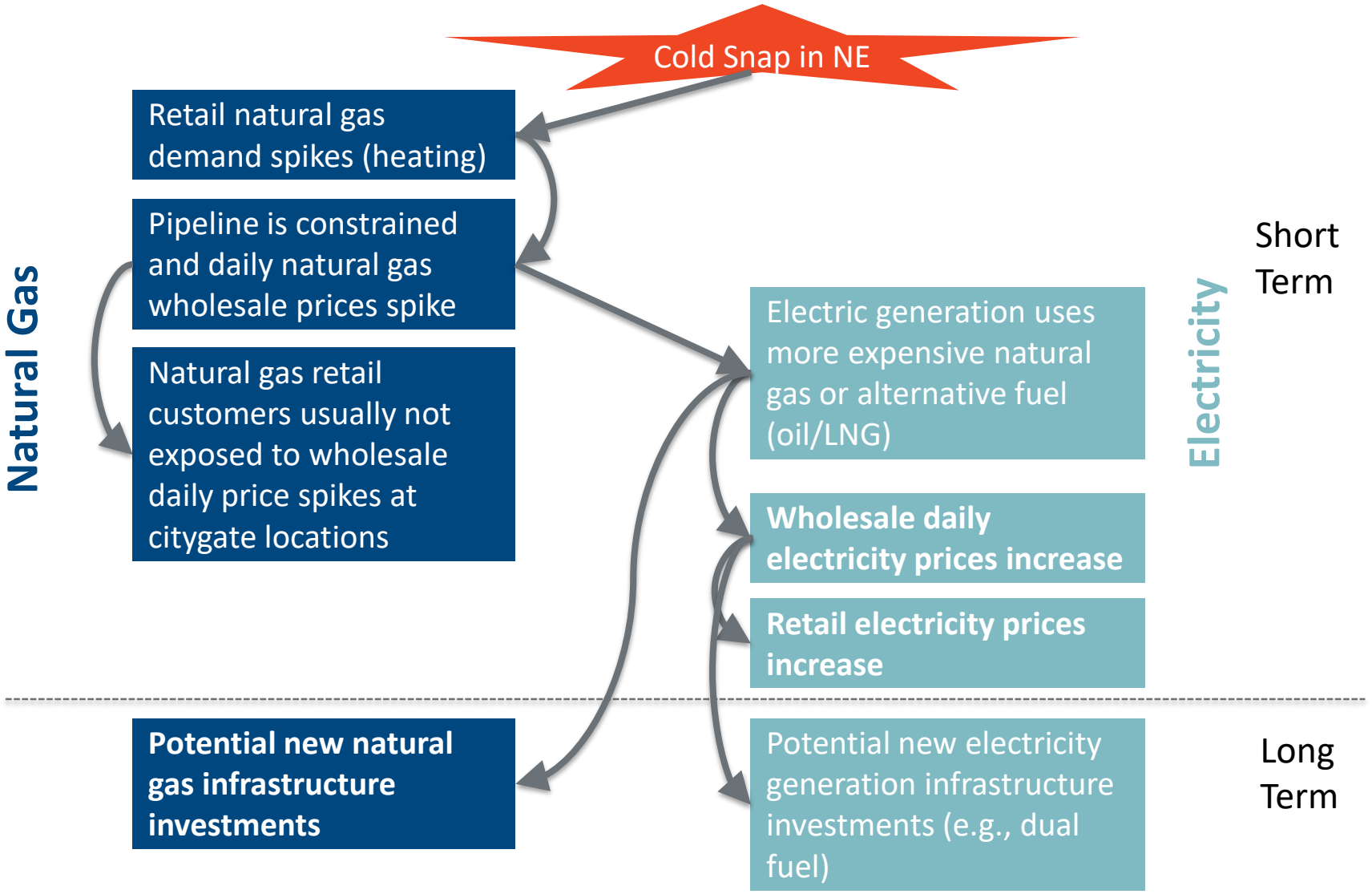
Natural gas DR is different from energy efficiency, which reduces *overall* consumption rather than *peak* demand

Natural gas supply constraints during peak demand periods result in high prices

For example in New England, daily natural gas price spikes (relative to the Henry Hub) have been significant in recent years at citygate locations



Sporadic high gas demand leads to higher short term and potentially long term costs



Repercussions of record highs natural gas prices on peak day electricity generation

"[In 2017] **fuel security** was already of particular **concern within New England and southern California** because of limited natural gas transportation and storage infrastructure"

Commissioner Neil Chatterjee at FERC's April 19 monthly open meeting

"[Commissioner Robert Powelson noted that] **in California**, a combination of nuclear plant closures, lower gas storage levels at Aliso Canyon and the state's ambitious target to get 50% of its energy from renewable resources have forced **FERC to approve reliability must-run agreements** for gas-fired units, which he called an **'alarming situation.'** "

S&P Global Market Intelligence, April 19, 2018

"The **intensely cold bomb cyclone weather event** in early January [2018] resulted in **record levels of U.S. natural gas demand** and elevated wholesale natural gas and **power prices** around the country. A constrained natural gas pipeline network led to a significant **increase in oil-fired and dual-fuel** generation in **New England and New York and, to a lesser extent, in the Mid-Atlantic**."

Northeastern Winter Energy Alert, EIA, Jan 22, 2018

Solutions available are often capital intensive, expensive or will take some time to achieve

	Cost	Capital Intensity	Implementation Speed	Environmental impact	Implementation challenges	Helps with winter peak
New gas pipelines	☹	☹	☹	☹	😐	☺
Existing LNG Infrastructure	😐	☺	☺	☹	☺	☺
New gas/LNG storage facilities	☹	☹	☹	☹	☺	☺
Energy Efficiency	☺	☺	☺	☺	☺	☺
Battery Storage	☹	☹	☺	😐	😐	☺
Electric DR	☺	☺	☺	☺	☺	☹
Natural Gas DR	?	☺	☺	☺	☹	☺

There is evidence that gas consumers do and can respond to signals

Gas energy efficiency programs have proven to be successful, including on peak days

- **SoCalGas**'s Seasonal Savings program for residential customers with a smart thermostat resulted in **8% gas heating savings** during the winter of 2016-17. The **MA DOER** Nest Seasonal Savings programs resulted in a **3.5% heating savings** in the winter of 2014-15 (73% of participants had gas fueled heating furnaces) – including significant results on the 10 peak days

Modest decrease in thermostat temperature could reduce gas demand

- In a 2014 presentation, Brattle estimated that a **1 degree (F)** increase in temperature during the winter could lead to ~ **2% or 40 MMcf/day reduction** in LDC demand in New England, and assumed that this estimation could be transposed to variation in thermostat temperature

Gas customers are price-sensitive

- E.g., recently, Auffhammer and Rubin, 2018 estimates a price elasticity on residential winter demand in California of **-0.52 for low income and -0.32 for other residential customers**

Interruptible rates for large C&I customers have long existed

- I.e., lower rates offered by the utility in exchange for the right to curtail customers with the ability to switch fuels. However, gas utilities tend to limit the use of this lever

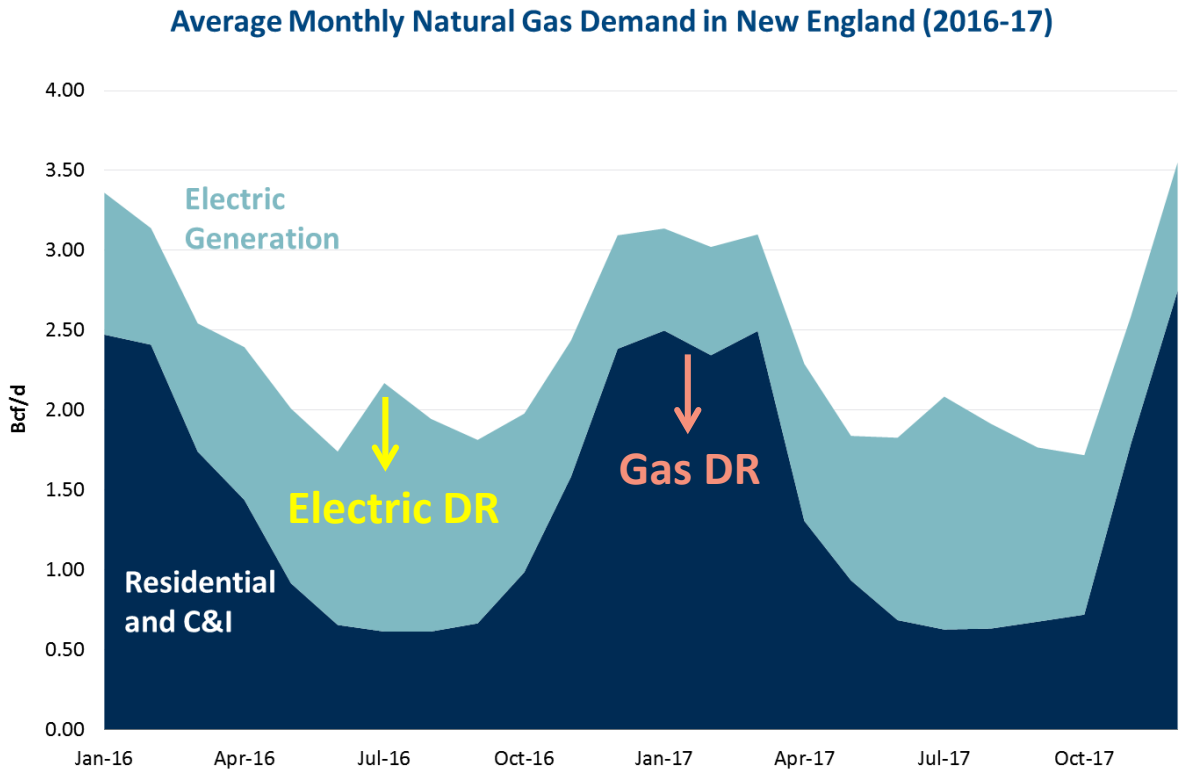
First residential gas DR initiatives show modestly encouraging results

- SoCalGas 2015-2016 Winter DR rebate pilot found a **3.7% average reduction in demand** on 3 of the 7 event days for residential My Account customers enrolled (with no smart thermostat) – other customer segments and other programs analyzed did not demonstrate any statistically significant results

Electric DR typically targets summer peak conditions; gas DR could help in winter peak conditions

Electric DR

Has the potential to reduce **summer peak** as it will impact gas demand for **electric generation** which peaks in the summer (air conditioning)



Gas DR

Has the potential to reduce **winter peak** as it will impact **residential and C&I** demand which peaks in the winter (space heating)

Source: The Brattle Group. Data from U.S. Energy Information Administration (2018).
Note: New England states include Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont

Electric DR programs are mostly focused on air conditioning, which is not available in the winter, when gas heating is dominant

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- **The Natural Gas DR Value Proposition**
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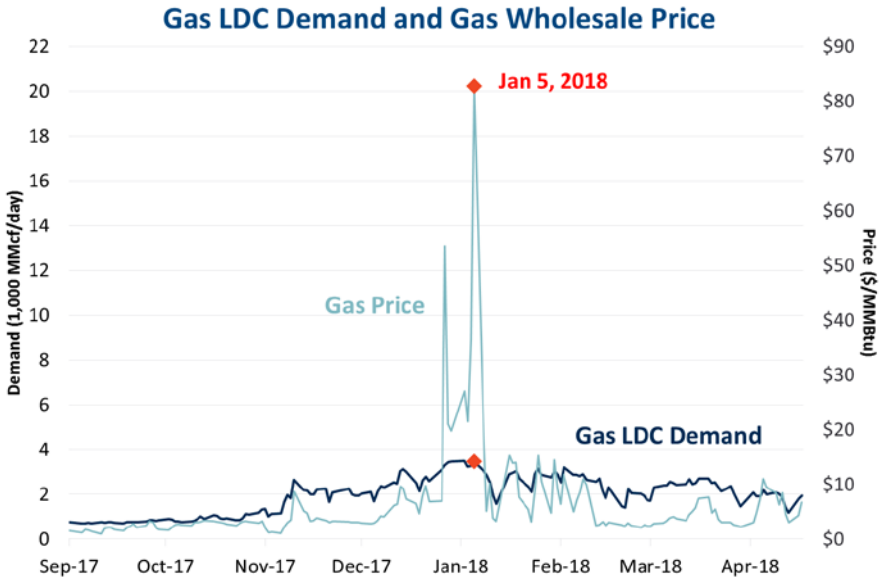
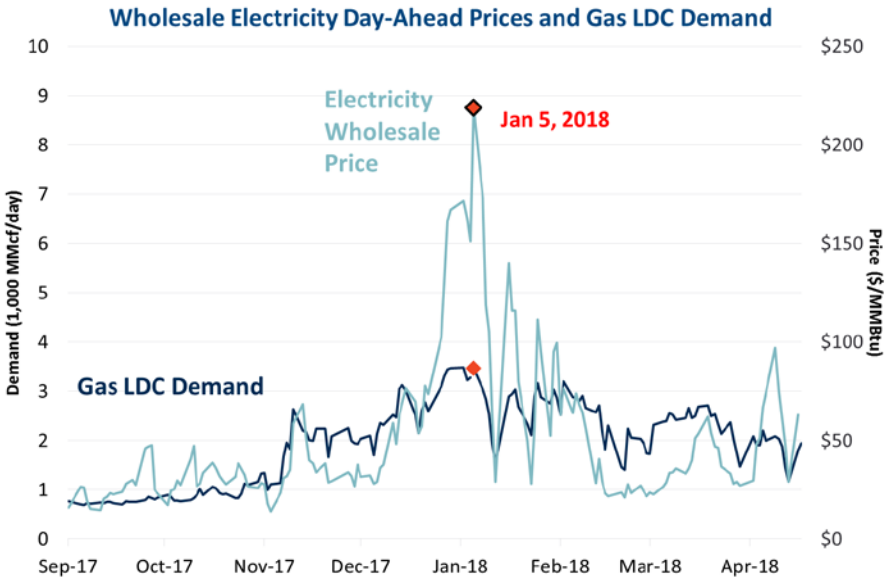
Peaking gas LDC demand coincides with wholesale electricity and gas price spikes

During the winter, both electricity and gas prices are strongly correlated with gas LDC demand, except on days when gas supply constraints occur and the marginal fuel switches to oil



Sources: S&P Global (prices) and Ventyx EV Operationally Enhanced Capacity dataset (demand).
Notes: Gas prices for Algonquin Citygates NG Price Hub. Demand for New England LDCs based on pipeline deliveries and not including LNG supply. New England gas utility sendouts totaled 4.13 Bcf on Jan 5, 2018 and 4.36 Bcf on Jan 6, 2018.



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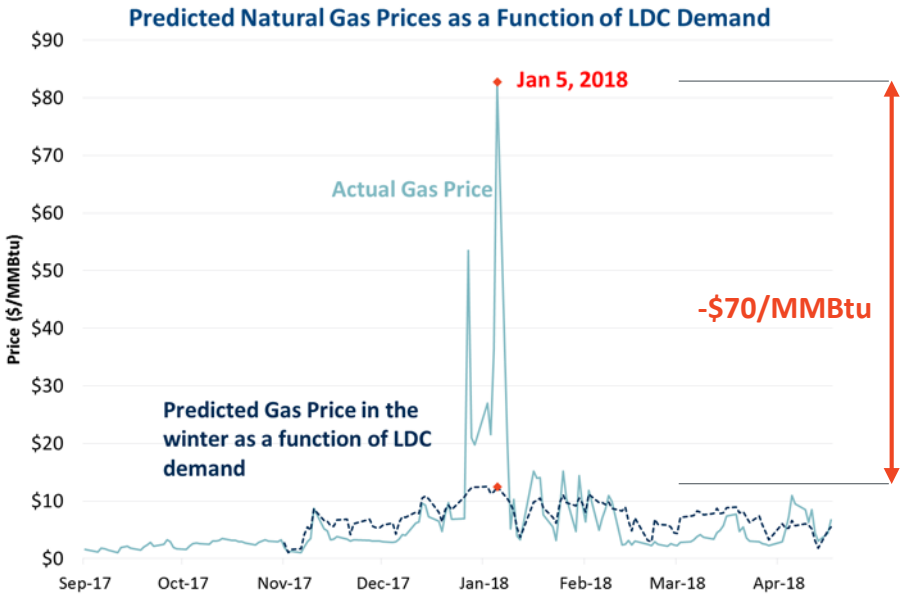
Notes: Electricity prices are for Northeast Mass Boston Price Node. Demand for New England LDCs based on pipeline deliveries and not including LNG supply. New England gas utility sendouts totaled 4.13 Bcf on Jan 5, 2018 and 4.36 Bcf on Jan 6, 2018.

Jan 5, 2018 is the day with the highest electricity on peak price, highest gas price, and 2nd highest gas LDC demand in the winter 2017-18

Reducing gas demand could help solve gas supply constraints and reduce price spikes

If constraints on the gas supply are relieved, wholesale electricity and gas spikes could be reduced

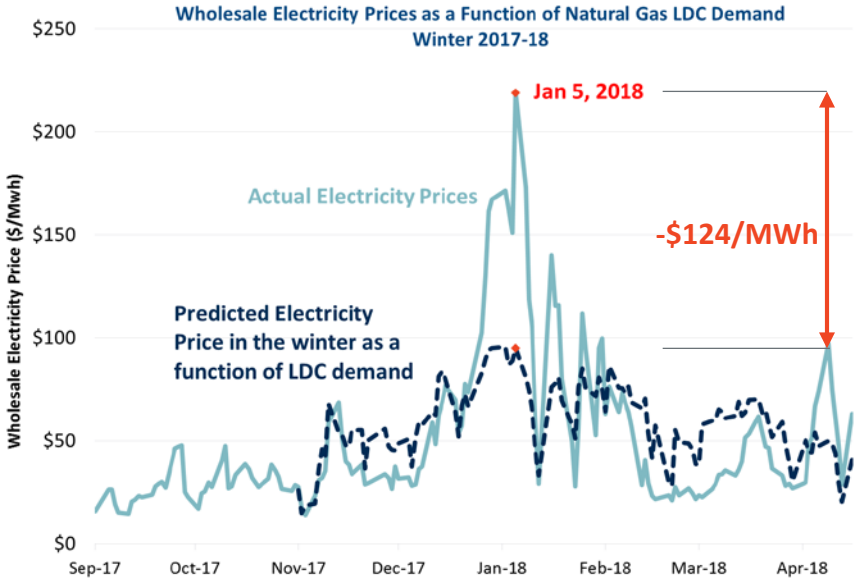
Illustrative Results



Source: S&P Global (actual price) and Brattle analysis (predicted price).
Note: Actual gas prices for Algonquin Citygates NG Price Hub.

Prices were predicted using a linear regression between wholesale gas price and gas LDC demand for winter days between 2013 and 2018, excluding the winter days when oil was the marginal fuel

Illustrative Results



Source: S&P Global (actual price) and Brattle analysis (predicted prices).
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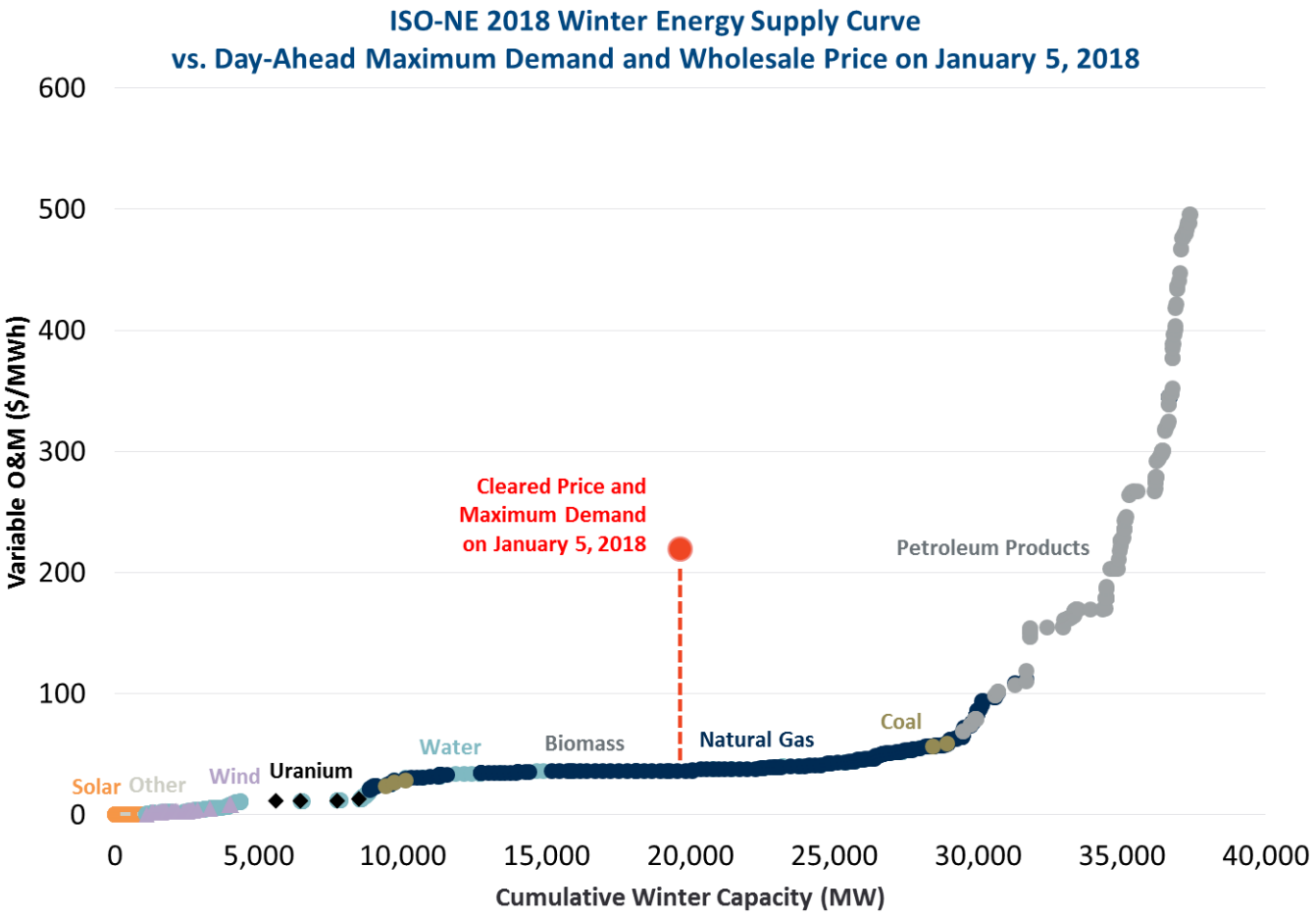
Prices were predicted using a linear regression between wholesale electricity price and gas LDC demand for winter days between 2013 and 2018, excluding the winter days when oil was the marginal fuel

During high natural gas demand periods, gas-fueled generation is not used to its full potential

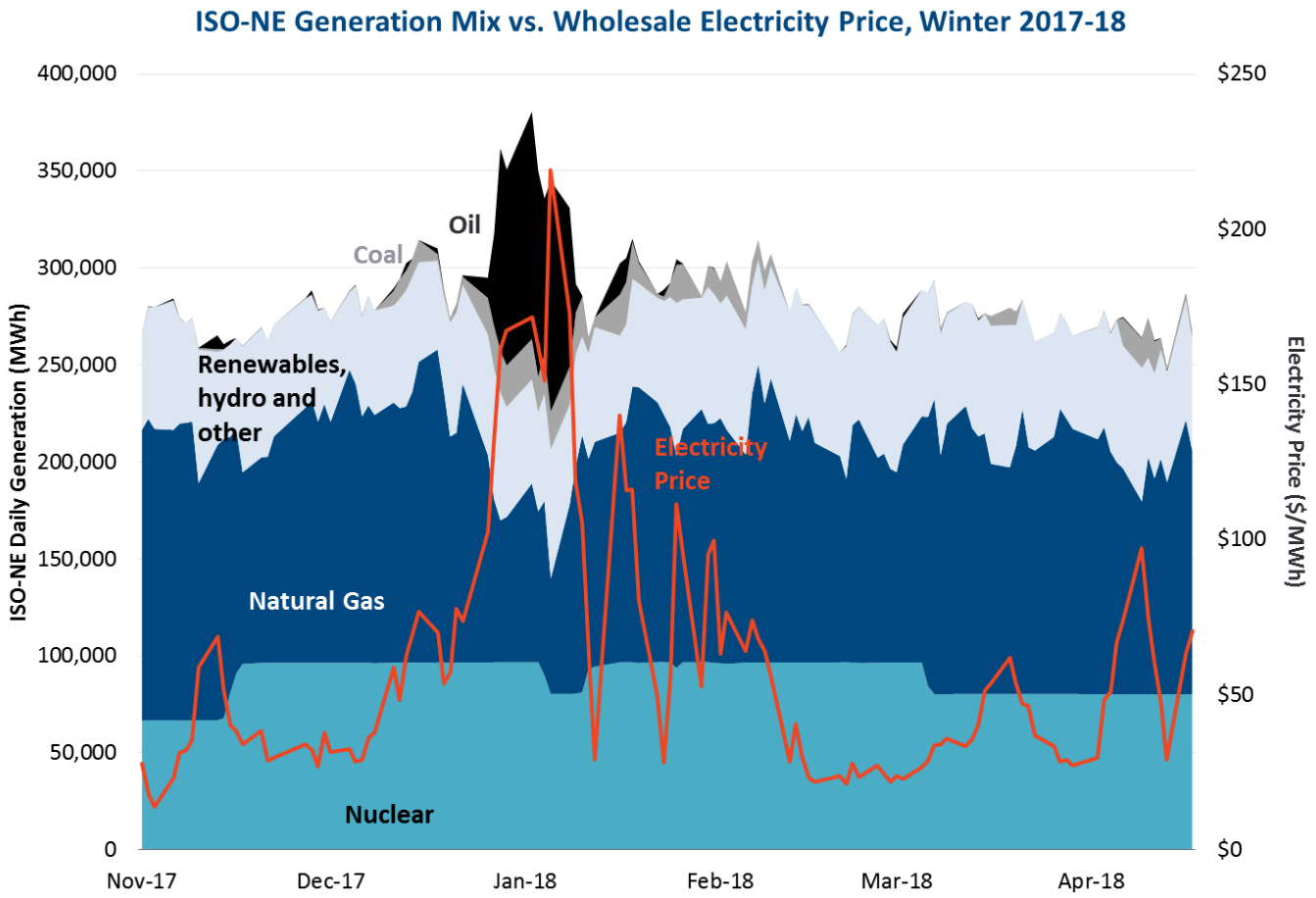
Example for Jan 5, 2018: the day of winter 2017-18 which has the highest on-peak electricity price, due to a shift to oil as the marginal fuel while natural gas-fired plants could have been used

Electricity market clearing price far above cost of natural gas fired generation implies that petroleum products were setting the market price and significant natural gas fired generating capacity was unused



Sources: S&P Global Market Intelligence LLC (supply and price) and ISO-NE (demand).

On the highest peak days of Winter 2017-18, significant amount of oil was burnt



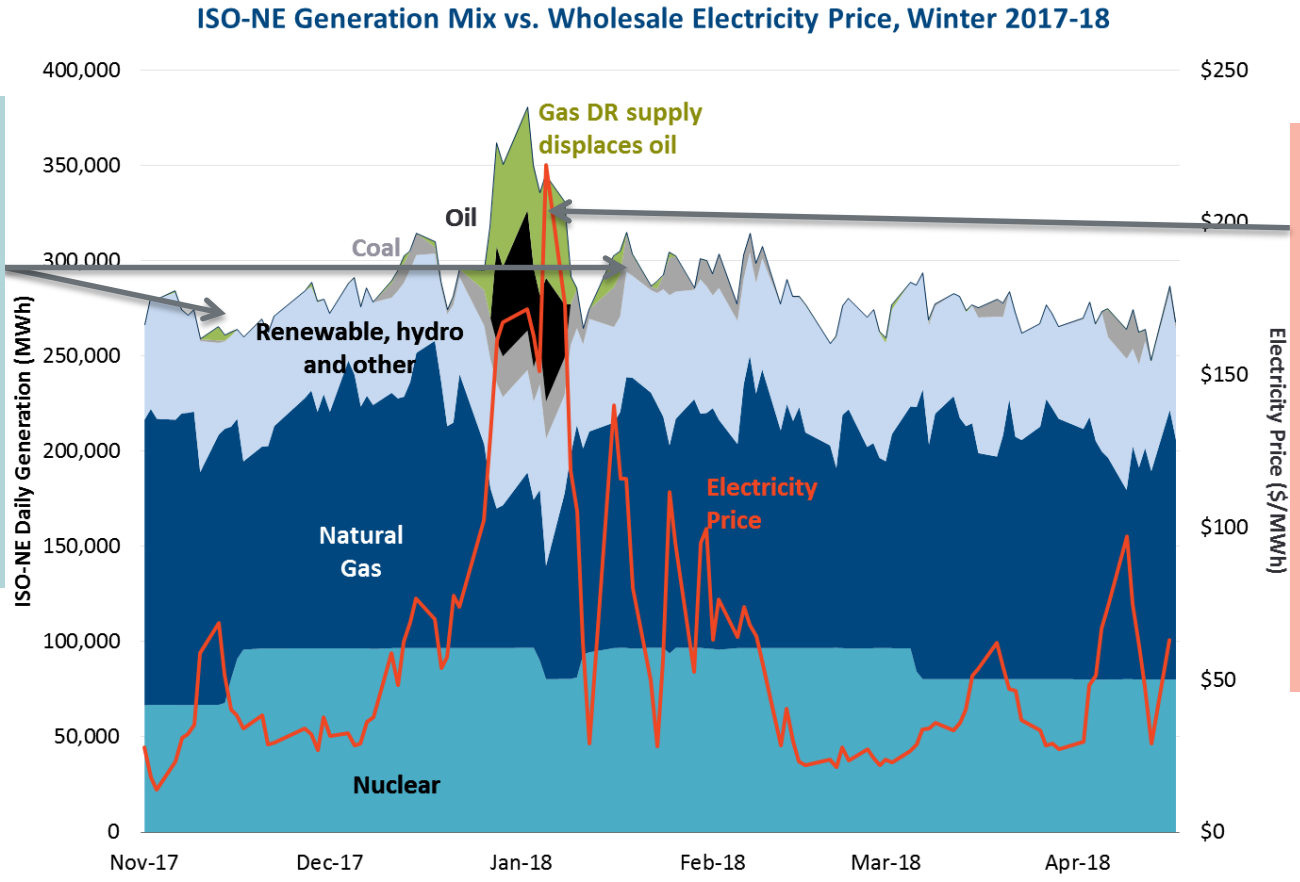
Sources: ISO-NE Daily Generation By Fuel (generation mix): https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/daily-gen-fuel-type; S&P Global Market Intelligence LLC

Note: "Renewables" include the solar and wind categories. "Other" includes the refuse and other categories.

Natural gas DR could entirely avoid some price spikes and help improve reliability

For instance, a 10% decrease in gas LDC demand on a peak day (~413 MMcf/d), could lead to 54,000 MWh/d additional electricity generated with gas (instead of oil)

Gas DR has the potential to solve the entire problem (gas generation sets the marginal price instead of oil)

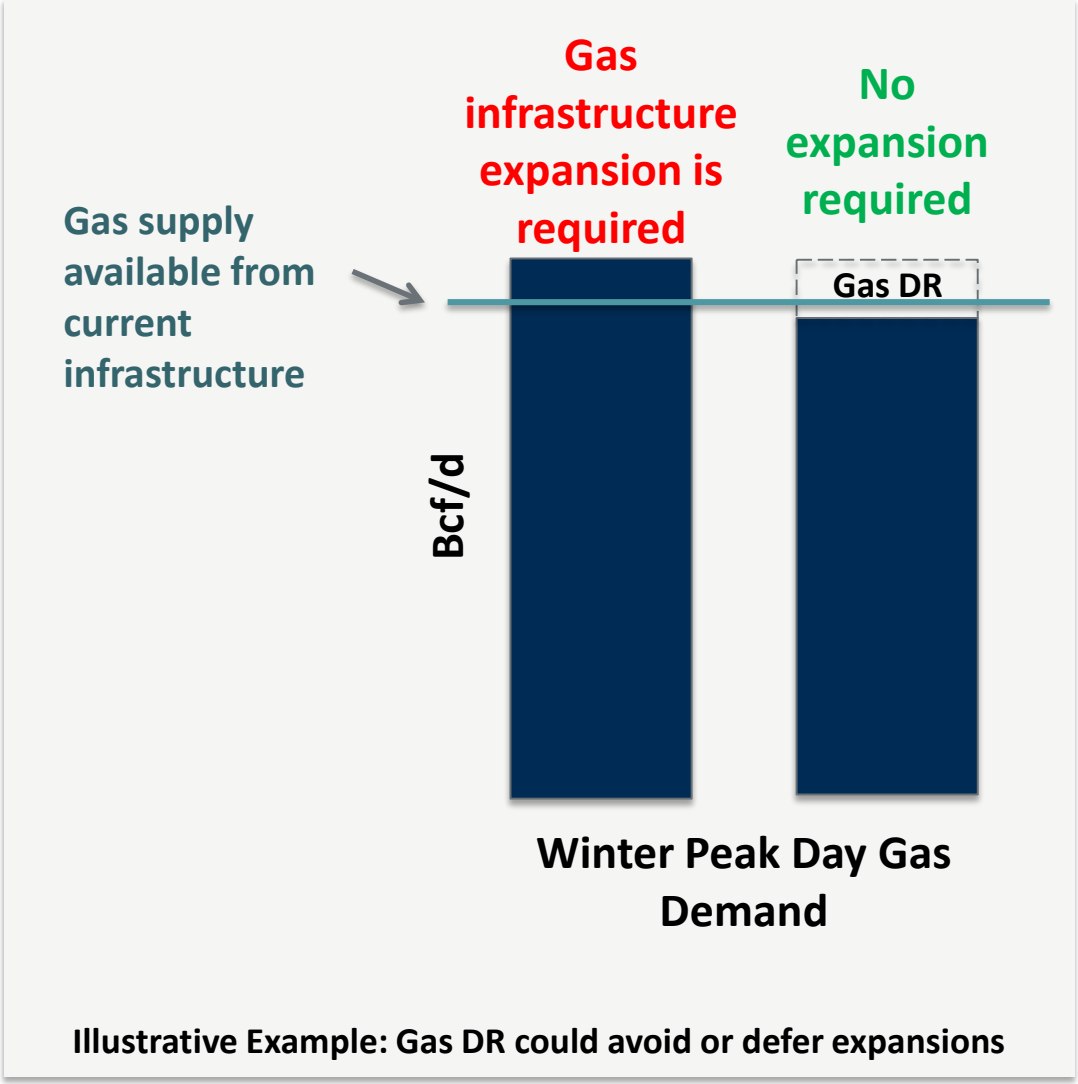


Gas DR solves part of the problem (oil still on the margin, but additional gas generation provides reliability benefits)

Sources: ISO-NE Daily Generation By Fuel (generation mix): https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/daily-gen-fuel-type; S&P Global Market Intelligence LLC

Note: "Renewables" include the solar and wind categories. "Other" includes the refuse and other categories.

Natural gas DR could also provide value by deferring or avoiding investments in the longer run



Illustrative Example: Gas DR could avoid or defer expansions

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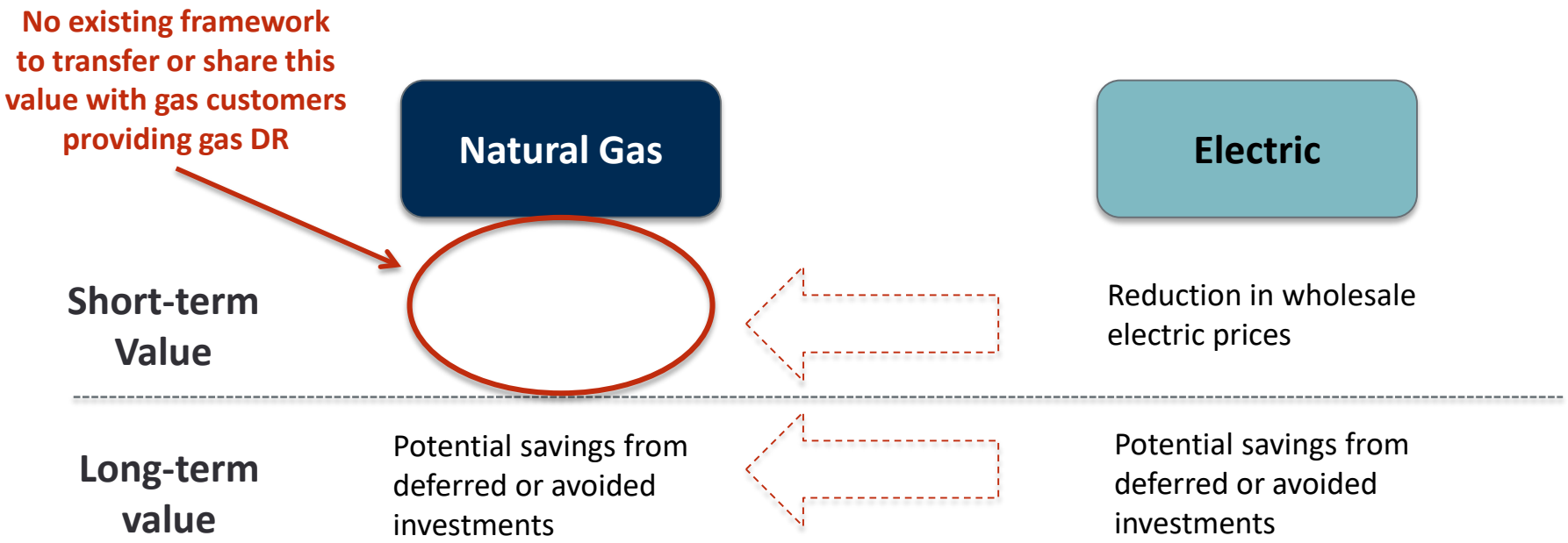
Current regulatory and market structure is inadequate to activate natural gas DR potential



Natural gas DR may also face other challenges

- Lack of diversity in natural gas uses
- Value of gas DR may be lower than electric DR because of existing gas storage capabilities
- Modest customer engagement so far
- Natural gas metering capabilities are limited

Technology-enabled programs often lead to better results

DR programs **can be implemented without "smart devices"**

DR programs expect better results when coupled with "smart" devices and/or when customers have access to more timely and precise usage data, such as

- **Smart thermostats**
- **AMI**

The **existing infrastructure** can be leveraged:

- Gas AMI is modestly deployed in the US (mostly for dual fuel utilities)
- Some smart thermostats have already been installed through electric EE and DR utility programs – joint gas and electric incentive programs could be designed

Smart thermostat

Smart meter

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A handful of utilities have already deployed natural gas DR programs

- **SoCalGas** deployed full scale the **Smart Thermostat Load Control** Demand Response program for the winter 2017-18 after its pilot testing
- **National Grid** deployed a **direct load control** program for **large C&I** customers in NY
- Multiple natural gas utilities offer **interruptible rates** for large C&I customers
- **ConEd** proposed a **natural gas DR program** for firm customers and aggregators for winter 2018-19

Several questions remain to be answered

- What are the primary sources of natural gas DR?
- What is the (regional) technical/economic potential for natural gas DR?
- What is the value of natural gas DR in the short and long run?
- What are the environmental impacts of the various flavors of natural gas DR?
- How responsive can small/large, residential/commercial/ industrial customers be?
- What are the regulatory barriers to natural gas DR and how can they be addressed?

A legislation to encourage natural gas DR was recently proposed

Senator Sheldon Whitehouse introduced a bill on April 11, 2018 directing the Dept. of Energy (DOE) to:

- **Study the potential** for natural gas demand response (DR) in the US
- **Establish a pilot program** allowing participants to develop natural gas DR programs

The Whitehouse bill would help provide preliminary answers and frame potential next steps

Where do we go from here?

- Estimating the contribution gas DR can have in solving “polar vortex” type events requires an assessment of the technical, economic and achievable potential on a regional basis

- Gas DR is a relatively unproven concept and therefore likely faces various challenges

- Gas DR potential studies could be useful to assess potential and identify various barriers for implementation

References

The potential of gas DR:

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- "Initial Report on Scope, Tasks, and Timelines for the Demand Savings Group," Massachusetts Energy Efficiency Advisory Council, March 31, 2016.
- "Gas Demand Response, A Solution to the Electricity/Gas Interface Issue?" The Brattle Group and Brown Rudnick LLP, June 4, 2014.
- "Natural Gas Price Elasticities and Optimal Cost Recovery Under Consumer Heterogeneity: Evidence from 300 Million Natural Gas Bills," Maximilian Auffhammer and Edward Rubin, Energy Institute at Haas working paper, January 2018.
- "Regional Gas Market Update," presented by Northeast Gas Association to ISO-NE Planning Advisory Committee, April 26, 2018, https://www.iso-ne.com/static-assets/documents/2018/04/a4_regional_gas_market_update.pdf.

Existing gas DR programs:

- SoCalGas Joins Nest to Announce Results of Winter Seasonal Savings Energy Efficiency Program https://www.prnewswire.com/news-releases/socalgas-joins-nest-to-announce-results-of-winter-seasonal-savings-energy-efficiency-program-300482114.html
- SoCalGas Launches Winter Rebate Program for ecobee Smart Thermostat Users https://www.sempra.com/newsroom/press-releases/socalgas-launches-winter-rebate-program-ecobee-smart-thermostat-users
- National Grid and AutoGrid Test Demand Response for Natural Gas in New York https://www.greentechmedia.com/articles/read/national-grid-autogrid-test-demand-response-for-natural-gas-in-nyc#gs.AWm6cy0
- Baker-Polito Administration Announces Over $4.6 Million in Grants for Peak Demand Reduction Projects https://www.mass.gov/news/baker-polito-administration-announces-over-46-million-in-grants-for-peak-demand-reduction
- Senator Whitehouse Introduces Innovative Natural Gas Demand Response Legislation https://www.whitehouse.senate.gov/news/release/whitehouse-introduces-innovative-natural-gas-demand-response-legislation

Presenter Information

LÉA GRAUSZ

Associate | San Francisco

Lea.Grausz@brattle.com

+1.415.217.1000

Léa Grausz is an associate in The Brattle Group's San Francisco office. Ms. Grausz has experience in dispute resolution and regulatory proceedings in energy markets, including: upstream natural gas long-term contracting and pricing; gas pipeline ratemaking; liquidity assessment in global oil and gas markets; tariff design for electricity and natural gas; incentive regulation for electric and gas utilities; and assessment of the impact of demand-side management programs.

Prior to joining The Brattle Group, Ms. Grausz worked for four years for Engie in Paris, France where she performed economic analysis for price negotiations and contract arbitrations for long-term gas supply contracts.

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