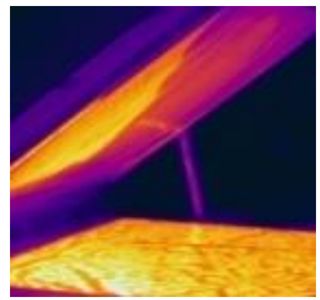
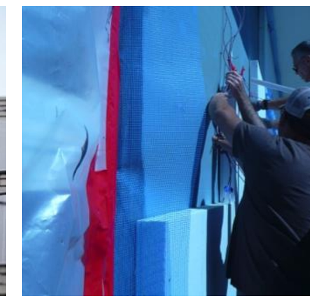
Gas Demand Response: The Next Frontier





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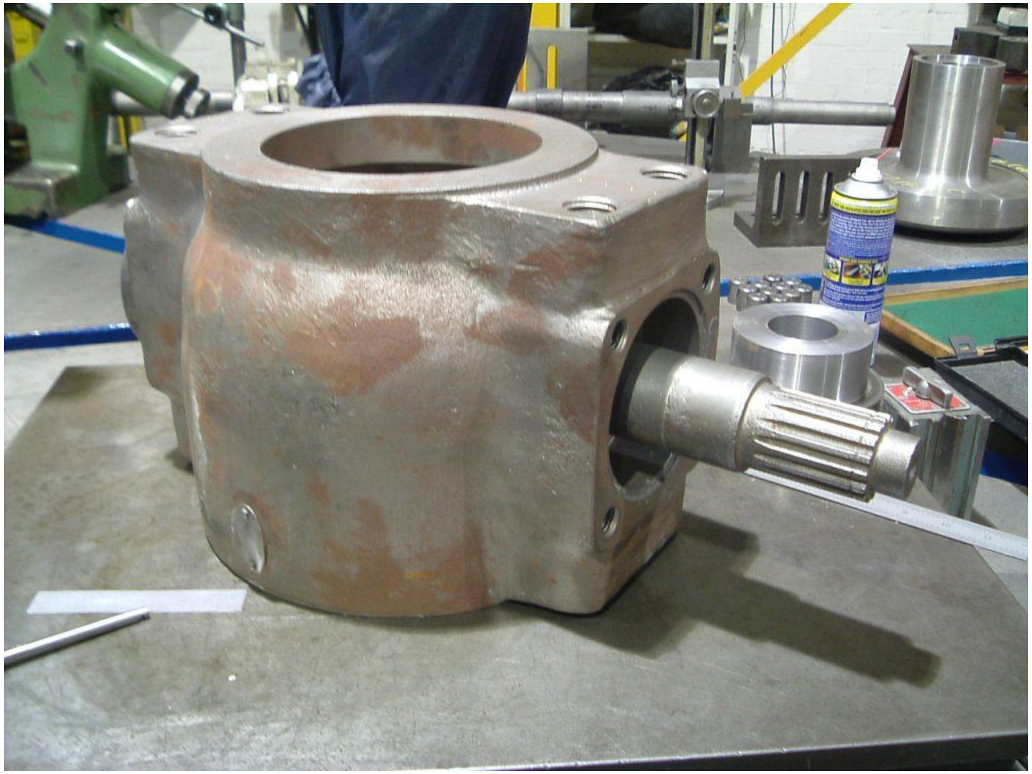
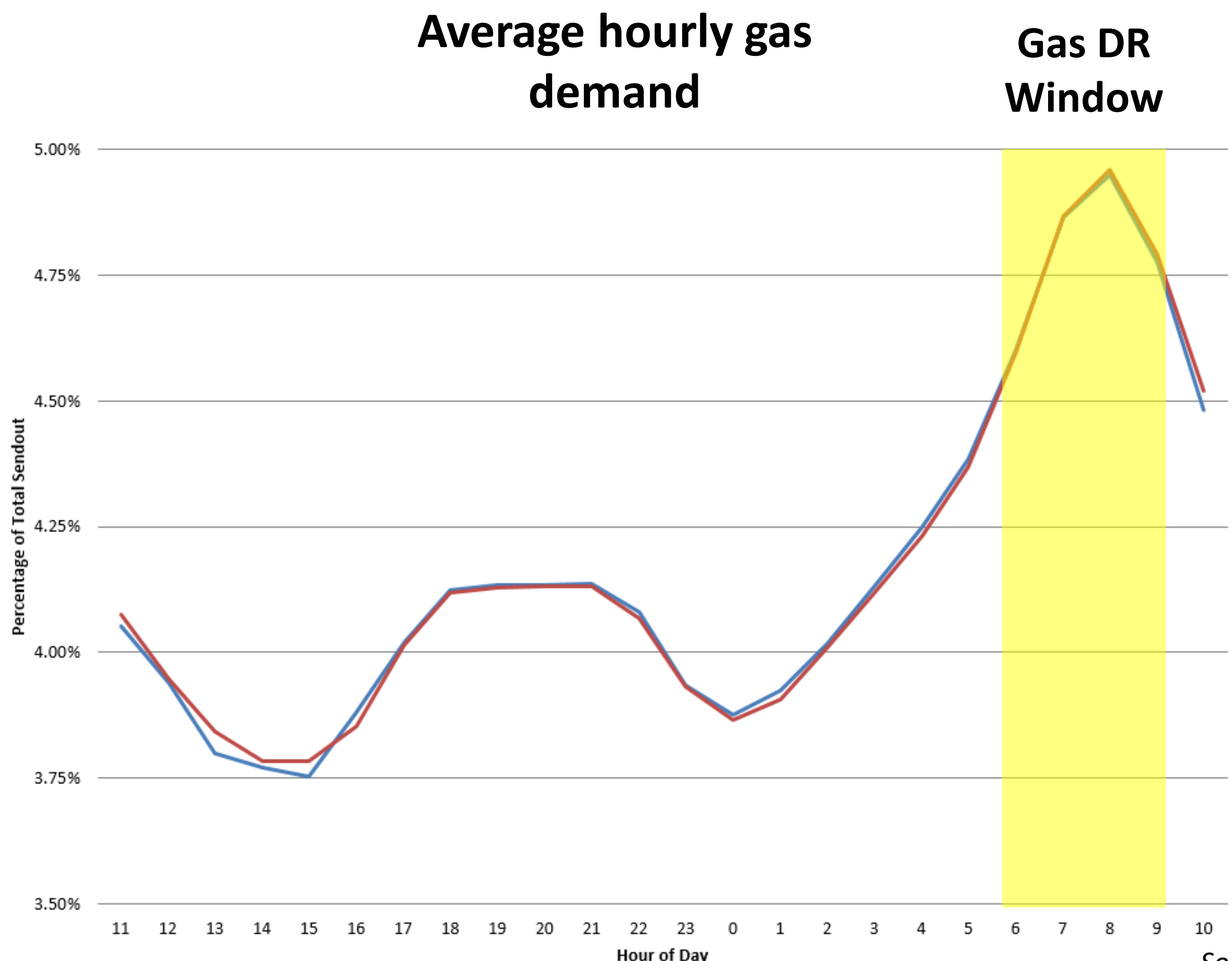
Gas DR seeks to address gas distribution system constraints.



Sources: Sprial Weld (2019), Vero Beach Magazine (2014).

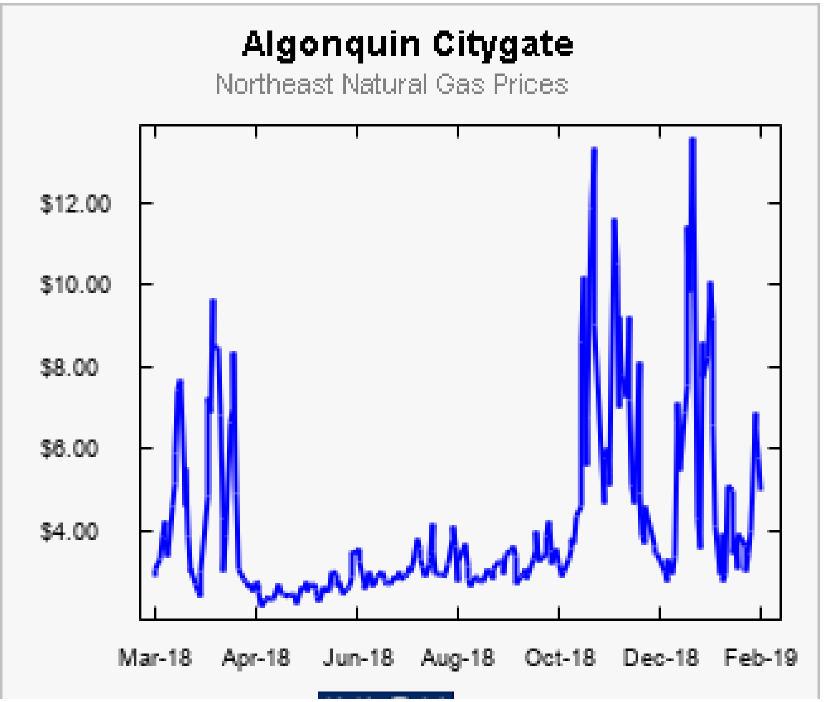
Gas DR seeks to reduce *peak* gas demand.



Sources: National Grid.

These gas DR programs are not designed to:

- Address gas *transmission* constraints
- Address spikes in daily gas prices
- Last for 24+ hours



Sources: Natural Gas Intelligence (2019), Slusarczyk (2013),

Gas DR Program Design: Two basic approaches

- **Direct Load Control (DLC):** Gas utility controls the operation of gas-fired devices, capacity commitment based on nameplate data
- **Fixed Service Level (FSL):** Gas customer manages their gas consumption to achieve a target gas consumption level relative to a pre-determined baseline during events

Sources: National Grid, Superior Boiler.

The Pros and Cons of DLC and FSL designs.

Attribute	DLC – New York	FSL - Massachusetts
Customer Flexibility	Customer chooses equipment controlled, but cannot override DLC.	Customer decides how to achieve FSL, can opt out of a limited number of events.
Performance Risk	Controlled devices do not consume gas during events – but other devices can.	- Customers may not achieve FSL targets. - Multiple possible baselines.
Infrastructure Required?	- Device-level control and actuation ($2.5-5k). - Communications can be a challenge	- High-resolution gas metering (≤15 minutes). - Existing automation facilitates achieving FSL.
Baseline Required?	None.	Required for performance assessment.

Gas DR program parameters

- **When is gas DR needed?** Coldest days of the year.
- **How many events are called?** Typically 3 to 6 expected.
- **How long does an event last?** Three hours, from 6-9AM
- **How are customer payments determined?**
  - *NY:* Based on nameplate under DLC
  - *Massachusetts*: Based on actual gas curtailment relative to baseline
- **What is compensation for gas DR:**
  - *NY:* Customers bid, average ~$30/therm for equipment curtailed
  - *Massachusetts:* $40/therm curtailed per event (avg. over 3h period)
- **Facility-level gas metering infrastructure?**
  - *NY:* KYZ pulse counter installed, 1-minute data uploaded every 5 mins.
  - *Massachusetts*: Existing gas metering provided 15-minute data

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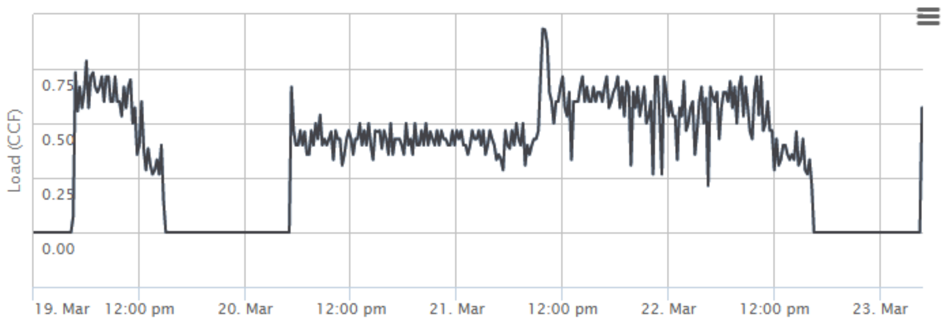
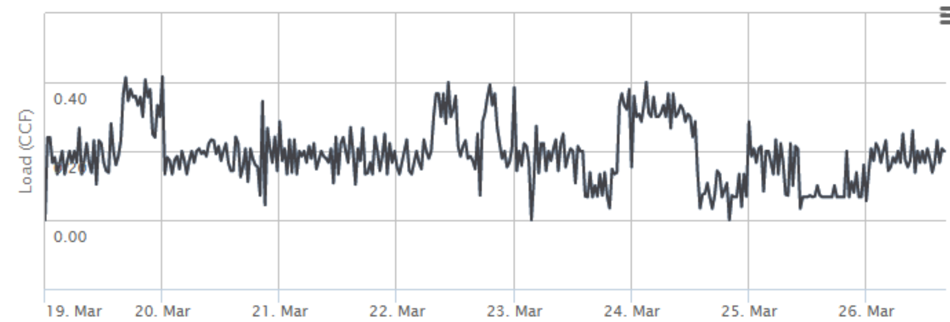
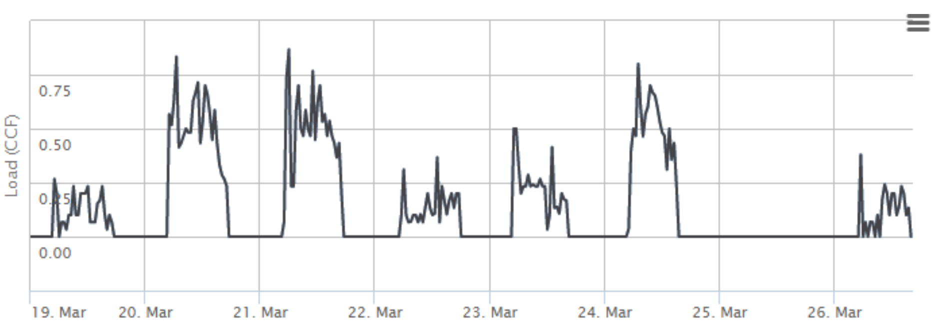
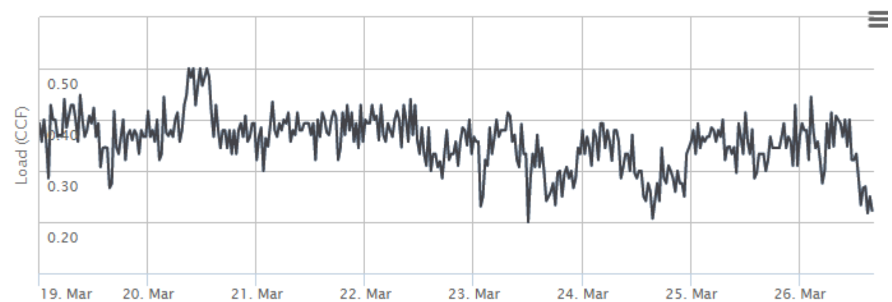
Customers' gas consumption profiles vary appreciably, affecting gas DR potentials.







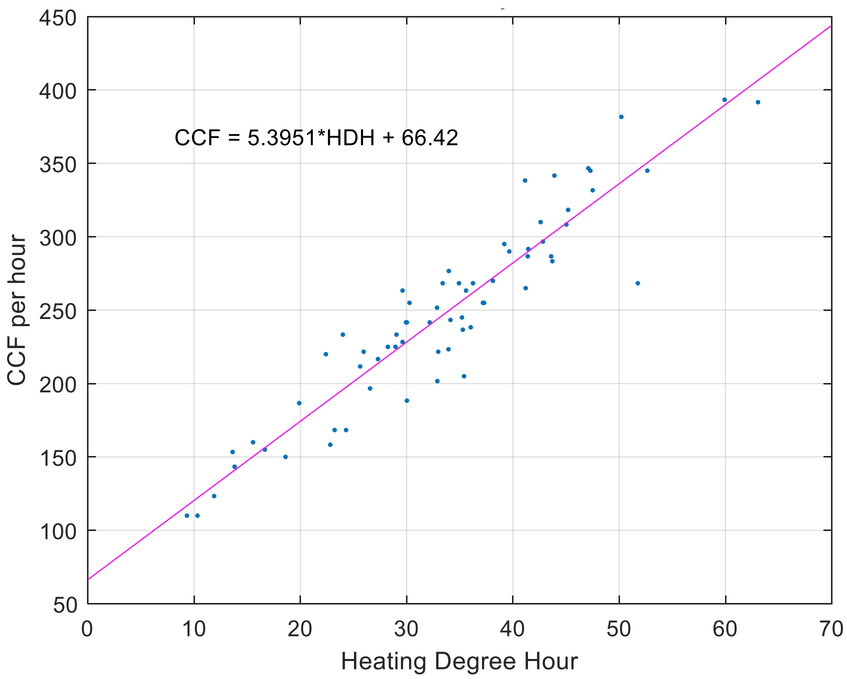


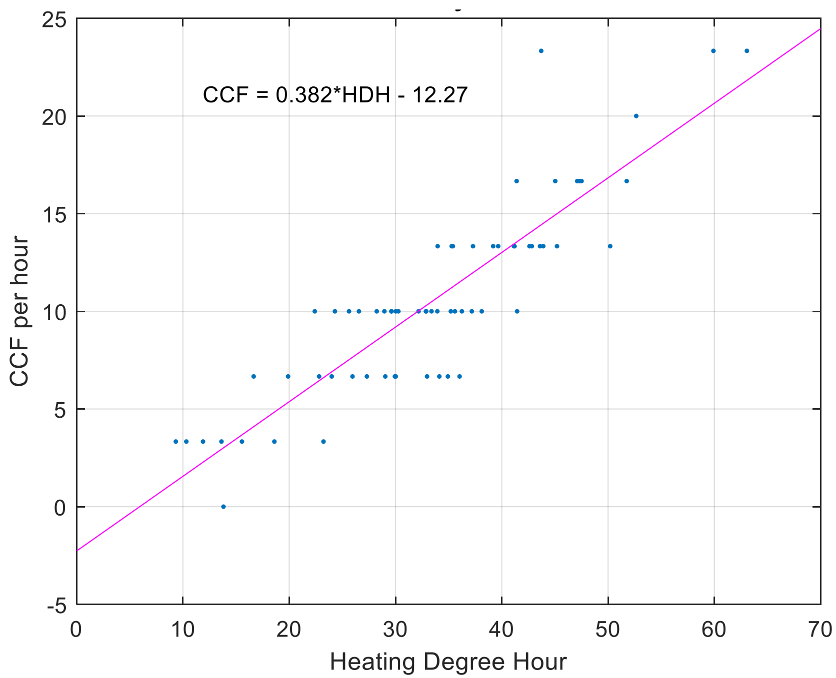
Sources: National Grid.

FSL Baseline calculation

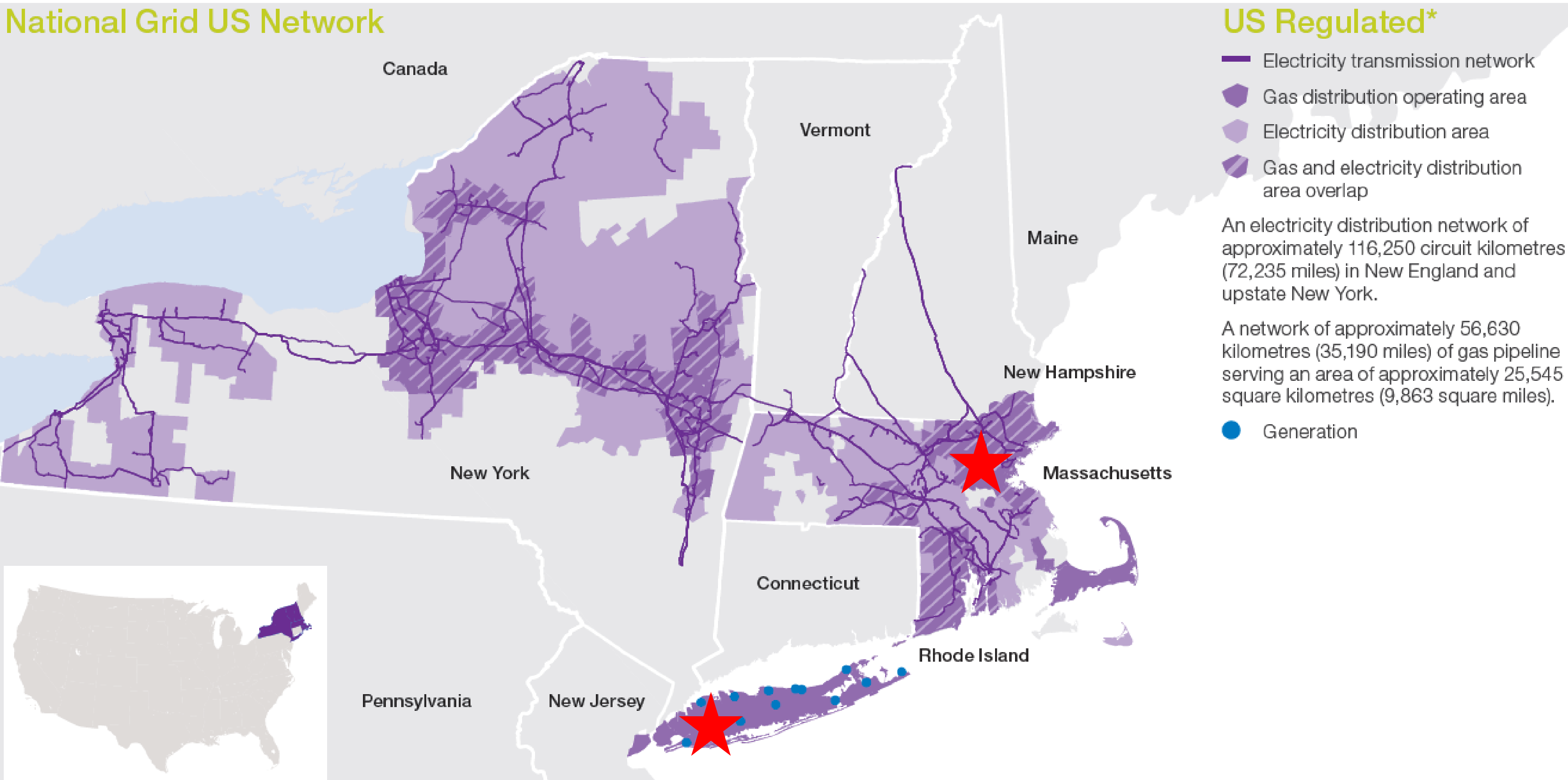
- Considered multiple approaches – Used Heating Degree Hour (HDH)
  - Uses hourly gas consumption from 6-9AM on non-event, non-vacation weekdays

$$HDH = 65^{o}F - T_{out}$$





Two Pilots, Two States.



Sources: National Grid

Recruiting: We approached the largest gas consumers in National Grid’s gas service territories.

What we learned:

- Customers are not familiar with the concept of gas DR
  - Many did not understand the concept
  - Some *think* they have been offered gas DR before: Electric DR? Third-party energy supplier?
- Commercial/institutional customers most likely to participate
- Industrial customers: Very reluctant to interrupt major process loads
- Most customers do not have the requisite infrastructure installed for gas metering or DLC
- Many customers had a negative reaction to DLC (particularly in Mass.)
- Poor experience with electric DR colored perception of gas DR

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Facility Manager Gas DR Survey: Findings

- Opt-out very important to most, many had a negative reaction to DLC
  - Willing to accept lower compensation to maintain control
- Very concerned about disrupting operations / productivity risk relative to compensation levels
- Implementation complexity a concern for many
  - Many valued technical support for identifying gas DR strategies
  - Fuel switching takes time
- Wary of time-varying (e.g., hourly) gas rates – not sure if they could effectively manage gas demand
- Typically want 48-72 hours notification for events
- Poor experience with electric DR colored perception of gas DR

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Recruiting Findings

New York:

- National Grid sent mailers to ~650 large gas customers
- In-person visits by National Grid with 30-35 large customers, crucial to explain and sell concept, identify major gas DR opportunities
- 16 participants recruited for pilot
  - Between Y1 and Y2, one participant added, one dropped

Recruiting Findings

Massachusetts:

- Fraunhofer outreach to ~60 very large gas customers, using National Grid contact information
- Response Rate: ~35%
- Follow up calls: ~15% - interest in revenue, ~real-time gas data
- On-site meetings: ~10%
- One very large customer recruited (university with multiple accounts)

- DLC was a major concern for just about all interested customers

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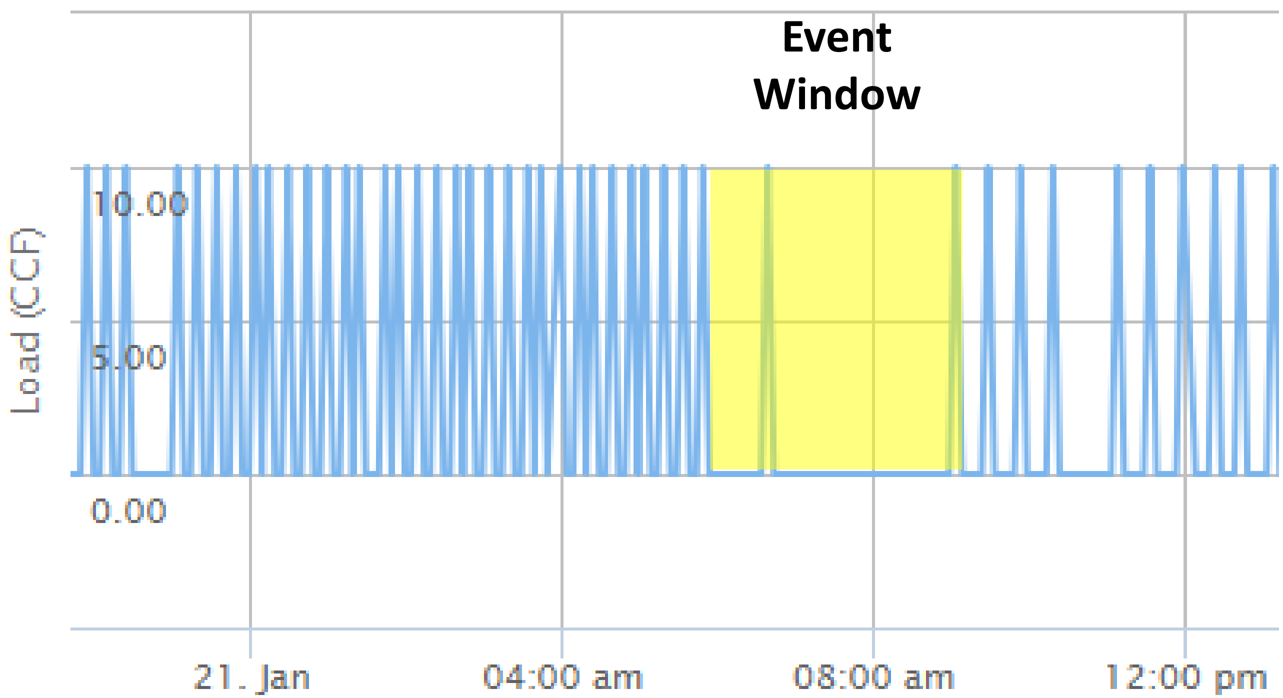
New York Results

- Primarily large boilers controlled, using electric interrupts
- Reduction in account-level gas consumption: 63%/50% (mean/median)

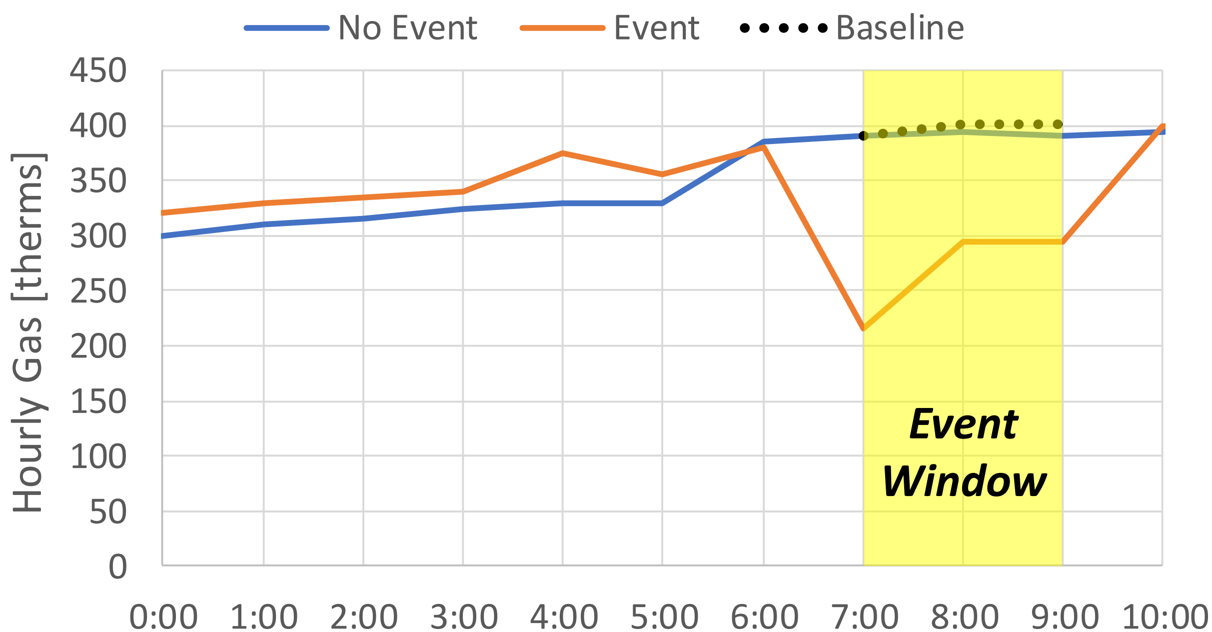


Results: A university consistently hit its FSL targets for four facilities.

FSL Baseline: 420 ccf
Average During Event: 270 ccf

Approaches:

- Pre-heat spaces
- Decrease T_{set}
- Decrease plant H_2O temperature
- Suspend outdoor air provision



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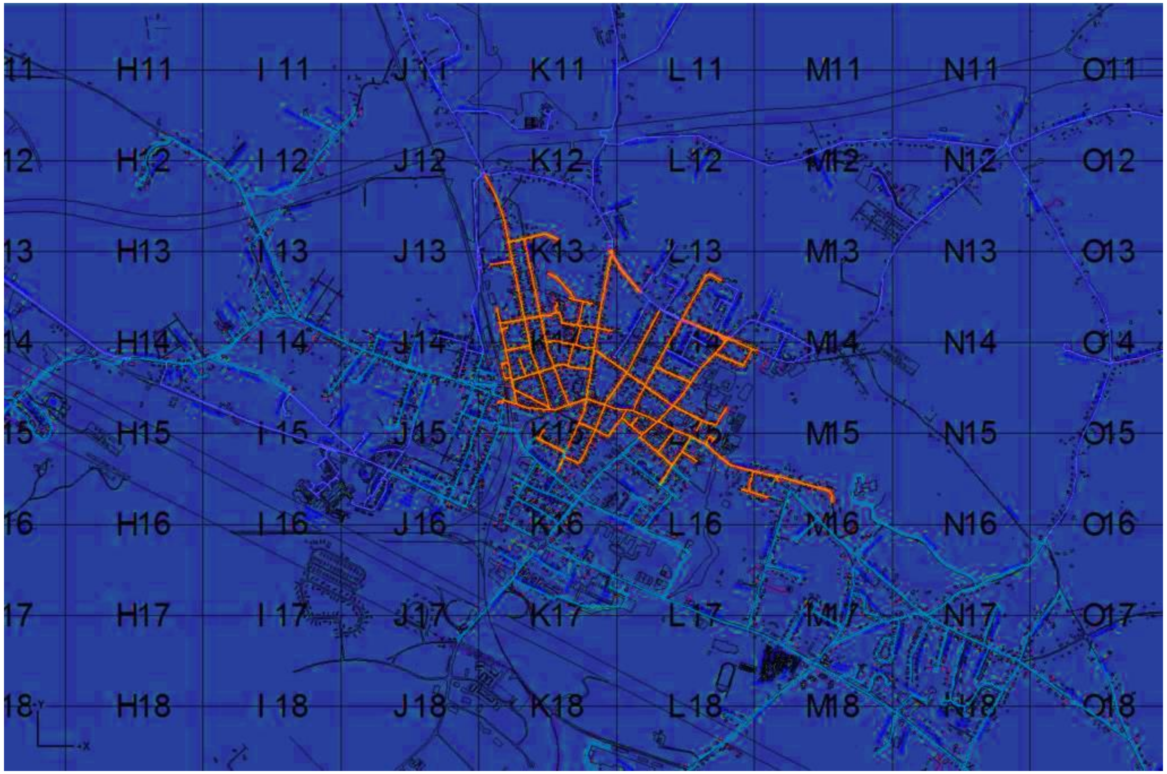
National Grid modeled how gas demand reductions affected distribution system pressures in locations where reinforcement projects were completed.



Sources: CHI Engineering.

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Our preliminary assessment shows that the impact of Gas DR varies appreciably among projects.

Normalized Pressure to Post-Reinforcement Pressures vs. Demand Reduction %

Project	0%	10%	15%	20%	25%	30%	Equivalent Years of Gas DR
1	0.91	0.96	0.98	1.00	**1.00**	1.02	3
2	0.79	0.83	0.83	0.85	0.85	0.85	Never
3	0.89	0.93	0.93	0.96	0.98	**1.00**	5
4	0.60	0.72	0.86	0.93	0.99	**1.05**	**36**
5	0.86	0.88	0.90	0.90	0.92	0.92	Never

Equivalent Years of Gas DR = (Reinforcement Cost)/(Estimated Yearly Gas DR Incentive)

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Conclusions

- Field tests show that facilities can achieve their target gas reductions
- System modeling shows that gas DR has the potential to defer some system reinforcement investments
- Customer recruitment can be challenging
  - New concept for customers – high touch and technical support needed
  - Customers generally prefer FSL versus DLC
  - Leverage relationships from existing EE programs
- Ongoing National Grid pilots in New York and Rhode Island

Outstanding Questions

- What portion of gas system reinforcement projects could gas DR potentially displace?
- How does gas DR participation vary with incentive level?
- How does gas DR potential vary among customer types and gas end uses?
- How does gas DR participation vary by customer type?
- Would hourly natural gas prices achieve a similar effect?
- What baseline approaches make sense for different customer types?

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