Gas Demand Response: The Next Frontier

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Gas DR seeks to address gas distribution system constraints.

Gas DR seeks to reduce *peak* gas demand.

Average hourly gas demand

Gas DR Window

*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.

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

\[ \text{HDH} = 65^\circ \text{F} - T_{\text{out}} \]
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
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
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
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
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.

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

FSL Baseline: 420 ccf
Average During Event: 270 ccf
National Grid modeled how gas demand reductions affected distribution system pressures in locations where reinforcement projects were completed.

Sources: CHI Engineering.
Our preliminary assessment shows that the impact of Gas DR varies appreciably among projects.

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

<table>
<thead>
<tr>
<th>Project</th>
<th>0%</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
<th>25%</th>
<th>30%</th>
<th>Equivalent Years of Gas DR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.91</td>
<td>0.96</td>
<td>0.98</td>
<td>1.00</td>
<td>1.00</td>
<td>1.02</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>0.79</td>
<td>0.83</td>
<td>0.83</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>Never</td>
</tr>
<tr>
<td>3</td>
<td>0.89</td>
<td>0.93</td>
<td>0.93</td>
<td>0.96</td>
<td>0.98</td>
<td>1.00</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>0.60</td>
<td>0.72</td>
<td>0.86</td>
<td>0.93</td>
<td>0.99</td>
<td>1.05</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>0.86</td>
<td>0.88</td>
<td>0.90</td>
<td>0.90</td>
<td>0.92</td>
<td>0.92</td>
<td>Never</td>
</tr>
</tbody>
</table>

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