Future of Heating, Residential Gas Demand Response Pilot in Single-Family and Multifamily Use Cases

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Project Overview

Project Objectives

- **Quantify peak-day and peak-hour therm savings from dispatchable controls on hybrid electric-gas heating systems**
  - Examine annual changes in customer electric and gas consumption from integrated controls
  - Measure GHG impacts
  - Determine impact on customer comfort pre and post-treatment
  - Determine cost effectiveness and scalability of heat pump-focused Gas DR program

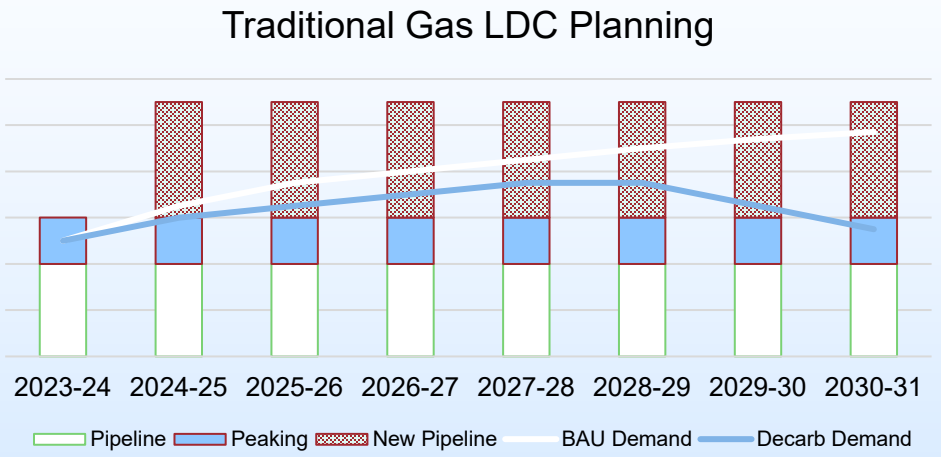
Award Details

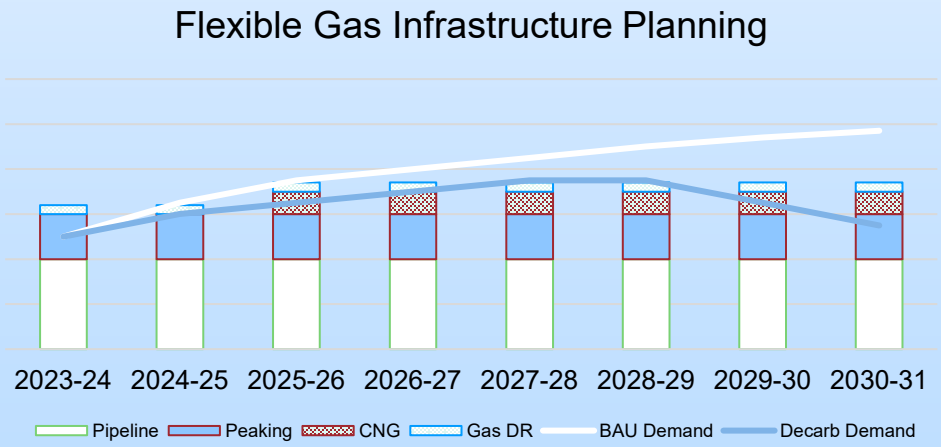
- **Recipient: National Grid US**
- **Award Date:** 10/1/2022
- **Project Cost:** $2,617,759
  - DOE Award: $950,188
  - National Grid Cost Share: $1,037,271
  - National Grid In-Kind Labor: $630,300
- **Project Period:** October 2022 to March 2027

Gas Demand Response Overview

- Northeast US utilities face significant pipeline constraints
  - Continued short-term growth in gas demand (Peak Day and Hour)
  - Regulatory and environmental push against new gas infrastructure

- National Grid runs Gas Demand Response programs in NY to limit buildout of gas infrastructure
  - Customers earn incentives to reduce gas consumption on the coldest days of the year

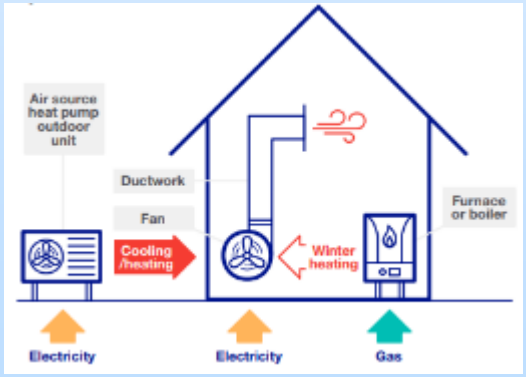




Gas DR Pilot

- National Grid currently operates a portfolio of Gas DR programs:
  - Curtailment and Fuel Switching
  - Temperature Setbacks
  - Residential Thermostat Control
  - Behavioral Messaging

- Proliferation of Air-Source Heat Pumps provide new potential avenue for customer participation
  - Residential customers adopting mini-split heat pumps for cooling
  - Customers adopting "hybrid" electric and gas heating systems
  - Multifamily buildings where upfront cost of full electrification is prohibitive



Gas DR Pilot Approach

Two-Track Pilot	
Multifamily (LMI)	Single-Family Residential
Installation of new, remotely controllable window-unit ASHPs	Add controls to existing partial load ASHPs

Goals and Benefits:

- Leverage new resource/participation type in Gas DR programs
- Lower cost hybrid heating pathway that lowers emission while managing peak gas demand
- Improvements to customer comfort and heating control
- Utilization of dormant resources (SF Res Track)
- Annual emissions reduction (MF Track)
- Improved Gas-Electric Coordination for overlapping single-commodity utilities

Two Track Project: Multifamily Scope

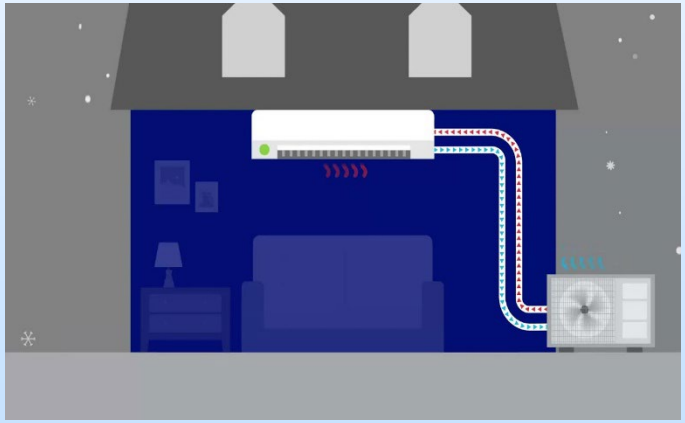
Key Milestones:

- Identify Customer and Site with ~80-unit Low-to-Moderate Income building willing to participate
- Negotiate Customer Agreement
- Installation of Window Unit Heat Pumps and Thermal Storage. Integrate boiler controls with Heat Pumps.
- New building operations:
  - Heat w/ high-efficiency HPs in mild weather (>32 deg F)
  - Utilize steam boiler during colder periods (<= 32 deg F)
  - Leverage both systems during 4-hour Gas DR events (< 10 deg F) as part of existing programs.
- Evaluations of impact on gas use, electric use, and customer comfort.

Two Track Project: Single Family Scope

Key Milestones:

- Study capabilities of manufacturers of Heat Pump Control devices and identify best fit
- Develop customer offering and begin outreach
- Wave 1 of Customer Control Device and Meter Installations
- Dispatch Heat Pumps to offset central gas heating systems during DR Events
- Waves 2 and 3 of Customer Outreach and Installations
- Impact Evaluations



Project Status: Multifamily Track

Site Selection

- National Grid's first step was to engage with a potential customer, identifying a public low-income housing authority in late 2022.
- National Grid and the housing authority worked to identify suitable sites based on certain criteria (size, heating system type, etc.)
- National Grid visited several potential sites, ultimately selecting a Building in Brooklyn in mid-2023.
- Contract negotiations ran concurrent with site selection, with terms finalized in Winter 2023.
- Currently that agreement is pending the housing authority's countersignature.

Building Details

Heating System: Natural Gas Boiler

Boiler Controller: Heat-Timer Platinum

Apartment Heating: Recessed Radiators

Annual Consumption: 56,000 therms

Zone Valves: Two (865-875 and 881-885)

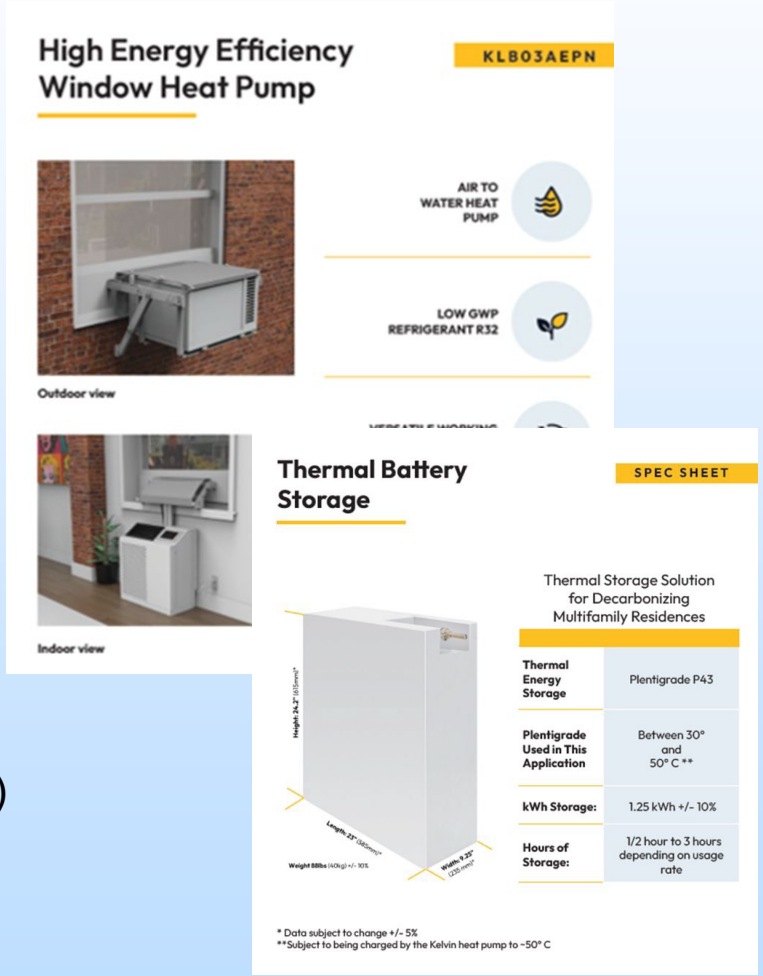
Apartments: 64 (all 2 BRs)

Electrical: 20 amp Circuit Breakers

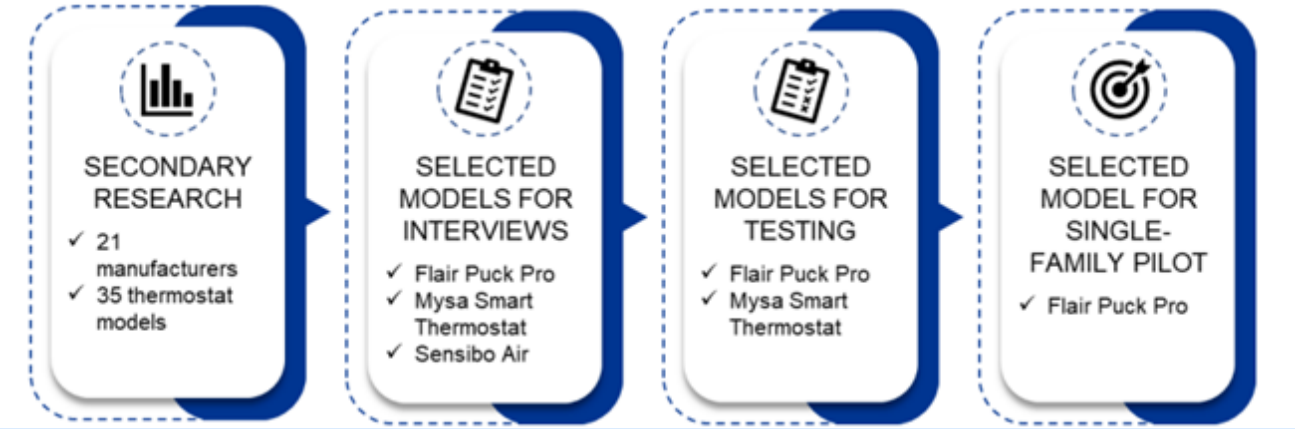
Project Status: Multifamily Track

Equipment and Installation

- Sample measurements have been taken at apartments of the selected site.
- Heat Pumps, Thermal Battery and associated materials have been manufactured according to building specifications.
- Installation of equipment has been delayed, currently planned for Spring 2024.
- Ahead of installation, outreach planned to building tenants (flyers, information booths, etc.) along with training for building staff.



Project Status: Single Family Track



Single Family Controls Technology Assessment

- 35 models narrowed down to selected device model (Flair Puck Pro)
- Criteria included:
  - Ease of install
  - Control capabilities
  - Cost
  - Aesthetics
  - Willingness to participate

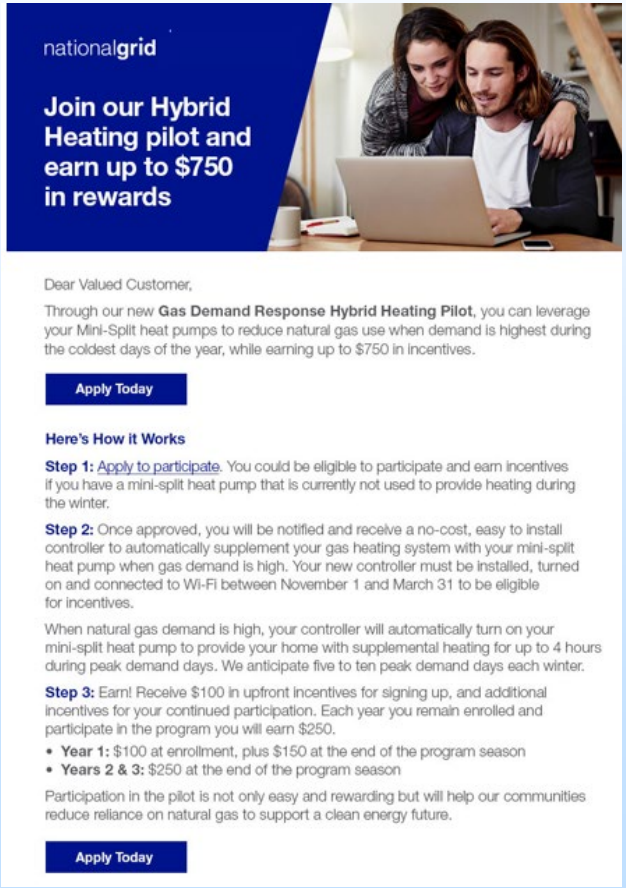
Project Status: Single Family Track

Initial Customer Outreach (Wave 1)

- Initial strategy of collaboration with electric utility failed to garner targeted leads
- Defaulted to broader campaign for National Grid customer adoption
- Established screening process to identify eligible customers
- Initial group of 14 selected from pool of applicants

Future Outreach (Waves 2 and 3)

- Combination of email, postcard and letter campaign starting May 2024
- Better screening
  - Check boxes (i.e. “I have a Heat Pump”)
  - Screening for eligible meter types



Project Status: Single Family Track

Installation

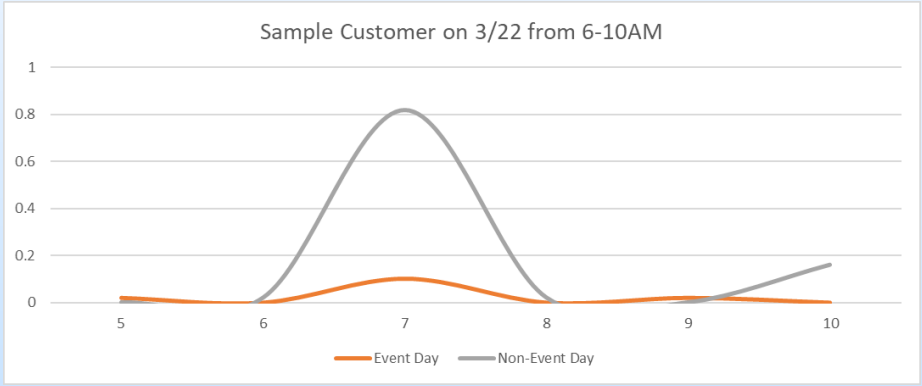
- 14 sites were selected for vendor-assisted installation before March 31, 2024.
- Learnings from installations include:
  - Proper distance between controller and heat pump indoor unit
  - Customer preference maintaining use of IR remote controls
  - Need for one wired Gateway device per floor (connectivity issues)
  - Gas meter compatibility for measurement and verification

Project Status: Single Family Track

Dispatch and Events

- Two DR events were conducted in Winter 2023/24
  - 3/1/2024 and 3/22/2024 from 6-10AM

- Full evaluation of events is pending, but events provided some early learnings:
  - Setpoint temps should be based on Average Temp, not Temp at 6AM
  - Aggressive setpoints (+2-4 degrees) needed to counter vary temps within a home
  - Customers tendency to override controls if they don't receive notice of event
  - Lack of two-way communication between Puck and Heat Pump prevents confirmation of signal receipt



Key Findings to Date

Multifamily

- Contracting with housing authorities can be prolonged and require extensive review and negotiation.
- Stakeholders in MF properties (housing authority, tenant association, tenants) are diverse and require coordination of messaging.

Single Family

- Cross-utility data sharing remains difficult due to privacy regulations
- Testing and vendor-assisted installations are critical for ensuring customer self-serve adoption
- Iterations on dispatch strategies (setpoints, adjustments and timing) lead to improved results
- Preliminary events indicate peak day gas reductions are possible

Appendix

Organization Chart

Team Member	Company	Role(s)
Mona Chandra	National Grid	Principal Investigator
Owen Tyrrell	National Grid	Planning, Regulatory, Data Analytics, Reporting
Alberto Edde	National Grid	Customer Outreach
David Barclay	DNV-GL	Project Management
Vijay Gopalakrishnan	DNV-GL	Project Management, Equipment Installation
Thomas Ledyard	DNV-GL	Research, Reporting
Aaron Schrader	DNV-GL	Data Analytics and Monitoring

Gantt Chart

Calendar Year	2022	2023				2024				2025				2026				2027
Quarter	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
1.0 Project Management & Planning	1.1																	
1.1 Project Management Plan	1.2	1.3																
1.2 Workforce Readiness			1.4															
2.0 Data Management Plan		2.1																
3.0 EJ and Econ Revit / Jobs Summary																	3.1	
4.0 Planning / Technology Assessment		4.1	4.2															
5.0 Customer Outreach & Engagement		5.1		5.2,5.3			5.4	5.5			5.6	5.7						
6.0 Equipment Installation / Metering						6.1	6.3	6.2		6.6,6.7			6.8,6.9		6.1			
7.0 Data Analytics							7.1				7.2				7.3			
8.0 Reporting	8.1		8.2		8.5			8.4,8.4				8.5	8.6				8.6	