Better Buildings, Better Plants
SUMMIT

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Electrification in Existing Multifamily Buildings: Challenges and Solutions

Wednesday, May 18
2pm ET
Agenda

1. Welcome and Introductions
2. Panel Discussion
3. Q & A and Closing
Today's Presenters

- **Andrew Brooks, Senior Director of West Coast Operations**
  - Association of Energy Affordability

- **Jordan Bonomo, Project Manager**
  - New York City Housing Authority

- **Ravi Malhotra, President**
  - ICAST
Andrew Brooks
Association of Energy Affordability
Multifamily Electrification

Electrification Challenges &
Central Domestic Hot Water
Solutions

Andy Brooks
Senior Director, AEA West
4/28/2022
AEA is dedicated to bringing the benefits of clean energy and energy efficiency to underserved and disadvantaged communities.

• Program Design & Implementation
• Advanced Building Technology Research & Demonstrations
• Training the Workforce and the Industry at Large
• Technical Services (Energy & Green Building Design Consulting)
• Policy and Advocacy

Decarbonizing the Built Environment is Our Specialty, Affordable Housing is our Priority
Common Multifamily Electrification Project Challenges

- Existing Electrical Infrastructure:
  - Building level capacity
  - Feeder sizes
  - Panel/Subpanel capacity
  - Space for new dedicated breakers / capacity
- Building modifications required
- Upfront cost
- Consumer knowledge
- Contractor knowledge (change in BAU)
- System design & sizing
- Range of options (many pros and cons)
- Programmatic quantification/reporting metrics
- Coordination with utilities
Heat Pump Water Heating

You can *definitely* electrify water heating in any existing building! *BUT*,

it is different from gas, so be fully aware of all differences.
HPWH Configuration – How to choose?

**Individual**
- More spread-out developments with larger units
- Individually-metered buildings, or condos (owner-occupied)
- Large equipment selection, eliminates T24 solar hot water (PV or thermal) requirements
- Can save cost on recirculation piping, but more pieces of equipment in each unit

**Central**
- Very dense developments with smaller units and tight sites
- Master-metered buildings (supportive housing)
- More limited equipment selection, subject to T24 solar hot water requirements
- Less hot water equipment overall, and easier to access/maintain

**Cluster**
- Saves on recirculation piping costs & energy waste – most efficient?
- Need to locate equipment
Heat Pump Water Heaters – Unitary/Individual

Split Heat Pump Water Heater

Combined Heat Pump Water Heater
Central Water Heating Systems
Central HPWH

Monoblock / Built-Up

Integrated Tank

TBD
Heat Pumps in garage

Hot water run through wall to storage tanks (no refrigerant runs)

Primary Storage Tanks

Recirculation Pumps

Electronic Mixing Valves

Recirculation Heater

Central Sanden Plant
Aermec
Central Heat Pump
Chiller (Reverse Cycle Chiller)
Central Sanden Plant
## Mitsubishi HEAT\textsubscript{2}O CO2 Heat Pump

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<tr>
<th><strong>Mitsubishi Heat\textsubscript{2}O – QAHV-N136TAU-HPB</strong></th>
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<td><strong>Power</strong></td>
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<td><strong>Capacity</strong></td>
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<td><strong>Dimensions</strong></td>
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<td><strong>Sound Pressure</strong></td>
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<td>**Refrigerant &amp; Charge</td>
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<td><strong>Additional Components</strong></td>
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Example Plumbing Drawing

Recirc, Swing Tank, & MV

Primary Storage Tanks

Secondary Pumps & Heat Exchangers

Heat2O Units

NOTES:
(1) ADD 12" VERTICAL DROP BEFORE STORAGE TANK TO GCA AS HEAT TRAP.
(2) SEE DETAIL 2 - HEAD-END PUMP DETAIL.
(3) SEE DETAIL 3 - SECONDARY PUMPS HEAT EXCHANGER.
(4) SEE DETAIL 4 - HEAD-END PUMP DETAIL.
(5) OVERFLOW VALVE CLIPS HEAT EXCHANGER AND RETURN FLOW TO SWING TANK OR BACK TO PRIMARY STORAGE TANK.

HPWH SCHEMATIC

Image: Ecotope
Central HPWH – Key Considerations

• Sizing of heat pumps vs. storage tanks
• Equipment location (form factor considerations, storage)
• Single-pass vs. multi-pass
• Recirculation
• Mixing valves
• Renewables – thermal vs. PV
• Refrigerants have different operating characteristics, what works in one application may not in another.
Central HPWH Sizing

Large Storage Tanks + Small Heat Pumps

• Advantages
  • Reduces overall hot water system cost, since tanks are cheaper than heat pumps
  • Reduces building electrical service requirements including wiring, panels, and service
  • Reduces owner exposure to high peak demand (kW) charges
  • Reduces heat pump equipment short cycling
  • Improves resiliency in event of power outage – thermal battery
  • Enables load shifting & demand response – can rely on storage and lock out heat pumps during peak pricing periods or demand response events

• Disadvantages
  • Large tanks need space
Central HPWH Sizing - Ecosizer

• Free tool for sizing CHPWH systems; developed by Ecotope w/ funding from SCE & SMUD
• Can dynamically trade off storage & recovery
• Multiple recirculation options
• Export sizing runs as PDFs

www.ecosizer.com
Thank You!

Andy Brooks
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Jordan Bonomo
New York City Housing Authority
Challenges and Solutions Electrifying NYCHA

Jordan Bonomo, NYCHA Project Manager, Energy Programs

May 18, 2022
With more than +/- 400k people, NYCHA’s population is larger than Las Vegas, Atlanta, or Miami.

$23,000 average household income

110,000 Children
77,000 Seniors
61% are employed

335 Individual developments
2,212 Residential buildings
177,611 Public housing apartments

1 in 15 New Yorkers are served by NYCHA's Public Housing & Section 8 Programs
Decarbonization Background

• NY State Climate Leadership and Community Protection Act (CLCPA)
  • Requires carbon-free electric grid by 2040
• NYC Local Law 97 (LL97)
  • 40% x 2030 and 80% x 2050 GHG emissions targets
• NYC Introduction No. 2317-A
  • Bans the use of fossil fuels for heating and hot water in all new construction and major renovations
• Steam heating systems will no longer be replaced in-kind
• To comply with the new laws, NYCHA plans to electrify space heat and DHW at its developments
Problem Statement

How can NYCHA electrify space heat and hot water in ~100,000 apartments, 60% of which are >50 years old, in the next 30 years?

• Steam distribution accounts for 93% of NYCHA’s space heat and DHW by floor area.
• Vacancy rate of 1.2% in 2020.
• Estimated ~$40 billion in needed capital repairs.
Early Electrification Efforts – Multi Split Heat Pump Pilot

• 21-story, 342-unit development in Northwestern Bronx
• Scope limited to 7 apartments on the top floor
• 4 outdoor units, 21 indoor units
• NYSERDA grant of $250,000
• Fujitsu donated equipment - Airstage J II VRF
• NYCHA capital funds covered the difference
• Total project cost per room (bedrooms + living rooms) = $24,000
Challenges From the VRF Pilot

• High project costs
  • Full MEP and structural sets were filed with NYC DOB
  • Multiple skilled trades involved – electrician, plumber, steamfitter, carpenter
  • Testing and special inspections
  • Hazmat testing and abatement
  • Long refrigerant runs with multiple envelope penetrations
  • Apartment panel upgrades and new common area panel on roof

• Extensive in-unit work
  • 5 – 7 days of in-unit work per apartment
  • Working around furniture and other resident belongings
  • Residents often not home at scheduled times

• Post installation refrigerant leak
  • GWP of R-410A is 2,088!
RetrofitNY Pilot

• Convert 48-unit NYCHA building to near Net Zero-Energy using Energiesprong retrofit approach.

• Scope of work includes:
  • Panelized exterior over-cladding with windows
  • Packaged heat pumps for apartment heating and cooling
  • Heat pump hot water maker
  • Energy recovery ventilation
  • Electric induction stoves
  • Rooftop solar PV canopy

• Construction proposals due June 24, 2022

• 70% energy reduction and system electrification through scope of work that approaches the building as a system

• Nascent industry with few qualified Solution Providers

• Big upfront investment
Developing a Scalable Solution

• Reduce the installed cost of electrification to be competitive with cost of steam boiler plant replacement.

• Develop hardware that can be universally adopted in all NYCHA buildings.

• Reduce the conversion timeline
  • Shorten design phase through increased standardization
  • Eliminate filing where possible
  • Minimize resident disruption and need for hazmat abatement.
Clean Heat for All Challenge

WHO: NYCHA-NYPA-NYSERDA

WHAT: Partnership to develop new all-in-one packaged cold climate heat pump installed through existing window.

HOW: RFP for bulk purchase

- Minimum Requirements Specifications
- Additional Design Target Specifications (scoring system)
- Initial purchase order: up to 24,000 units

WHERE: 6 NYCHA developments

- NYCHA estimated internal demand: 156,000 heat pump units over next decade.
- External demand: Letters of interest from 13 stakeholders: PHAs, government agencies, ESCOs representing over 75,000 housing units. *Price guarantee allows others to purchase at the same price.*
Desired Product Specifications

• Form factor with approximate size and weight of a typical window or through-the-wall AC with all refrigerant piping hermetically connected within the unit and no exterior core drilling required for installation;
• Run on 115 VAC +/- 10% single phase, 60 Hz and plug into a standard 3-prong outlet, 15 amp circuit;
• Minimum efficiency of 1.85 COP at 17°F outdoor temperature and 70°F indoor temp in heating mode, at rated capacity;
• Shall operate down to 0°F and shall not use backup resistance heat for space heating;
• Variable speed compressor with capacity of 9,000 Btu/hr heating at 17°F outdoor temp;
• Condensate line and pump (if needed) are internal and discharge outdoors or nearby indoors with no need for plumber labor;
• Can be installed so it is airtight around its perimeter without any degradation to the overall R-value or infiltration of the building envelope;
• Provide BACNet compatibility for BMS integration with no external proprietary cloud software required; and
• Can be installed by unskilled labor within approximately two hours.
### Clean Heat for All Timeline

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<tr>
<th>Milestone</th>
<th>Date/Period</th>
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<tr>
<td>RFP Release</td>
<td>December 2021</td>
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<tr>
<td>RFP Award</td>
<td>August 2022</td>
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<tr>
<td>Development Phase</td>
<td>9 – 18 Months</td>
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<tr>
<td>Demonstration Phase</td>
<td>1 Heating Season</td>
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<tr>
<td>Full Installation Start</td>
<td>TBD</td>
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Image Source: Grain Collective
Questions

Contact:

Jordan.Bonomo@nycha.nyc.gov
Electrification For Multifamily Buildings

Sponsored by BTO at DOE
Who We Are

- 501C3 national nonprofit
- **Population Served:** Low-to-Moderate Income
- **Market Served:** Multifamily Properties *(cluster of 4+ units under single ownership)*
- **Mission:** Provide economic, environmental, and social benefits to LMI communities
- **Motivation:** Affordability of Housing, Climate Change and Economic Development
The Problem:
A very old and inefficient central boiler and chiller system, with high repair and utility costs paid by all tenants through their HOA dues.

The Solution:
1) Central electric HVAC & unitary heat pump-based HVAC units in each apartment reducing HOA dues for each tenant; 2) Leverage incentives to reduce energy financing costs.

- Replacing central boilers and chillers with 75 new very high efficiency heat pump HVAC systems

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75-unit market-rate apartment community
Annual Utility Savings ~ $35,950
Project Payback - 9 years
Total Project Cost - $399,800
Total Rebates - $74,895
Carbon Saved Annually - 275 Tons
The Problem:
Tenant complaints – 1) high utility costs; 2) inability to put furniture in desired locations due to the small size of the units.

The Solution:
1) High-efficiency, high wall-head, heat pump HVAC; 2) Incentives to get the desired high-efficiency equipment to work within their budget.

- Very high-efficiency heat pump HVAC systems
- Higher Insulation
- Smart thermostats
- LED lighting

$39,278
In Total Rebates From Utilities

48-unit affordable apartment community
Annual Utility Savings ~ $15,056
Project Payback - 5 years

Total Project Cost - $119,596
Annual kWh Savings - 130,926
Carbon Saved Annually - 120.44 Tons
The Problem:
1) Electric baseboard heaters resulting in high utility bills for tenants & causing occupancy issues; 2) Health and comfort issues due to insulation issues around window air conditioning units.

The Solution:
High-efficiency heat pump-based HVAC units replacing the window A/C and baseboard heaters.

- Interior and exterior lighting
- Smart thermostats
- VHE heat pump HVAC systems in every unit

The Kirk Apartments

48-unit affordable apartment community

Total Project Cost - $230,790
Utility Incentives - $78,780

Project Payback - 5 years
Annual kWh Savings – 262,602
Annual Energy Cost Reduction – 29%

$30,199 Average Annual Utility Savings
Lessons Learned

1. Appropriate incentives crucial to achieve scale for retrofits
   - MF market extremely price sensitive
   - Incentives MUST cover cost differential between baseline & VHE equipment
   - Since costs vary, the size of incentives vary by region

2. Cost of energy does NOT impact successful scaling of VHE solutions
   - New Construction has already achieved cost parity

3. Contractors MUST be on board to market VHE solutions
   - Essential to train contractors in best design/install practices for VHE equipment
Lessons Learned

4. Keep the programs simple
   ✓ Tailored to unique challenges of MF market

5. Policy changes - legislative mandates / regulatory changes are critical for electrification or VHE installations

6. Smart Devices – Higher value and demand for controllable equipment

7. Holistic view – Electrification upgrades PLUS other EEMs will ensure utility cost savings for LMI residents

Resource Guide at icastusa.org
What We Do

- Green retrofits of existing MF properties
  - One-Stop-Shop for DER installs
- Design Consulting for New MF Construction
  - All-electric, high-performance buildings
- 28,400 apartments upgraded in 2021
  - Avg. 23% energy savings across portfolio
- Over 12,000 HP HVAC installs
  - HP DHW are another story
  - Waiting for combo HP product
Thank You!

Questions?

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Thank You!

Provide feedback on this session in the Summit App!

Download the Whova app to your mobile device or use the QR code to access the web version.