About VEIC

- Nonprofit founded in 1986
- 300+ employees
- Locations: DC, NY, OH, VT
- Design and deliver programs and policies nationwide:
  - Energy efficiency
  - Clean transportation
  - Renewable energy

- Our customers:
  - Utilities
  - Government
  - Foundations
  - Environmental & consumer groups
  - Business
Topics

- Overview of heat pump policies and programs in the Northeast
- Efficiency and electrification: strategic partners
- Updating EE programs in the context of electrification
Heat Pumps in the Northeast: Lessons Learned
Research Objectives

• Review policy and program frameworks in Northeast states – New England & New York

• Identify key factors driving program success for air source heat pump (ASHP) adoption

• Develop recommendations for states and utilities interested in promoting heat pumps

Northeast Electric Grid is Getting Cleaner


Northeast Electric Grid is Getting Cleaner
Limited Access to Natural Gas in the Region

Natural Gas Pipeline in Northeast US

<table>
<thead>
<tr>
<th>State</th>
<th>Housing Units Heated with Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>33.6%</td>
</tr>
<tr>
<td>MA</td>
<td>50.1%</td>
</tr>
<tr>
<td>ME</td>
<td>6.0%</td>
</tr>
<tr>
<td>NH</td>
<td>19.7%</td>
</tr>
<tr>
<td>NY</td>
<td>56.8%</td>
</tr>
<tr>
<td>RI</td>
<td>51.8%</td>
</tr>
<tr>
<td>VT</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

Source: U.S. EIA Energy Mapping System

Source: U.S. Census Data 2015
Heat Pumps Have Lowest GHG Emissions
Heat Pump Usage in the Northeast

• Most common application:
  o Ductless mini-split
  o Installed in home with oil or propane boiler
  o Home retains backup fossil fuel system
  o Adds new cooling load

• Wide variability in use of heat pump vs. backup system

• NEEP Cold Climate specification designates products that meet heating performance standards at low temperatures
## State Policies Promoting Heat Pumps

<table>
<thead>
<tr>
<th>State</th>
<th>Policy</th>
<th>Binding Target?</th>
<th>Dedicated Funding Source?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>Comprehensive Energy Strategy</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>MA</td>
<td>Alternative Portfolio Standard</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
| ME    | State Energy Plan
Legislation directing Efficiency Maine to focus on reducing heating costs | No              | Yes                      |
| NH    | Thermal Renewable Energy Certificate program but ASHPs not currently included | No              | No                       |
| NY    | REV Clean Energy Fund                                                  | Yes             | Yes                      |
| RI    | Resilient Rhode Island Act
Power Sector Transformation                                                      | No              | No                       |
| VT    | Comprehensive Energy Plan
Renewable Energy Standard including energy transformation                  | Yes             | Yes                      |
Policy Lessons Learned

• Policies are most effective when backed by binding targets and dedicated funding

• EE savings targets are necessary but not sufficient to drive heat pump adoption

• Examples of program metrics to drive heat pumps:
  o Number of installations
  o Fuel-neutral energy savings
  o GHG reduction

• When there are multiple program administrators, careful coordination is needed to avoid customer and market confusion
## Savings Assumptions

<table>
<thead>
<tr>
<th>State</th>
<th>Program/Utility</th>
<th>Incentive Level</th>
<th>Incremental Electric Savings</th>
<th>Retrofit Fuel Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>Energize CT</td>
<td>$300</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>MA</td>
<td>Mass Save</td>
<td>$100-300</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ME</td>
<td>Efficiency Maine</td>
<td>$500</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>NH</td>
<td>NH Saves</td>
<td>$375-750</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>NY</td>
<td>NYSERDA</td>
<td>$500</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Utility Programs</td>
<td>$100-300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RI</td>
<td>National Grid</td>
<td>$100-300</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>VT</td>
<td>Efficiency Vermont</td>
<td>$600-800</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Savings & Incentives Lessons Learned

• Electric utility programs that only value incremental electric savings tend to offer lower incentives ($100-300/unit)

• Programs that offer higher incentives (> $500/unit):
  o Count the fossil fuel savings towards program goals (e.g., Efficiency Vermont) OR
  o Have non-utility program administrators with broader goals for renewable thermal adoption or GHG reduction (e.g., Efficiency Maine, MassCEC, NYSERDA)
## Incentives and Installation Rates

<table>
<thead>
<tr>
<th>State</th>
<th>Program/Utility</th>
<th>Incentive Approach</th>
<th>Incentive Level</th>
<th>Annual Install Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>Energize CT</td>
<td>Midstream</td>
<td>$300</td>
<td>0.10%</td>
</tr>
<tr>
<td>MA</td>
<td>Mass Save</td>
<td>Downstream</td>
<td>$100-300</td>
<td>0.26%</td>
</tr>
<tr>
<td></td>
<td>MassCEC</td>
<td>Downstream</td>
<td>$625-1000</td>
<td></td>
</tr>
<tr>
<td>ME</td>
<td>Efficiency Maine</td>
<td>Downstream</td>
<td>$500</td>
<td>0.82%</td>
</tr>
<tr>
<td>NH</td>
<td>NH Saves</td>
<td>Downstream</td>
<td>$375-750</td>
<td>0.16%</td>
</tr>
<tr>
<td>NY</td>
<td>NYSERDA Utility Programs</td>
<td>Midstream to contractor</td>
<td>$500</td>
<td>0.06%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Downstream</td>
<td>$100-300</td>
<td></td>
</tr>
<tr>
<td>RI</td>
<td>National Grid</td>
<td>Downstream</td>
<td>$100-300</td>
<td>0.22%</td>
</tr>
<tr>
<td>VT</td>
<td>Efficiency Vermont</td>
<td>Midstream</td>
<td>$600-800</td>
<td>1.20%</td>
</tr>
<tr>
<td></td>
<td>Utility RES Compliance</td>
<td>Downstream</td>
<td>$150-375</td>
<td></td>
</tr>
</tbody>
</table>
Program Design Lessons Learned

• Midstream programs are effective at driving the market
  o Proactive supply channel engagement
  o Instant discount at point of sale
  o Distributor and/or contractor incentives

• Contractor and customer training is key
  o Contractor incentives (NYSERDA)
  o Trade ally networks (Efficiency Vermont)

• Bundle installation of heat pumps with:
  o Weatherization (NH Electric Coop)
  o Controls (Eversource pilot in CT)
Energy Code Lessons Learned

• Federal preemption rules are a key barrier to promoting high-efficiency mechanical equipment like heat pumps

• States can use local amendments to IECC to work around this constraint:
  o Limit compliance options to only a performance-based path
  o Develop multiple prescriptive paths that include options for higher mechanical efficiencies while maintaining at least one package that utilizes the federal minimum standard
  o Include an additional high efficiency “Options” package from which builders must choose a minimum number of additional efficiency requirements
  o Promote a voluntary stretch code with more stringent requirements
Vermont’s Pathway: Efficiency, Electrification, and Renewables

Avoided vs. Reference Electricity Natural gas Gasoline Jet kerosene Kerosene Diesel Residual fuel oil LPG Oil Ethanol Solar Thermal Hydrogen Coal CNG Biodiesel Wood chips Wood pellets Cord wood

Trillion British Thermal Units
Bulk System Impacts

2016 Rhode Island Peak Energy Demand

Top 1% of hours = $23 million, or 9% of total spend

Top 10% of hours = $67 million, or 26% of total spend
Distribution

Grid Impacts
Building-Level Impacts: “Zero Energy”

- PV output and building electricity demand from October through December

- Small commercial office in Vermont
- High performance building envelope upgrades and cold climate heat pumps
The DER Toolbox: Deploying Electrification & Efficiency Strategically

New

Traditional

Efficiency
Example: Controllable Load to Accommodate Renewables

- Steele-Waseca Cooperative Electric, in Minnesota
- Community solar program allows members to subscribe to solar and receive a free, controllable electric water heater
- Thermal storage capacity now exceeds solar generation capacity
- Co-op was able to reduce coincident peak charges, keeping rates low
Example: Time-Targeted Efficiency

Vermont’s duck curve problem: sunny vs. cloudy days
Which Efficiency Measure Better Addresses Vermont's Duck Curve?

Efficient Refrigerator

LED Lightbulb
Different Measures Provide Different System Value

Green Line: Average Efficiency Shape

Efficient Refrigerator

LED
Electrification & Efficiency: Strategic Partners

✓ The grid has capacity for electrification at the right time and place

✓ Efficiency reduces peak demand and creates space for electrification on the grid

✓ Building shell improvements make heat pump heating and cooling loads more flexible and avoid oversized HVAC and PV systems
Updating EE Programs in Context of Electrification
Northeast States Are Starting to Evolve EE Goals for the Future

• Massachusetts
• New York
• Rhode Island
# Massachusetts: Broadening EE Program Scope

<table>
<thead>
<tr>
<th>Old Goal</th>
<th>New Goal</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime kWh savings</td>
<td>Lifetime MMBtu savings</td>
<td>• Converts electric, oil, and propane savings to common units</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Encourages energy optimization by providing holistic view of tradeoffs</td>
</tr>
<tr>
<td></td>
<td>Peak kW savings</td>
<td>• Measures savings from both active and passive demand reduction</td>
</tr>
<tr>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MA Clean Energy Bill

• MA Legislature passed clean energy bill on July 31, 2018

• Key provisions of H.4857, An Act to Advance Clean Energy:
  • Replaces “electric” with “energy” in EE statute
  • Adds energy storage, active demand management, and strategic electrification as eligible under EE programs
  • Adds programs that result in customers switching to renewable energy sources or other clean energy technologies to EE plans
  • Broadens cost-effectiveness screening to ensure that programs "obtain energy savings and other benefits with value greater than the costs of the program" rather than energy savings and system benefits
  • Requires cost-effectiveness at sector level rather than measure level
New York: Incenting Key Outcomes

Under REV, New York seeks to:

- Transition from cost-of-service to **performance-based ratemaking**
- Provide incentives (**earning adjustment mechanisms** or EAMs) to utilities for achieving desired outcomes
- Take a system-wide view of energy impacts to **encourage private sector activity**, not just program-based activity
## Earnings Adjustment Mechanisms
New Upside Performance Incentives in Niagara Mohawk Power Co. Joint Proposal

<table>
<thead>
<tr>
<th>EAM Category</th>
<th>Metrics</th>
<th>Measurement</th>
<th>Drivers</th>
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</thead>
<tbody>
<tr>
<td>System Efficiency</td>
<td>Peak Reduction</td>
<td>NYCA-coincident peak load</td>
<td>Demand response, Storage, Peak-focused EE, DG Interconnection, VDER, VTOU, off-peak EV Charging, heat electrification, VVO/CVR</td>
</tr>
<tr>
<td></td>
<td>DER Utilization</td>
<td>Sum of annualized MWh for incremental load-reducing DERs</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>Incremental EE</td>
<td>Incremental MWh EE Savings</td>
<td>ETIP, incremental NMPC administered EE, EE financing, E-Commerce Platform, LED Street Lighting, Project Juniper, NY SERDA coordination, 3rd party coordination</td>
</tr>
<tr>
<td></td>
<td>LED Street Lighting</td>
<td>LED SL conversions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resi Energy Intensity</td>
<td>% decrease in MWh/customer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C&amp;I Energy Intensity</td>
<td>% decrease in MWh/customer</td>
<td></td>
</tr>
<tr>
<td>Interconnection</td>
<td>Meeting SIR standards is threshold for earning</td>
<td>Survey score</td>
<td>Developer cost sharing; Developer opportunity to construct upgrades; online interconnection portal</td>
</tr>
<tr>
<td></td>
<td>Developer Satisfaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Reduction</td>
<td>Beneficial Electrification</td>
<td>MT CO2 reduced from incremental heat pumps and EVs</td>
<td>Electric heat initiative, EV charging &amp; marketing, rate design, Juniper</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
## Rhode Island: Baby Steps Toward Performance-Based Regulation

<table>
<thead>
<tr>
<th>PIM</th>
<th>Objective</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>System efficiency (new PIM)</td>
<td>Reduce demand during ISO-NE peak hour</td>
<td>Sum of annual MW capacity savings from:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demand response</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Incremental net-metered behind-the-meter PV distributed generation in excess of forecast levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Incremental installed energy storage capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Non-wires alternatives that reduce system peak</td>
</tr>
<tr>
<td>EE savings (incentivized</td>
<td>Annual MWh and therm savings</td>
<td>Also testing new metrics:</td>
</tr>
<tr>
<td>under EE program)</td>
<td></td>
<td>• CO2 reductions from delivered fuel programs (Wx, heat pumps, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lifetime MWh savings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cost of energy saved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Customer satisfaction</td>
</tr>
</tbody>
</table>
Steps to Update Efficiency Programs in the Context of Electrification

- Build on efficiency program skills and success
- Coordinate delivery of efficiency, demand management, and electrification programs to avoid creating program silos
Steps to Update Efficiency Programs in the Context of Electrification

✓ **Update cost-benefit tests** to include the full benefits of building electrification
  - GHG reduction, fuel security, comfort, health, economic development

✓ **Change program rules** that discourage fuel switching from natural gas to electricity

✓ **Support – and dedicate funding for – pilots and innovation**
Set Next-Generation Goals

✓ Align EE program goals (and utility performance incentives) with state policy goals:
  o Peak demand reduction
  o Fuel-neutral energy savings or GHG reduction
  o Market transformation indicators
  o Energy or GHG savings for low-income customers or other target groups

✓ Identify building blocks to achieve statewide goals – including dedicated targets for EE savings

✓ Assign responsibility (and funding) for each building block
A Possible Model?

New York 185 TBtu Savings Target

Btu Savings from EE

Btu Savings from Clean Heating

Btu Savings from MT

Btu Savings from LMI Initiatives

Utility A Target

Utility B Target

Utility A Target

Utility B Target

MT Target

LMI Target
Thank you!

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