GRID-INTERACTIVE EFFICIENT BUILDINGS: VALUE PROPOSITIONS AND SECTORAL PERSPECTIVES

NASEO 2019 ANNUAL MEETING
SEPTEMBER 16, 2019

MASSACHUSETTS DEPARTMENT OF ENERGY RESOURCES
DEPUTY COMMISSIONER JOANNE MORIN
Massachusetts
Energy Use and Emissions by Sector

Massachusetts Energy Demand
Total: 1,074 Trillion BTU in 2016

Transportation 44%
Non-Electric (Thermal) 39%
Electric Sales 17%

Massachusetts Greenhouse Gas Inventory

Electric - ISO-NE

Thermal

Transportation

Electricity 0%
Jet Fuel 13%
Motor Gasoline 71%
Other 1%

Other Fossil 2%
Other 6%
Solar 2%
Wind 2%
Natural Gas 41%
Net Imports 17%
Nuclear 26%
Fuel Oil 24%
Biomass 2%
Propane 3%
Coal 0%
Diesel 15%
CEP Findings:
Impact on Emissions and Rates

Average Residential Monthly Expenditures in 2030
Electric, Heating, and Transportation Bills

Emission Reduction Impacts Beyond Sustained Policies in 2030
In the Sustained Policies scenario, we assume that policies are implemented such that the charging of electric vehicles is focused in two main periods: while Massachusetts residents are at work and school, and again at night. Figure 46 displays the assumed load shape for electric vehicle charging.
CEP Policy Priorities and Strategies

**Thermal Sector**
- Leverage investments made in the clean energy sector through electrification
- Promote fuel switching from more expensive, higher carbon intensive fuels to (electric air source heat pumps and biofuels)
- Reduce thermal sector consumption
- Drive market/consumer demand for energy efficiency measures and fuel switching
- Invest in R&D for clean heating fuels such as renewable gas and biofuels that can utilize investments already made in heating infrastructure

**Electric Sector**
- Prioritize electric energy efficiency and peak demand reductions, including Clean Peak Standard
- Increase cost-effective renewable energy supply
- Support grid modernization and advanced technologies, including microgrids and storage
- Develop policies to align new demand from the charging of EVs and heating/cooling with the production of clean, low-cost energy.
- Include cost-effective demand reduction and additional energy efficiency initiatives in our nation-leading energy efficiency programs and plans

**Transportation Sector**
- Increase the deployment of EVs and charging infrastructure
Non-Linear Pathway toward Decarbonization

Grid Interactive Buildings

- Renewables
- Energy Storage
- Demand Reduction
- Electrification
- Efficiency
**Clean Energy**

- Renewable Portfolio Standard 55% by 2050
- Alternative Portfolio Standard 12.5% by 2050
- Clean Energy Standard 80% by 2050
- After SMART incentive program is completed, over 4,000 MW of solar in Massachusetts

**Clean Energy Procurements**

- Hydroelectric - New England Clean Energy Connect 1200 MW / 9.5 TWh
- Offshore wind - Vineyard Wind 800 MW Selected
- Bids for Second solicitation for offshore wind under evaluation
- DOER recommended another 1600 MW of offshore wind
Pounds of emissions to deliver 1 MMBtu of heat into a space

<table>
<thead>
<tr>
<th>Source</th>
<th>2020</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>170</td>
<td>170</td>
</tr>
<tr>
<td>Propane</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Gas</td>
<td>120</td>
<td>120</td>
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<tr>
<td>Electric Resist</td>
<td>205</td>
<td>60</td>
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<tr>
<td>Electric Cold Climate Air Source Heat Pump</td>
<td>65</td>
<td>20</td>
</tr>
<tr>
<td>Electric Ground Source Heat Pump</td>
<td>45</td>
<td>15</td>
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</tbody>
</table>

85% Less
ELECTRIFICATION OF BUILDINGS & TRANSPORTATION

Fig. 6
PUBLIC AND PRIVATE EV CHARGING OUTLETS
Available charging has increased steadily over the years, however, significant increases are still needed to meet future charging demand.

Data Source: Alternative Fuels Data Center (AFDC)
2008 ZNEB Task Force Report

- Enhance Energy efficiency
- Expand renewables incentives
- Asset rating pilots
- Education and workforce development
- State Government Pilots

Pathways to Zero Grant Program

- $1.9 million for feasibility studies, integrated design, construction
- 16 new and existing residential and C&I building projects
Peak Demand: Energy Efficiency

Projected Summer Peak Demand With and Without EE and PV Savings

Note: Summer peak demand is based on the “90/10” forecast, which accounts for the possibility of extreme summer weather.

Energy Storage Initiative

- 2016 State of Charge Study
- $20M Advancing Commonwealth Energy Storage (ACES) Grant
- 26 projects for 32 MW / 85 MWh

**2015**
- 3 PROJECTS
  - 1.4 MW / 0.45 MWh

**2019**
- 232 PROJECTS
  - 190 MW / 470 MWh
  (operating & in development)
NEW SOLAR INCENTIVE PROGRAM

1st in the nation – solar + storage incentive
Launched November 2019
Storage compensated via
- variable adder based on ratio of storage to solar capacity
- Duration of storage

Long term certainty with 10 – 20 years of fixed revenue streams
Alternative on-bill credit mechanism
Incentives for projects on brownfields, landfills, parking lots, rooftops
$4.7 billion in cost savings to ratepayers when compared to previous solar programs
By 2030, Massachusetts will have a substantial clean energy, however generation will not necessarily coincide with peak demands. The highest cost and emissions hours are not being addressed.

Massachusetts will remain dependent on gas and oil generation to meet our peak demand, resulting in high costs and emissions, despite our substantial investment in clean energy resources.

Production profile for 1,090 MW Hydro, 3,200 MW Offshore Wind, 5,000 MW Solar PV
The CPS will send a market signal to clean energy generation to invest in storage technologies to deliver energy to load users to reduce demand during peak periods, thereby reducing the emissions and costs associated with these periods.
Clean Peak Standard

- Qualified Clean Peak Resources eligible to generate CPCs during Seasonal Peak Periods until 2051
- New RPS Class I eligible resources in operation on or after 1/1/19
- Qualified Energy Storage Systems
- Demand Response Resources
- Existing RPS Class I / Class II resources that are paired with a Qualified Energy Storage System on or after 1/1/19
• **Green Communities Act (2008)** requires all cost-effective energy efficiency and demand reduction

• **An Act to Advance Clean Energy (2018):**
  – Expands allowable energy efficiency investments to include active demand management (including storage), strategic electrification, and fuel switching to clean energy sources
  – Broadens electric efficiency plans to “energy” efficiency plans
  – Changes Department of Public Utilities cost-effectiveness review to sector-level
**KEY CHANGES TO ENERGY EFFICIENCY PLAN**

**Fuel Switching:** Customers will be provided information on cleaner fuel options for heating with new incentives for customers to fuel switch to air source heat pumps and other renewable heating options.

**Active Demand Reduction:** Programs that help offset the most expensive hours of the year through load reduction and active dispatch including energy storage.

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### Electric Efficiency Plans

| MWH Reduction | MW Reduction |

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### Energy Efficiency Plans

- **MMBtu Reduction** (electric, oil, propane, etc.)
- **MWH Reduction** (excluding fuel switching)
- **Peak Demand Reduction** (Summer, Winter), including *active* demand
Active Demand Reduction

- Continue to focus on energy efficiency, while pivoting reducing energy usage during times when demand and costs are highest
- **Active Demand Reduction Programs** include residential direct load control, energy storage, C&I load curtailment

<table>
<thead>
<tr>
<th>Statewide Goal</th>
<th>2019-2021</th>
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<tbody>
<tr>
<td>Summer MW Total</td>
<td>693</td>
</tr>
<tr>
<td>Winter MW Total</td>
<td>544</td>
</tr>
<tr>
<td>Active Summer MW</td>
<td>200</td>
</tr>
<tr>
<td>Active Winter MW</td>
<td>50</td>
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**In 2015:**

- The top 1% of Hours accounted for 8% of MA Spend on Electricity
- Top 10% of Hours accounted for 40% of Electricity Spend
# Active Demand – Residential Strategies

## Devices

<table>
<thead>
<tr>
<th>Connected Thermostat</th>
<th>![Connected Thermostat Image]</th>
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<table>
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<tr>
<th>Battery</th>
<th>![Battery Image]</th>
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<table>
<thead>
<tr>
<th>Electric Vehicle</th>
<th>![Electric Vehicle Image]</th>
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## Active Demand – C&I Strategies

### Typical Application

| Targeted Dispatch | • Usually Manual  
|                   | • Temperature setback ~3F  
|                   | • VFD speed limiting  
|                   | • Early setback  
|                   | • Process Changes  
|                   | • Rarely Lighting  
|                   | • Generators  
|                   | • Combined Heat and Power  

| Daily Dispatch   | • Usually Automatic  
|                  | • Batteries  
|                  | • Flywheels  
|                  | • Thermal Storage  
|                  | • Industrial Freezers  

| Winter Dispatch  | • Usually Manual  
|                 | • Snowmaking  
|                 | • Industrial Processes  
|                 | • Generators  

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**Source:** Massachusetts Department of Energy Resources
CHALLENGES

- Upfront Costs vs. long-term benefits
  - e.g. TLEDs vs. lighting fixtures with controls
- Higher cost of electricity
- Complexity and cost of retrofitting existing buildings, esp. C&I
- Getting price signals right for dispatchable assets
  - e.g. upfront vs. performance based incentives
- C&I Building Operator skillset related to advanced controls/technologies
- Consumer awareness and resistance
  - e.g. new technology and privacy perceptions
THANK YOU