EBC Energy Resources Program:
Efficiency as a Grid Resource
Welcome

Jackson Bailey

Communications & Marketing Coordinator

Environmental Business Council
Welcome to Brown Rudnick LLP

Greg Sampson

Counselor at Law
Brown Rudnick LLP
Thank you to the Collaborating Organization
Program Purpose & Overview
What You Will Learn

Matthew Christie

Program Co-Chair

Director – Energy Efficiency

TRC
Efficiency as a Grid Resource

October 30, 2018
Market transformation and regulatory consulting

Completing the efficiency lifecycle, with consulting services that pave the way for and validate programs and projects.
Residential new construction and multifamily programs

Customer-focused, award-winning residential programs from pilots to large-scale that wholly serve the market.
Power Used = Power Produced. Always
A whole lot of new concepts are hitting the grid:

- Demand response, the ‘duck-curve’, wind curtailment and negative spot prices, electrification, smart-buildings
From Simple to Dynamic

The Evolution of the Electric Utility System

**Before** Smart Grid:
One-way power flow, simple interactions

**After** Smart Grid:
Two-way power flow, multi-stakeholder interactions

Adapted from EPRI Presentation by Joe Hughes
NIST Standards Workshop
April 26, 2008
Thank You!

Matt Christie
mchristie@trcsolutions.com

Tom Rooney
trooney@trcsolutions.com
Distributed Energy Resources in Markets and System Planning

Environmental Business Council

Eric Winkler, Ph.D.
Distributed Energy Resources

Source: IESO.CA
Value Proposition - Retail, Distribution, Wholesale Markets

Avoided Costs
- Wires and substation infrastructure
- Regional Network service
- Demand Charges
- Capacity Tag
- Energy

Revenue Streams
- Wholesale Market (Energy, Ancillary Service, Capacity)
- Rebates and Incentives
- ITC
Value of NE Wholesale Market Products

Energy Efficiency and Behind-the-Meter Solar Are Reducing Peak Demand Growth

Source: https://www.iso-ne.com/static-assets/documents/2018/03/a3_draft_2018_celt_iso_ne_annual_energy_and_summer_peak_forecast.pdf
Energy Efficiency and Behind-the-Meter Solar Are Flattening Annual Energy Use

Source: https://www.iso-ne.com/static-assets/documents/2018/03/a3_draft_2018_celt_iso_ne_annual_energy_and_summer_peak_forecast.pdf
Impact of Peak Demand Reductions on Bulk Power and Distribution Systems

Reductions in Installed Capacity Requirement for Resource Adequacy

Lower Energy Market Revenues

Lower 90/10 load forecast influencing transmission system upgrades

Potential to improve capacity factor of system (Summer/Winter)

ICR cost allocation to load in area of demand reduction transferring cost to areas with higher demand

Reduce need for distribution system upgrades
Technical and Financial Challenges from Peak Load Reduction

**Bulk Power System**

- Increase transmission import/export constraints creating zones of separation and changes to transfer limits
- Capacity factor changes with corresponding large energy reductions from energy efficiency
- Shift in system peak due to variable generating resources
- Impacts to existing supply and new market entrants

**Distribution System**

- Increased fixed costs due to lower volumetric sales and stranded infrastructure
- Increased costs at distribution level due to more variable load and distributed generation

  - Spur the need for more sophisticated monitoring and controls
  - Investment in technology to handle two way flow of energy with increased penetration of distributed generation
Retail and Wholesale Market Opportunities

Grid Mod
- Time of Use Rates
- Metering Infrastructure defines limits to opportunity
- Cost effective deployment of interval meters expand opportunities for Demand Response

Competitive Auctions with Sponsored Policy Resources (CASPR)
- Continuation of Renewable Technology Resource offer floor price exemption
- Designed as second auction to primary FCA, trading obligations from resources wanting out of market with subsidized policy resources
- Will result in future price suppression with renewable resources occupying existing capacity

Fuel Security
- Response to baseload retirements and winter reliability program
- Limited NG supply in winter
- Questions about effectiveness of capacity market reforms and pay-for-performance
- ISO proposal to develop alternative day-ahead energy market to address challenges with posturing limited fuel generators
Energy Efficiency: Innovation in Technology & Delivery

Ariel Horowitz

Director of Technology Development
Massachusetts Clean Energy Center

Environmental Business Council of New England
MassCEC’s Mission

Grow the state’s clean energy industry while helping to meet the Commonwealth’s clean energy, climate and economic development goals.

INVEST

Invest in programs that increase renewable energy adoption by residents, businesses and communities.

CONNECT

Connect employers, job seekers, students, communities and investors to the clean energy industry.

INNOVATE

Help to spur innovation through infrastructure, funding and technology development support.
How MassCEC Operates

**FUNDING SOURCE**

- **Massachusetts Utility Customers**
- **5 Municipal Lighting Plant Customers**

**$22M annually**

Collected via a surcharge equal to $.29/month for an average residential customer

**CORE ACTIVITIES**

- **Renewable Energy Generation**
- **Investments**
- **Innovation & Industry Support**
- **Wind Technology Testing Center**
- **Marine Commerce Terminal**
MassCEC Innovation Programs

FUNDING OPPORTUNITIES

BUSINESS RESOURCES

INNOVATION SUPPORT TEAM

Supporting innovation at research institutions, startup companies, incubators and business accelerator programs
Agenda

• Why energy efficiency?
• From new technology to incentivized energy conservation measure
• Where are the needs?
Why energy efficiency?
What have we achieved?

The State Energy Efficiency Scorecard

http://aceee.org/state-policy/scorecard
What have we achieved?

Massachusetts - Energy Savings from Energy Efficiency Programs

Savings
Equivalent GHGs (tonnes/yr)

http://www.massavedata.com/Public/PerformanceDetails
How did we get here?

Baseline – “business as usual”

More efficient technology -> saves energy
More expensive than baseline -> requires incentive

Purchased price:

Energy used:

With energy efficiency program and incentives

More efficient technology becomes the baseline -> savings no longer qualify ->
Costs decline

Old measures enter baseline -> new measures and technologies needed!
Where are we going?

Transition from residential lighting toward a bigger emphasis on:

• Enabling fuel-switching and capturing the energy savings
### Where are we going?

Transition from residential lighting toward a bigger emphasis on:
- Reducing peak energy demand

#### Draft 3-year plan from EEAC

<table>
<thead>
<tr>
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<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2019-2021</th>
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<td>Net Lifetime All Fuel</td>
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<td>72,423,717</td>
<td>73,077,284</td>
<td>216,936,178</td>
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<tr>
<td>(MMBTu excluding CHP</td>
<td></td>
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<tr>
<td>and ADR)</td>
<td></td>
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<td>Peak Demand Reduction</td>
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<td>(kW) (excluding fuel</td>
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<tr>
<td>conversions)</td>
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<td>Net lifetime electric</td>
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<td>13,803,754</td>
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<td>Net lifetime gas</td>
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<tr>
<td>(excluding fuel</td>
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<td>conversions)</td>
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<tr>
<td>Total Statewide Budget</td>
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<td>($)</td>
<td></td>
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<tr>
<td>Benefits ($)</td>
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<td>6,968,367,928</td>
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</table>
New technology -> incentivized ECM
QUALIFYING A TECHNOLOGY FOR MASS SAVE® INCENTIVE PROGRAMS

BASIC QUALIFICATIONS: Energy efficiency product, Technology Readiness Level 8+, fully deployable and market-ready

1) INITIAL SCREENING at monthly meetings
2) SECONDARY RESEARCH
   - PA engineers input
   - 3rd party engineers input
   - Applicant presentation

Innovative Technology (new market entrant)
Does it save energy?

MTAC REFERS TO PROGRAM ADMINISTRATORS
- Referral letter sent out to applicant

PROGRAM ADMINISTRATORS INCLUDE:
- Berkshire Gas
- Blackstone Gas Company
- Cape Light Compact
- Columbia Gas
- Eversource Electric & Gas
- Liberty Utilities
- National Grid Electric & Gas
- Unitil

MTAC SAVES ENERGY

SUBMIT TO MASSACHUSETTS TECHNOLOGY ADVISORY COMMITTEE (MTAC) FOR REVIEW
- Technology development team submits application for review by MTAC
  - CL_MTAC@masssave.com
  - Residential_MTAC@masssave.com

UNDERGO REVIEW BY MTAC
- Review to determine if technology saves energy

1) INITIAL SCREENING at monthly meetings
2) SECONDARY RESEARCH
- PA engineers input
- 3rd party engineers input
- Applicant presentation

PA'S TEST COST-EFFECTIVENESS
Using total resource cost (TRC) test

Is it cost effective?

Eligible for incentives

SUBMIT TO MASS SAVE® PROGRAM ADMINISTRATORS (PA) FOR REVIEW
via:
- Individual PA implementation team
- Statewide PA Management Committee

Energy savings calculations defined in TRM or custom engineering analysis

How much energy is saved, and how?
Innovative Technology (new market entrant)

Does it save energy?

Submit to Massachusetts Technology Advisory Committee (MTAC) for review

Technology development team submits application for review by MTAC

CI_MTAC@masssave.com
Residential_MTAC@masssave.com

MTAC refers to program administrators

Referral letter sent out to applicant

☑ Saves energy

Undergo review by MTAC

Review to determine if technology saves energy
INNOVATION IN DELIVERY

**SUBMIT TO MASS SAVE PROGRAM ADMINISTRATORS (PA) FOR REVIEW**

via:
- Individual PA implementation team
- Statewide PA Management Committee

**PA'S TEST COST-EFFECTIVENESS**

*Using total resource cost (TRC) test*

**✔ COST EFFECTIVE**

**COST-EFFECTIVENESS TESTING**

- PA’s use Total Resource Cost test as required by the Green Communities Act.
- Total benefits (including energy and non-energy) must exceed measure cost over a specified number of years.
- PA’s examine the total cost of the resource to the PA and the customer.
- Benefits may include reduced CO₂ emissions, improved quality of life, and others.

**Massachusetts Clean Energy Center**
Where are the needs?
HOW CAN MASSCEC HELP?

Product Development

Testing and Qualification

Case Study

Catalyst Program

InnovateMass Program

DeployMass Program

MTAC
Funding Opportunities from MassCEC

Investment Size

Research & Prototyping

- Catalyst Program
  - Up to $65K Grant
  - ≤14 Grants / Year

Demonstration & Acceleration

- AmplifyMass
  - Project Cost Share
  - Up to $500K Grant

- AccelerateMass
  - $150K Convertible Note
  - ≤5 Awards / Year

- InnovateMass
  - Up to $250K Grant
  - ≤10 Awards / Year

Commercialization & Growth

- Venture Debt
  - $100K - $1M Debt Investment

- Equity Investments
  - ~$500K Equity Investment
  - 1-3 Deals / Year

- DeployMass
  - Project-dependent

Workforce Development Programs

- InnovateMass
  - Up to $250K Grant
  - ≤10 Awards / Year

- Venture Debt
  - $100K - $1M Debt Investment

- Equity Investments
  - ~$500K Equity Investment
  - 1-3 Deals / Year
Where are the needs?

- Measures
  - New technologies
- Delivery
  - New business models
- Data
  - Clean energy research
What have we funded in this space?

- Measures
  - IoT, sensors, and building energy management
  - HVAC efficiency
    - Latent heat control
    - Indoor air scrubbing
  - Process efficiency
    - Industrial drying
    - Wastewater treatment
  - New insulation technologies
  - Lots and lots of energy storage
What have we funded in this space?

• Delivery
  • DER comparison shopping
  • Risk management insurance policies
  • Dynamic electrification
What have we funded in this space?

• Data
  • Distribution system state estimator
  • Automated BEMS data cleaning and categorization
What’s next?

• **Temporal granularity** for ECM
  - Measures targeted for greatest cost-effectiveness, climate impact
  - Requires data on load shapes and avoided costs

• **Gas/electric coordination** on the demand side
  - Measures, practices, and business models targeted at relieving system constraints
  - Requires innovation in measure usage and implementation

• **Interoperability and controls** of building-level energy technologies
  - Measures to enable DERs to operate better together
  - Requires technology development and wide adoption of standards

More sophisticated, more specific, more data-driven
Thank you!

Questions?

Ariel Horowitz – ahorowitz@masscec.com
Utility Programs – Bringing Demand Side Resources into the Mix:
Commercial and Industrial

Roshan Bhatka
Supervisor, Large C/I Efficiency Programs
Eversource Energy

Environmental Business Council of New England
Energy Environment Economy
Commercial & Industrial

- Energy Efficiency
- Eversource 2018 Demonstrations
- Demand/Storage (summer/winter)

EBC Energy Resources Program: Efficiency as a Grid Resource

October 30, 2018
Presenter: Roshan Bhakta, Eversource
Traditional EE – Grid Benefits

- Massachusetts EE Program Funding:
  - Customer surcharge: $0.0025/kWh
  - Forward Capacity Market Payments
  - RGGI & Others

Source: https://www.iso-ne.com/about/key-stats/markets#fcaresults
Summer Peak Days

Loads by Rate Class on an Illustrative Peak Day

Annual System Peak Day, Hour, and Load

<table>
<thead>
<tr>
<th>Peak Date</th>
<th>Hour End</th>
<th>System Peak Load</th>
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<tbody>
<tr>
<td>8/09/2001</td>
<td>15:00</td>
<td>-24,723.332</td>
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<td>8/14/2002</td>
<td>15:00</td>
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<td>8/22/2003</td>
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<td>8/30/2004</td>
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<td>7/27/2005</td>
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<td>06/13/2017</td>
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<tr>
<td>08/29/2018</td>
<td>17:00</td>
<td>-25,528.391</td>
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</table>
**Central Question:** How can we develop strategies and deploy technology to have an impact at three levels of the system - ISO, distribution, customer.

- **Battery Storage**
- **Thermal Storage**
- **Software & Controls**
- **Demand Response**

Integrated energy efficiency and demand reduction approaches remain a priority.
Eversource Demonstration Project – DR Curtailment

Technology: Demand Response solution offered to existing DR customers currently participating in ISO-NE Forward Capacity Market

Target Customers: Large C&I customers with discretionary load to curtail

Customer Benefits: Additional revenue generated from additional DR hours and added ability to manage ICAP tag for next year

Program Offer: Revenue stream from Demand Response program beyond that from the FCM. Summer 2018, Winter 2018/2019, Summer 2019
# Eversource Demonstration Project – Battery Storage

<table>
<thead>
<tr>
<th>Description</th>
<th>Customer sited, behind the meter lithium ion batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Types</td>
<td>Large commercial &amp; big box retail, manufacturing</td>
</tr>
<tr>
<td>Why Test</td>
<td>Technology is market-ready</td>
</tr>
<tr>
<td></td>
<td>Customer excitement</td>
</tr>
</tbody>
</table>

**Pilot Installation:** Large University Campus  
**Technology:** 520 kW Battery Electrical Storage System  
Long-duration lithium ion batteries with EMS  
**Customer Benefits:** Cost effectively reduce summer peak demand, winter price peaks and customer energy cost  
**Company Benefits:** Load Reducer; Protection equipment specified to restrict any export of power; with proper monitoring and control system battery could help alleviate light load conditions caused by solar in the area
Eversource Demonstration Project – Battery Storage

08/27/18
5:00 PM

- Grid: 3200.0 kW
- Total building: 3394.8 kW
- Battery: 194.8 kW

Battery charge: 22.0%
# Eversource Demonstration Project – Thermal Ice Storage

<table>
<thead>
<tr>
<th>Description</th>
<th>Uses HVAC equipment to create ice at night and then draws on that thermal mass during the day to reduce AC peak loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Types</td>
<td>Small and medium commercial customers with 3-20 ton AC units</td>
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<tr>
<td>Why Test</td>
<td>Can boost efficiency of cooling High peak coincidence</td>
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</table>

**Pilot Installation:** Vocational Training Facility

**Technology:** Ice Battery integrated to 2 existing 10 ton Trane HVAC Units

**Benefits:** Customer and Company receive permanent Peak Load Reduction without an impact on cooling capacity
Eversource Demonstration Project – Thermal Ice Storage

- HVAC Compressor Power
  - Stage 1 = On
  - Stage 2 = On

- Ambient Outdoor Air Temperature = 95°F

- Ambient Outdoor Air Temperature = 77°F

- Ice Make Compressor Power = 3.9 kW

- Ice Bear Power = 300 Watts @ 10 tons/hr. cooling

- 2 pm
- 7 pm
Eversource Demonstration Project – Thermal Phase Change

<table>
<thead>
<tr>
<th>Description</th>
<th>PCM absorbs and releases thermal energy in order to maintain a regulated temperature</th>
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</thead>
<tbody>
<tr>
<td>Customer Types</td>
<td>Large commercial and industrial facilities, e.g., warehouses, with cold storage and/or freezers</td>
</tr>
<tr>
<td>Why Test</td>
<td>Innovative, targeted solution Small modular units easily adaptable to various locations</td>
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</tbody>
</table>

Pilot Installation: Large Food Bank

“We need to guarantee that food stays protected as inexpensively as possible, so we can provide at least one meal a day to every person in need in the areas we serve. The Thermal Energy Storage system better enables us to achieve that goal.”
Eversource Demonstration Project – Thermal Phase Change

PEAK DAY LOAD PROFILE

ANNUAL IMPACTS

PROGRAM PERIOD
CONSUMPTION
reduced
75%

PROGRAM PERIOD
PEAK DEMAND
reduced
76%

METRIC TONS OF CO₂
PER YEAR
reduced
17.2

TEMPERATURE LIMITS MAINTAINED
100% of the time

ADDITIONAL GBFB MEALS PROVIDED
10,500 per year
<table>
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<tr>
<th>Initiative</th>
<th>Season</th>
<th>Target Periods</th>
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<tbody>
<tr>
<td>C&amp;I Interruptible</td>
<td>Summer and Winter</td>
<td>Target ICAP and/or 10 of top 20 peak hours</td>
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<tr>
<td></td>
<td></td>
<td>5 events in winter based on electric demand</td>
</tr>
<tr>
<td>C&amp;I Storage Performance – Peak Shaving</td>
<td>Summer and Winter</td>
<td>Target ICAP and/or 10 of top 20 peak hours</td>
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<td>5 events in winter based on electric</td>
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<tr>
<td>C&amp;I Storage Performance – Daily Peaks</td>
<td>Summer and Winter</td>
<td>Target daily peaks</td>
</tr>
<tr>
<td>C&amp;I Custom</td>
<td>Summer and Winter</td>
<td>Custom</td>
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</tbody>
</table>
Eversource envisions developing a portfolio of demand reduction resources, including BTM storage, that can be coordinated and dispatched to achieve operational objectives.
Roshan Bhakta
Supervisor, Energy Efficiency
C&I Implementation
Eversource Energy
978-758-6664
Roshan.bhakta@eversource.com
Utility Programs – Bringing Demand Side Resources into the Mix: Residential

Tom Palma

Manager of Distributed Energy Resources
Planning and Design
Unitil
Residential

- Energy Efficiency
- Demand/Storage (summer/winter)
- Home Energy Management
- Strategic Electrification

**EBC Energy Resources Program:** Efficiency as a Grid Resource

October 30, 2018
Presenter: Tom Palma, Unitil
### Residential Energy Efficiency Program Impacts on Demand

<table>
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<th>Year</th>
<th>Evaluated MW</th>
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<td>2016 Passive</td>
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<td>2017 Passive</td>
<td>84.0</td>
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<td>2018 Passive</td>
<td>77.5</td>
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<td>2021 Passive</td>
<td>47.2</td>
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<td>2021 Active</td>
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* Reduction in lighting savings: LEDs market federal standards
Residential Energy Usage

Energy Usage in the U.S. Residential Sector in 2015

From 1993 to 2009, energy for appliances, electronics, and lighting rose from 24% to 35%.

http://needtoknow.nas.edu/energy/energy-use/home-work/
Appliances included in Programs with Buy Down of Installed Cost

- Room Air Cleaner
- Clothes Washer
- Dehumidifier
- Room Air Conditioner
- Refrigerator
- Electric Clothes Dryer
- Thermostat
- Electric Central Air Conditioning
<table>
<thead>
<tr>
<th>Initiative</th>
<th>Season</th>
<th>Trigger</th>
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<tbody>
<tr>
<td>Residential Direct Load Control – WIFI Tstats for central AC</td>
<td>Summer</td>
<td>Target ICAP and/or 10 of top 20 peak hours</td>
</tr>
<tr>
<td>Residential Battery Storage</td>
<td>Summer/Winter</td>
<td>Target ICAP and/or 10 of top 20 peak hours</td>
</tr>
<tr>
<td>Residential Battery Storage</td>
<td>Summer/Winter</td>
<td>Target daily peak periods</td>
</tr>
</tbody>
</table>
Battery Storage Programs with Buy Down of Installed Cost

- Unitil MA – up to 6 units connected to Solar PV – approved by MA DPU
- Cape Light Compact – up to 1,000 units proposed to MA DPU
- Liberty NH – up to 1,000 units proposed to NH PUC
**Battery Storage**

**Pros**
- Systems are really “cool”
- No maintenance
- Ten year life or more
- Works with Solar PV

**Cons**
- High Cost per system. 13 kWh, 5 kW systems cost between $8,000 and $15,000 installed.
- Challenging value proposition for customers
  - Automatic backup generator
Electric Vehicles and Demand

- MA goal - 300,000 by 2025.
- MA MOR-EV rebate program will lower emissions but will add demand.
- Program Administrators may offer a P4P incentive to mitigate the peak demand impacts.
Programs for Winter Gas Demand

Seasonal Savings Program
WIFI Tstat

Weatherization
Home Energy Management Systems

Grid Opportunities
- Manage peak electricity use from appliances, etc.
- Manage distributed energy resources

Barriers
- Low consumer awareness and expensive.
- Security concerns.
- Device set up and ease-of use may not be ready for the mainstream.
- Difficult to evaluate savings for Program Administrators.

Next Step for Program Administrators
- May add as a measure during 2019 - 2021
Appliances that Could Be Controlled
Beyond Heat Pumps for Demand

- Room Air Cleaner
- Clothes Washer
- Dehumidifier
- Room Air Conditioner
- Refrigerator
- Electric Clothes Dryer
Strategic Electrification

• Use electricity instead of fossil fuels

• Energy supply moves towards 100% renewables with storage
Strategic Electrification: Fossil Fuel Uses

Source: Synapse Energy Economics, based on data from the U.S. Energy Information Administration
Electric Heat and Water Heat buy down incentives in Programs

Cold Climate Mini Split Heat Pump
Cold Climate Central Heat Pump
Heat Pump Water Heater
Strategic Electrification: Pros and Cons

Pros

- Higher efficiency, saves money for end user – caveats
  - Does not save $ converting from Natural Gas to Heat Pumps
  - Check on math of electric vehicles with your electric rates
- Cleaner Air – Less NOx, SOx, Mercury
- Lower CO2e Emissions

Cons

- Potentially creates new or higher summer and winter peaks
- Need Nuclear Power at least for now
- Supply Side Renewables Cost More per kWh
- Need Storage at a high cost – Battery $1.0 to $1.5M per MW
- NIMBY – mainly windfarms and could be large batteries
Questions and Contact Information

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Networking Break
Panel Discussion

Panel Moderator: Matthew Christie, TRC

Panelists:
- Roshan Bhatka, Eversource Energy
- Ariel Horowitz, MassCEC
- Tom Palma, Unitil
- Eric Winkler, Winkler Energy Consulting