MA Leading by Example Council Meeting

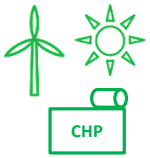
DOER Massachusetts Department of Energy Resources

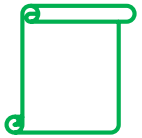
November 12, 2019

Saltonstall Building

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

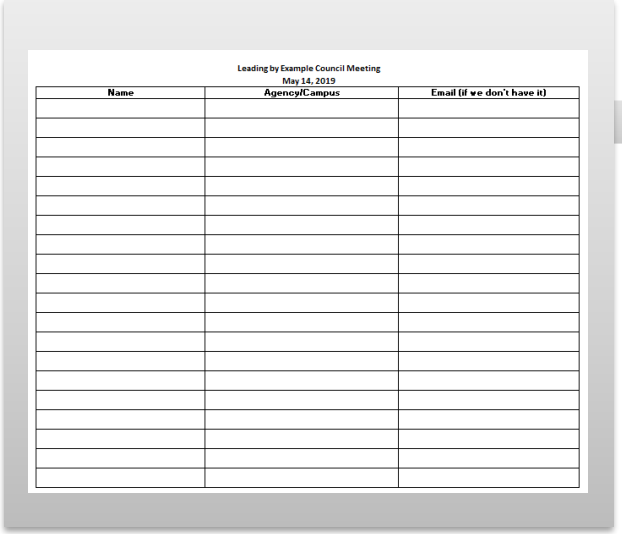
State Government Progress – as of November 2019

Greenhouse Gas (GHG) Emissions	Energy Use Intensity per Square Foot	Electricity via Renewable & Onsite Generation	Heating Oil Consumption at State Facilities
			
↓ 26% 2004 -2018	**↓ 13%** 2004-2018	**19%** In 2018	**↓ 84%** 2006-2018

26.7 MW Installed Solar PV at State Sites	87 LEED Certified State Buildings	148 Electric Vehicle Charging Stations at State Sites	Leading by Example Grants Awarded
			
18.6 MW Since 2015	**50** Since 2015	**84** Since 2015	**$11.3 M** Since 2015

Welcome and Introductions

Share your name and organization



Leading by Example Council Meeting
May 14, 2019

Name	Agency/Campus	Email (if we don't have it)

Please make sure to add yourself to the sign-in sheet when it comes around

“Untold human suffering” will be unavoidable

From Bioscience, 11/5/2019

“On the basis of this obligation and the graphical indicators presented below, we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency….

Especially worrisome are potential irreversible climate tipping points and nature's reinforcing feedbacks (atmospheric, marine, and terrestrial) that could lead to a catastrophic “hothouse Earth,” well beyond the control of humans (Steffen et al. 2018).”

Flooding level shown against a speed limit sign in Finchfield, IA.
Credit Don Becker, USGS

Aerial View from space of the fires that burned in the Amazon earlier this year
Osorioartist/Shutterstock

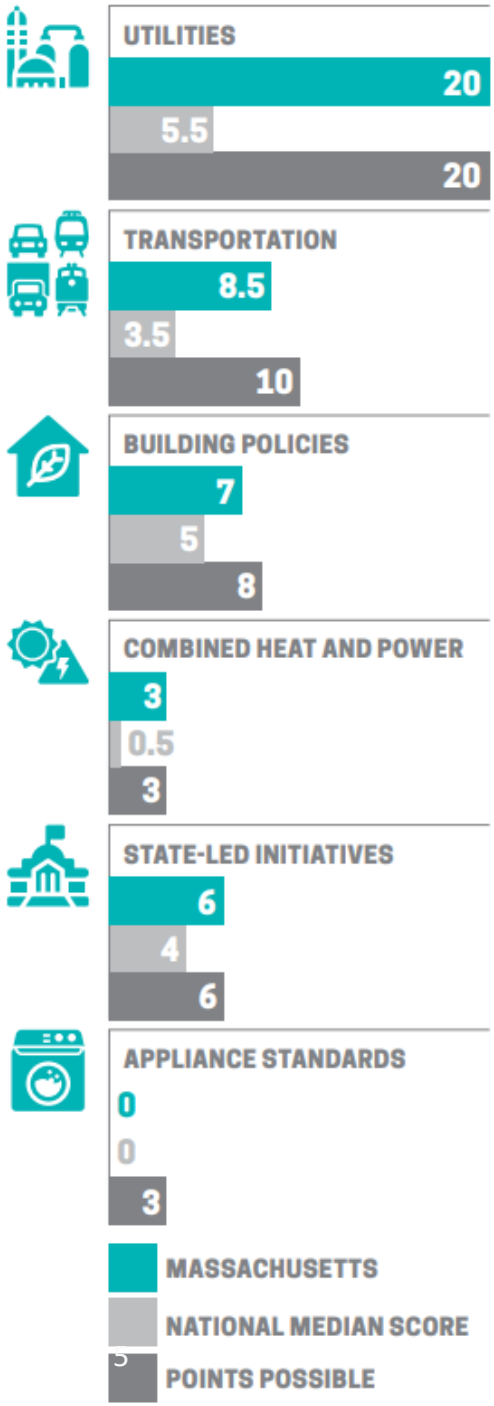
Source: Bioscience

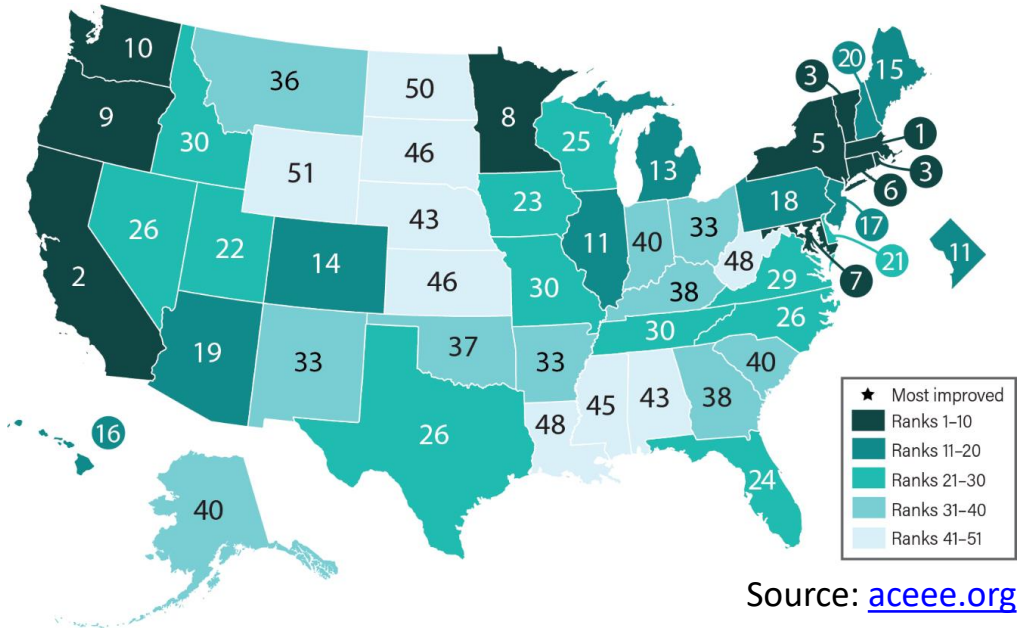
Agenda

- Long-Term Strategic Electrification
  - Policy and Program Landscape
  - Strategic Electrification: Technologies and Applications
  - Innovation and Emerging Solutions
- News and Updates: World, MA, and LBE

MA Leads Country in Energy Efficiency for 9th Year!!!

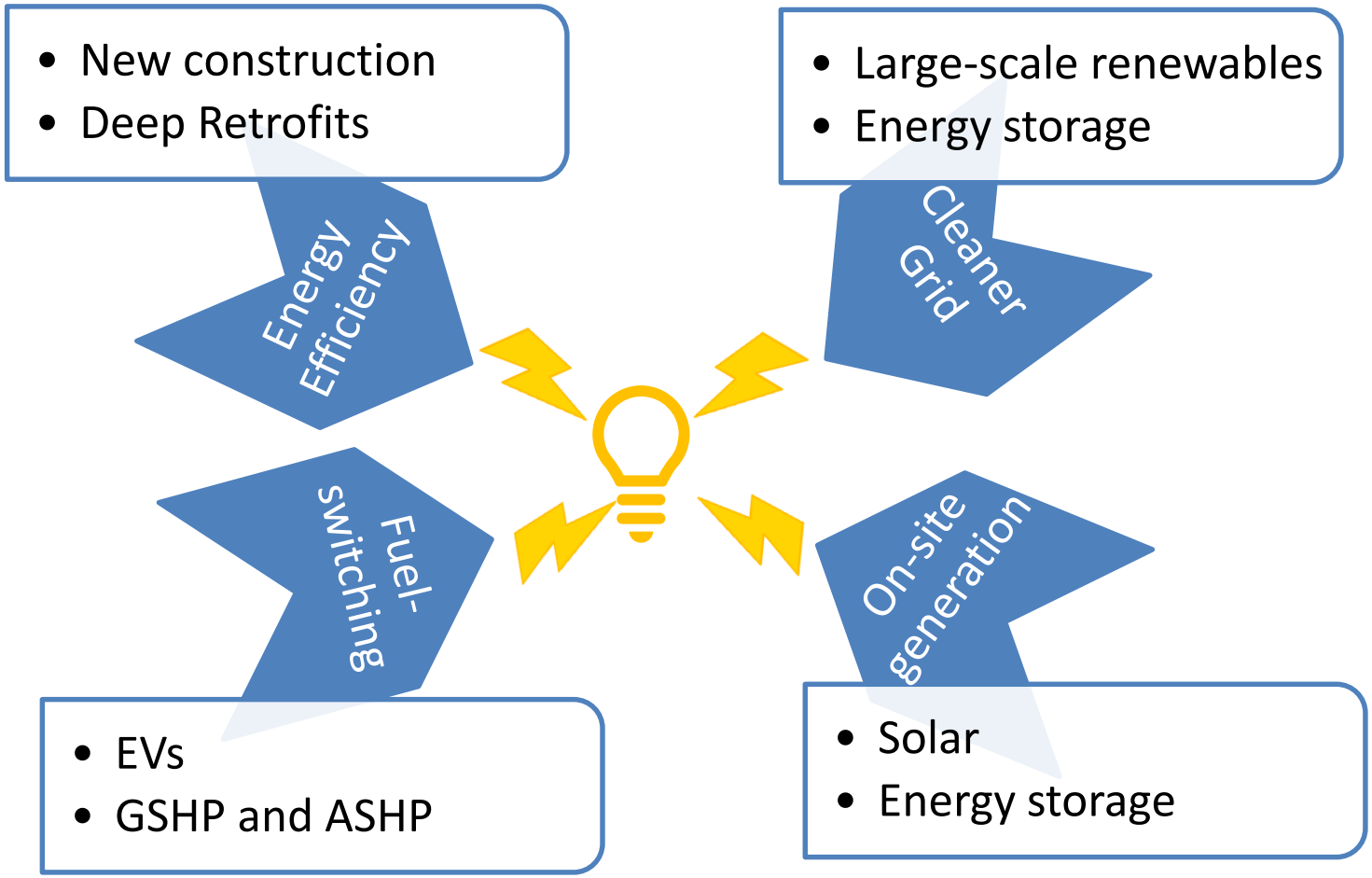
- American Council for an Energy-Efficient Economy's 13th annual report: MA is #1 for 9th consecutive year





Source: aceee.org

Pathway to Strategic Electrification



Creating A Clean, Affordable and Resilient Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

Challenges

- Matching renewables availability with demand
- Limited technical solutions currently
- Upfront Costs vs. long-term benefits
- Higher BTU cost of electricity
- Complexity and cost of retrofitting
- Price signals for dispatchable assets
- Building Operator skills
- Resistance to new technology

Massachusetts Department of Energy Resources

I: Strategic Electrification Policy and Program Landscape

80x50 Study: Roadmap to a Decarbonized MA

Claire Miziolek
80x50 Study Manager
Executive Office of Energy and Environmental Affairs (EEA)

Massachusetts Global Warming Solutions

Agenda

- The W's of the 80x50 Study
  - Who, what, where, when, why (and how!)
- Strategic Electrification 101

Who is doing this?

- The Executive Office of Energy and Environmental Affairs (EEA) is charged with this study.
- EEA is an umbrella agency for:

Massachusetts Department of Agricultural Resources →

Department of Conservation & Recreation →

Department of Fish and Game →

Department of Public Utilities →

Massachusetts Office of Coastal Zone Management →

Massachusetts Environmental Police →

Administrative Council on Toxics Use Reduction →

Advisory Committee to the Administrative Council on Toxics Use Reduction →

Massachusetts Department of Energy Resources →

Massachusetts Department of Environmental Protection →

Massachusetts Environmental Policy Act Office →

Massachusetts Environmental Trust →

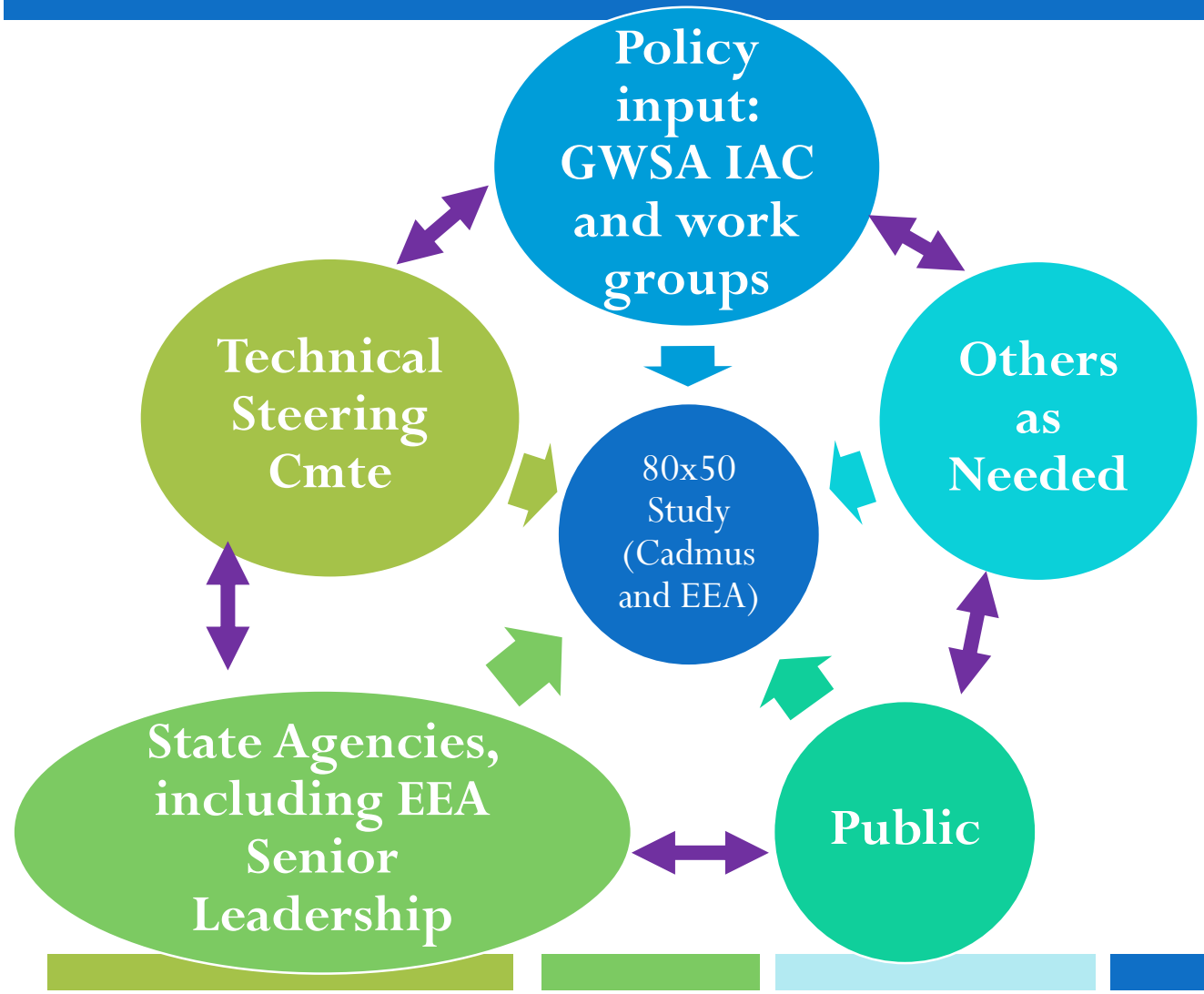
Water Infrastructure Advisory Committee →

Division of Conservation Services →

EEA Office of Grants and Technical Assistance →

Water Resources Commission →

Who else is involved?



What: The "80x50 Study"

- EEA is developing a roadmap to 2050 that will identify the strategies, policies, and implementation pathways for MA to achieve at least 80% GHG reductions by 2050.
- The 2050 Roadmap will also inform the setting of the 2030 emissions limit and the development of the CECP for 2030.
- Analysis supporting the roadmap will examine ways to decarbonize the **buildings**, **transportation**, **electricity**, and **non-energy** sectors; the role the Commonwealth's **natural and working lands** can play in decreasing greenhouse gas emissions; and the impacts of policy implementation, including:
  - Impacts to Environmental Justice (EJ) communities;
  - Economic costs and benefits;
  - Public health impacts;
  - Changes to the landscape; and
  - Co-benefits for climate change resilience.

More information at www.mass.gov/2050Roadmap

Why: The Global Warming Solutions Act (GWSA) [...and science]

- GWSA, signed into law in 2008, sets statutory emissions limits and implementation plans to achieve them:
  - 25% GHG emissions reduction by 2020
    - 2020 Clean Energy and Climate Plan (CECP)
  - At least 80% GHG reduction by 2050
  - To be set: 2030 GHG emissions limit, set by Secretary of EEA in 2020

  Note: reductions are below **1990** emissions levels, and GWSA compliance is benchmarked on ***gross*** emissions, not ***net*** emissions.
- Additionally (MGL Ch. 21N §4(d):
  - The secretary shall evaluate the total potential **costs** and economic and noneconomic **benefits** of various reduction measures to the **economy, environment and public health**, using the best available economic models, emissions estimation techniques and other scientific methods.
- Non-GWSA mandate:
  - Executive Order 569, requiring coordination of GHG mitigation policy with climate change adaptation policy

When: Project Timing

2019	2020

Project kick-off, develop Workplan

Sector **Models** Built and Tested

Initial **Policy** Analysis

Scenario Development

Models, policies, and scenarios analyzed together

Public meetings on findings

Report Writing

Release of 2030 CECP, 2050 Roadmap, and set 2030 limit

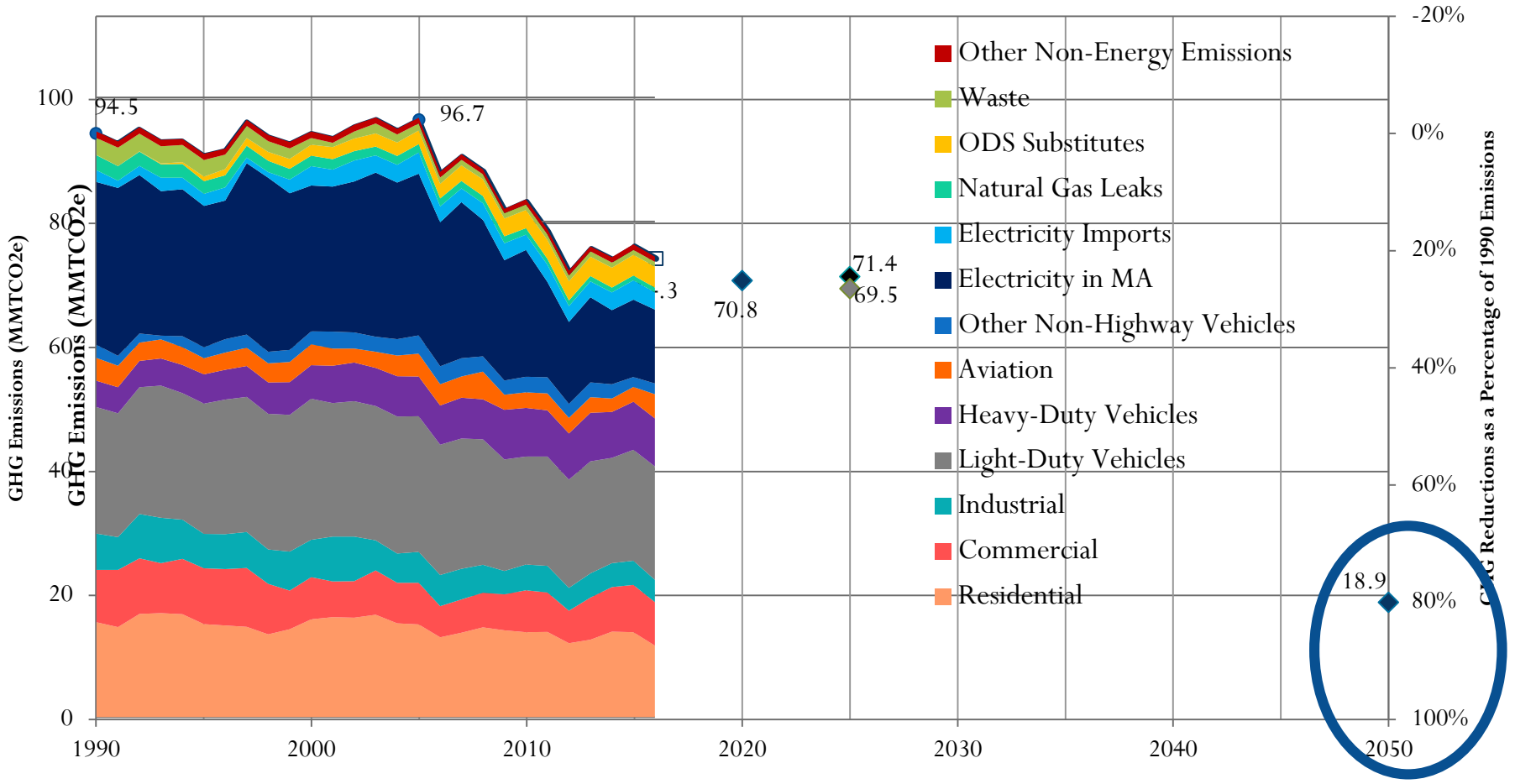
Stakeholder Engagement

Policy Analyses: LBE as example

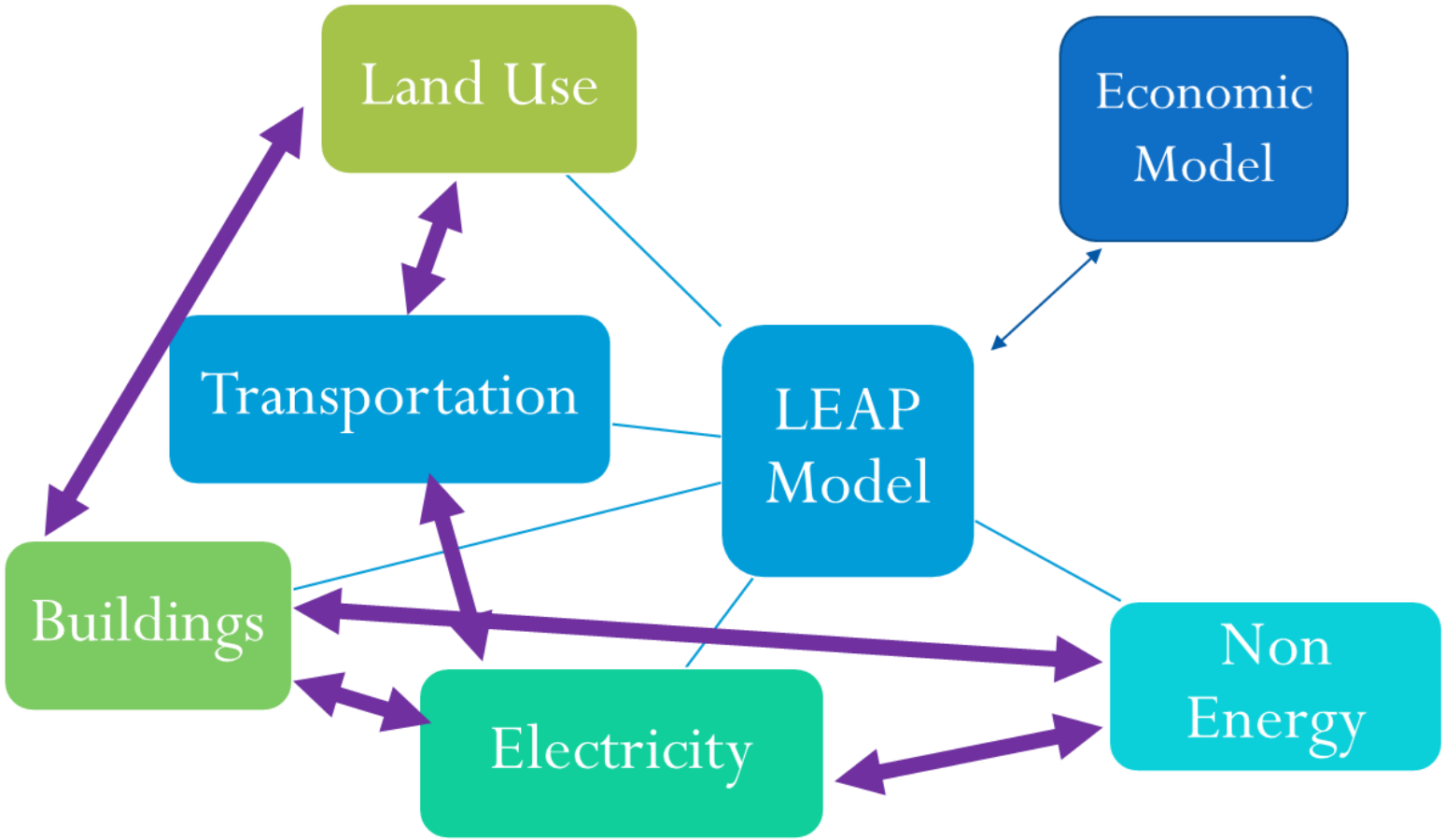
How...

Transformation

MA GHG Emissions (historic) and GWSA and Paris Agreement Targets



First comes the modeling: Figuring out what to expect from these sectors in 2050



Then comes the implementation… Introducing: *Strategic* Electrification

- Source: https://neep.org/initiatives/strategic-electrification

- It's not just using less or producing renewables, but also making sure that the energy operating our economy can take advantage of those renewables.
- Goal: all** electric!

Step-by-step

Dramatically improve the efficiency of energy use

Decarbonize the electric grid through the use of distributed as well as large scale renewable energy sources for electricity generation

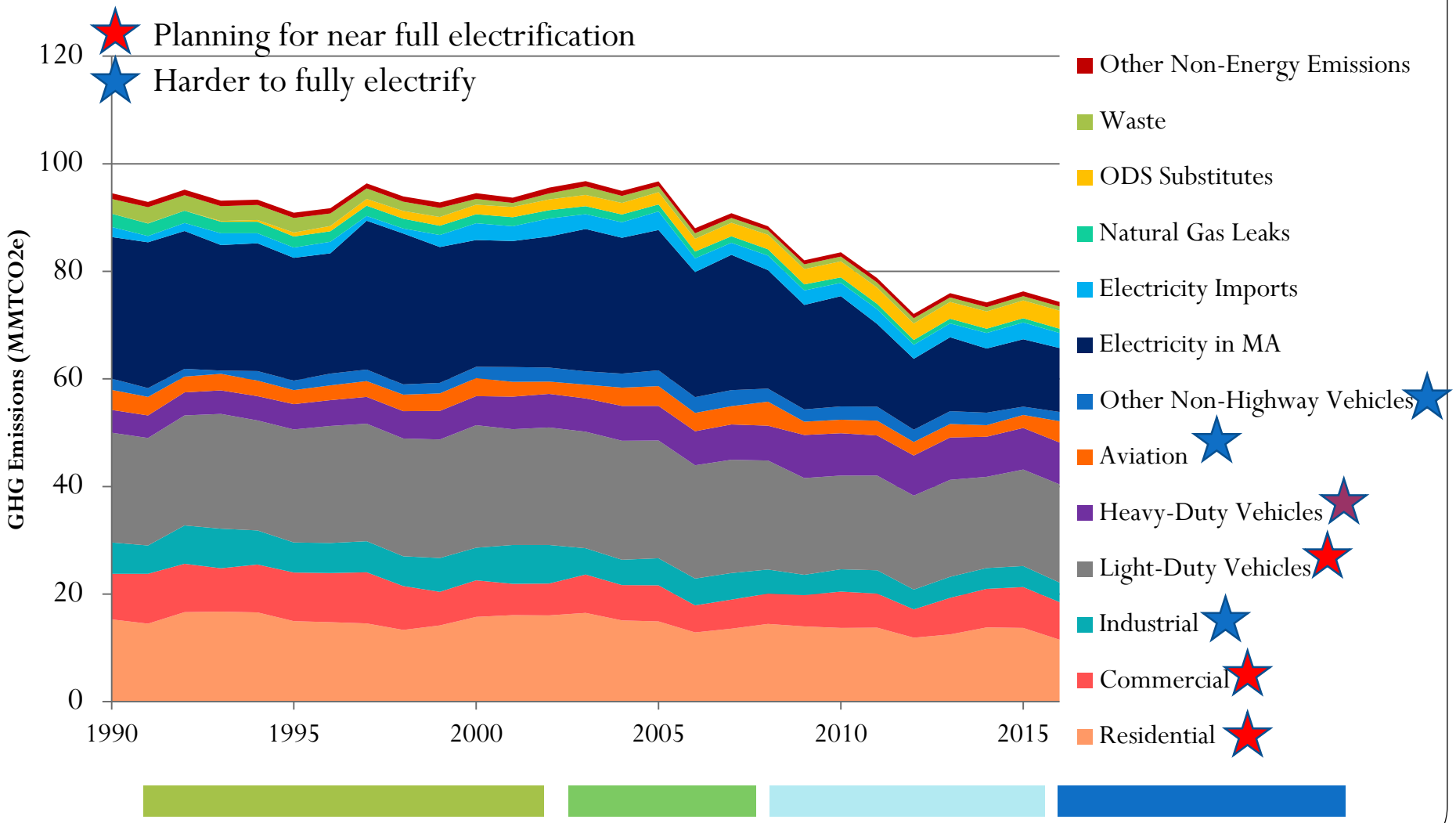
Move as many end uses as possible to renewable electricity

Use lower carbon fuels for remaining needs

- Source: https://neep.org/initiatives/strategic-electrification

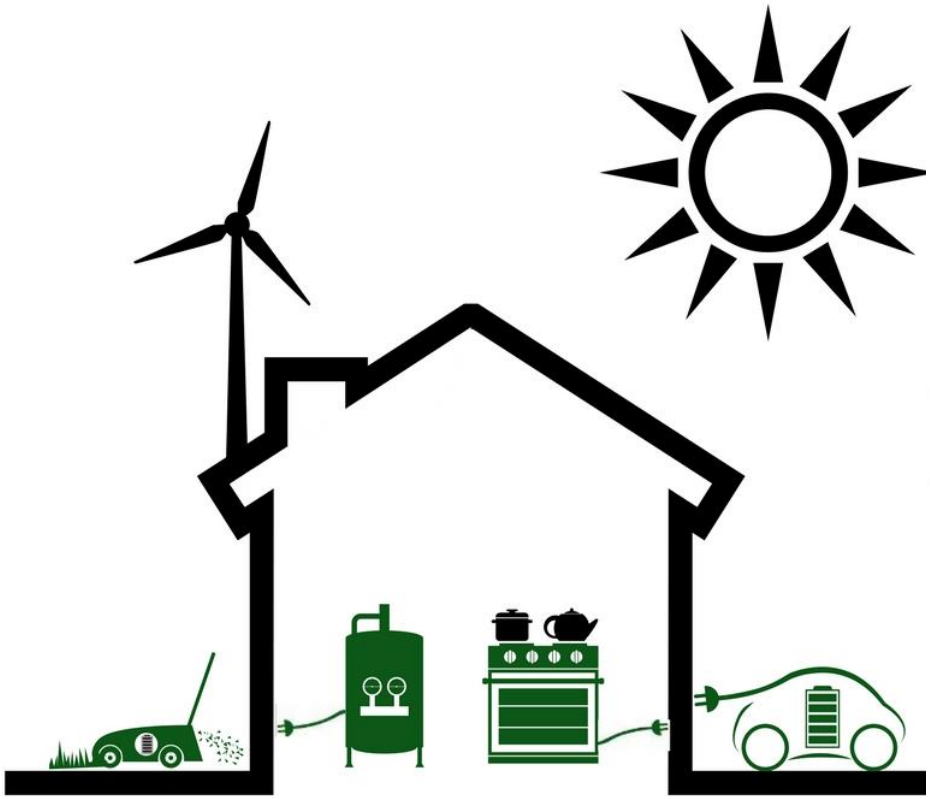
- And then figure out the policy levers to push to make this happen

Back to MA Emissions.
Need to Strategically Electrify:

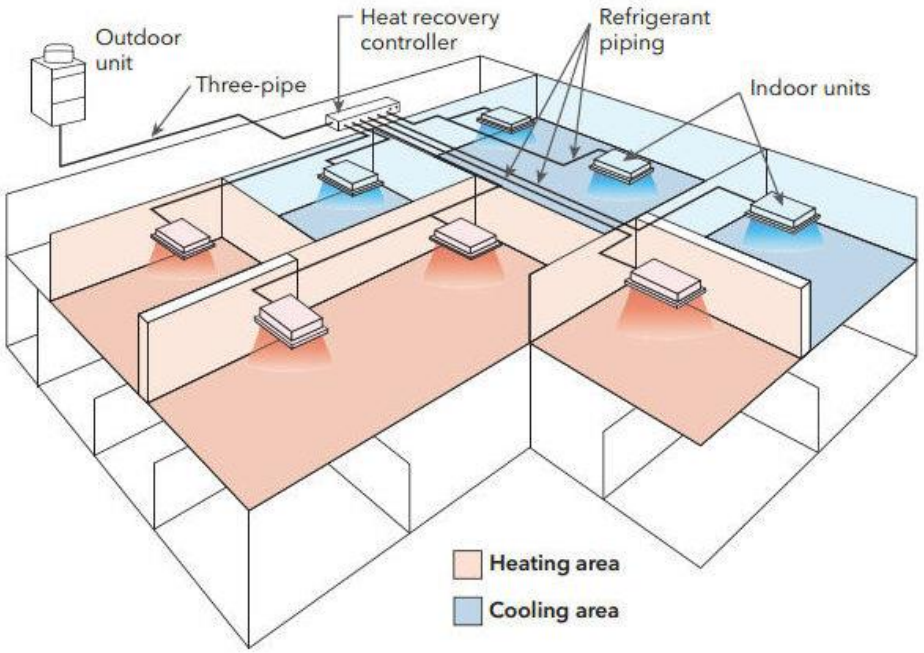


Examples: All electric homes, but also electric HVAC (VRF) for larger buildings

Source: EESI



Source: Seventhwave



Questions?

- Strategic electrification in the next frontier of change needed to decarbonize MA's economy.
- LBE Facilities can help lead the way!

- More information: www.mass.gov/2050Roadmap

Thank you!

Claire Miziolek

80x50 Study Manager

Executive Office of Energy and Environmental Affairs (EEA)

Claire.Miziolek@mass.gov

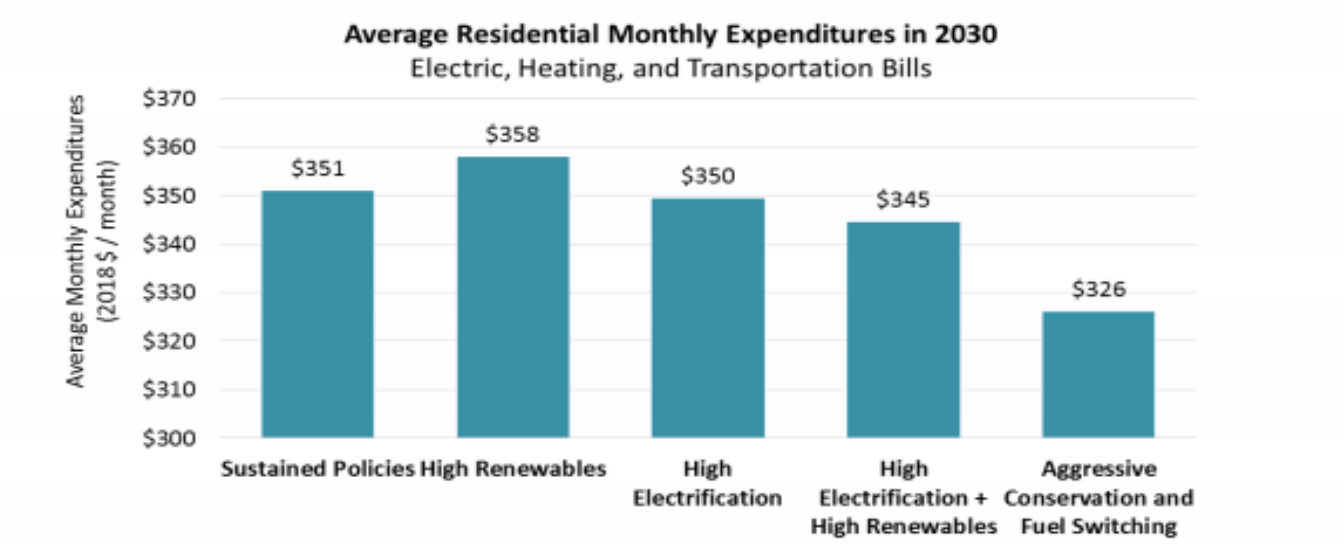
617-626-1193

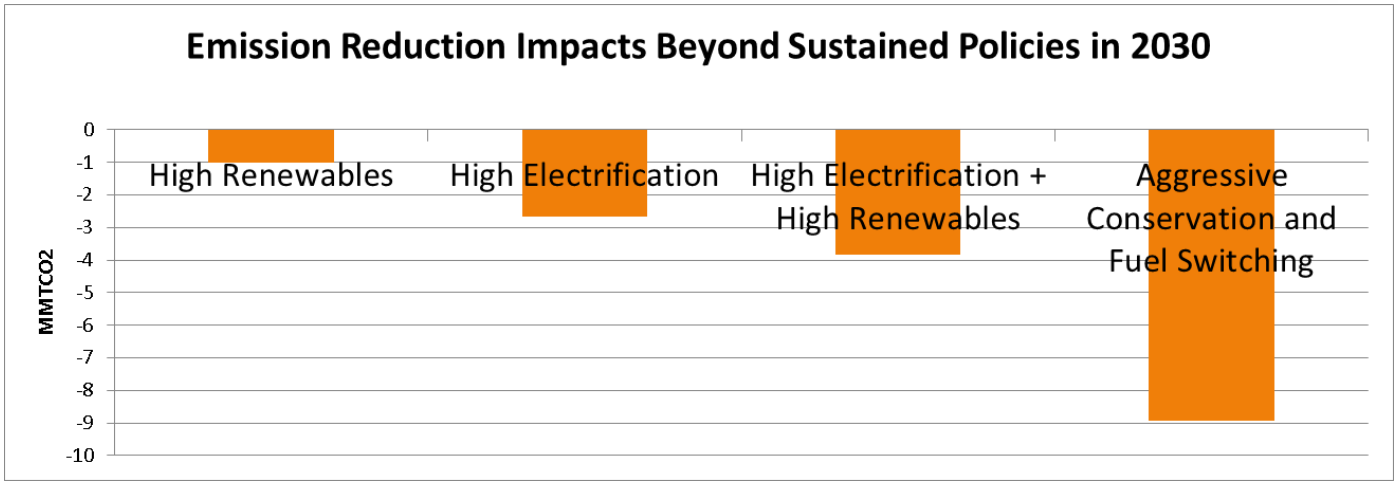
www.mass.gov/2050Roadmap

MA Policies and Programs

Joanne Morin
Deputy Commissioner, Department of Energy Resources

CEP Findings:
Impact on Emissions and Rates





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

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
    - Mayflower Wind 804 MW Selected
  - DOER recommended another 1600 MW of offshore wind

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

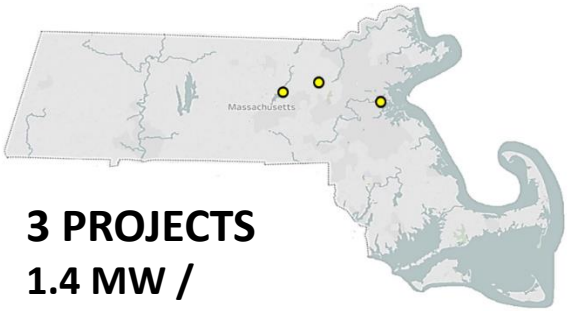
Alternative Energy Portfolio Standard

- Requires a certain percentage of the state's electric load to be met by eligible technologies:
  - Combined Heat and Power
  - Flywheel storage
  - **Renewable thermal energy**
    - **Biomass, Biofuel, Biogas**
    - **Solar**
    - **Heat pumps (air and ground source)**
  - Fuel cells
  - Waste-to-Energy thermal

PEAK DEMAND: ENERGY STORAGE

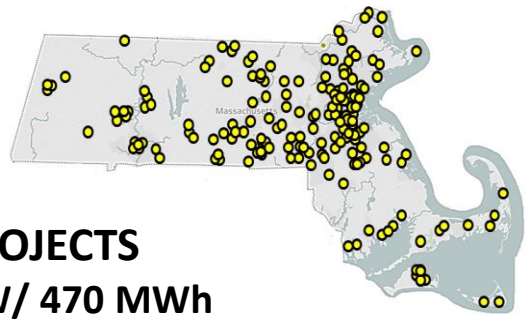
- **Energy Storage Initiative**
  - 2016 State of Charge Study
  - $20M Advancing Commonwealth Energy Storage (ACES) Grant
  - 26 projects for 32 MW / 85 MWh

2015



3 PROJECTS
1.4 MW /
0.45MWh

2019

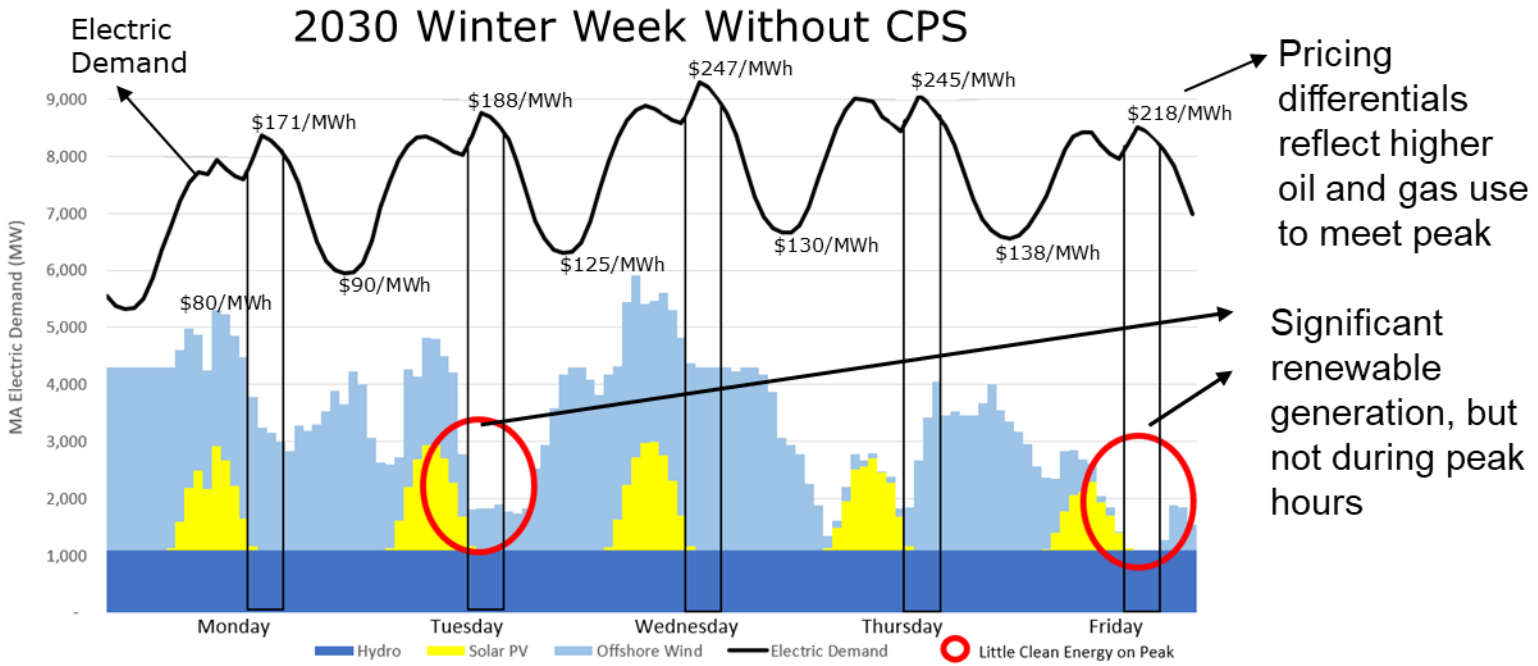


232 PROJECTS
190 MW/ 470 MWh
(operating & in development)

STATUS QUO CHALLENGE TO RESOLVE

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

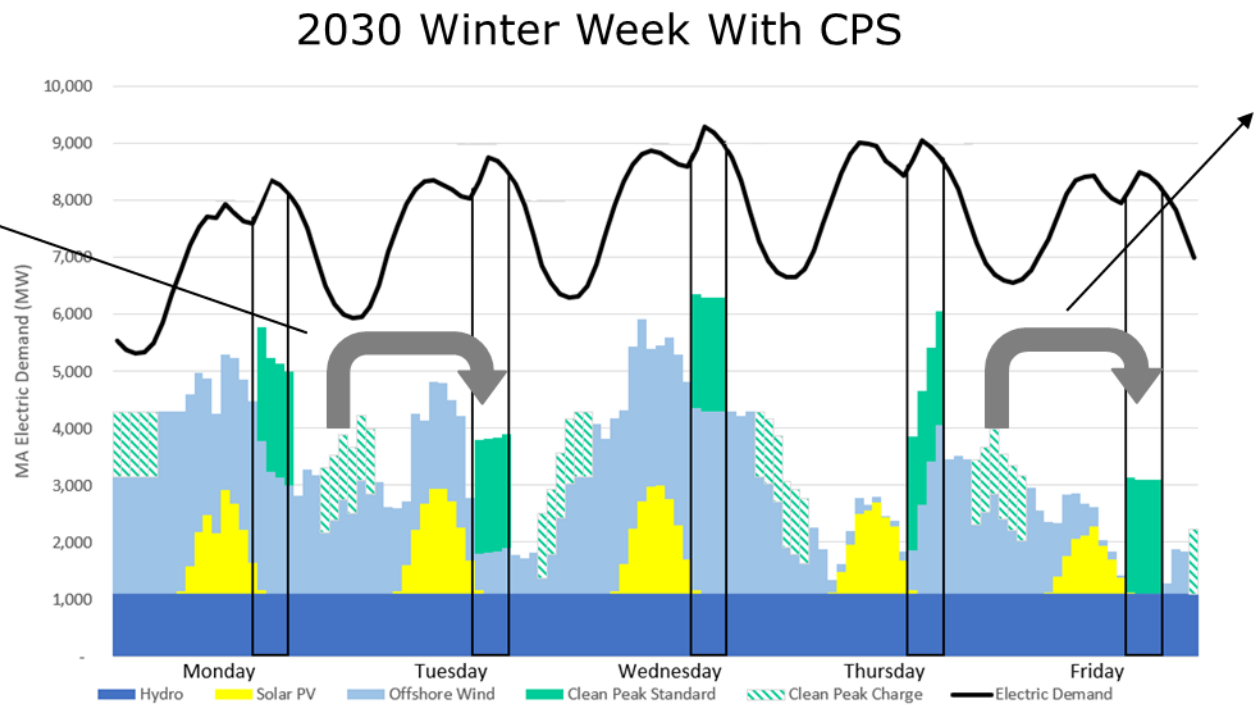


Production profile for 1,090 MW Hydro, 3,200 MW Offshore Wind, 5,000 MW Solar PV

Clean Peak As a Solution

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

Opportunity to shift clean energy to peak periods through storage



CPS shifted wind energy generated overnight when prices and demand are lower to evening peak when demand is high

Production profile for 1,090 MW Hydro, 3,200 MW Offshore Wind, 5,000 MW Solar PV

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

MA Energy Code Update

Ian Finlayson
Deputy Director, Energy Efficiency Division

MA Base energy code - amended IECC2018 – starting in 2021

MA Stretch energy code update – under development

MA Residential Energy Code: HERS & Passive-house updates

HERS path encourages electrification via trade-offs:

- HERS 55 or
- HERS 60 with heat-pump space heating
- HERS 60 with solar PV
- HERS 65 with heat-pumps and solar PV

Passive-house path indirectly promotes electric HVAC

- Mass Save incentives of $3,000 per unit
- Electrified space heating typically most cost-effective given low heating/cooling load requirements
- Heat or energy recovery ventilation required

MA Commercial Base-code & Electrification

- C406: Pick 3 out of 10 options
  - New option for cold-climate heat pumps / VRF
- EV Readiness
  - 1 charging point in new parking with 15+ spaces
- Solar Readiness (IECC appendix CA)
  - Requirement increases from 3-story to 5-stories or less

What about 'Net Zero' codes?

Massachusetts: BBRS on stretch code update

- Energy Advisory Committee looking at 'net zero' option
- AIA 'zero code' proposal submitted in November

National: IECC 2021 (MA base code in 2024?)

- Residential HERS 0 appendix
- Commercial AIA 'zero code' appendix

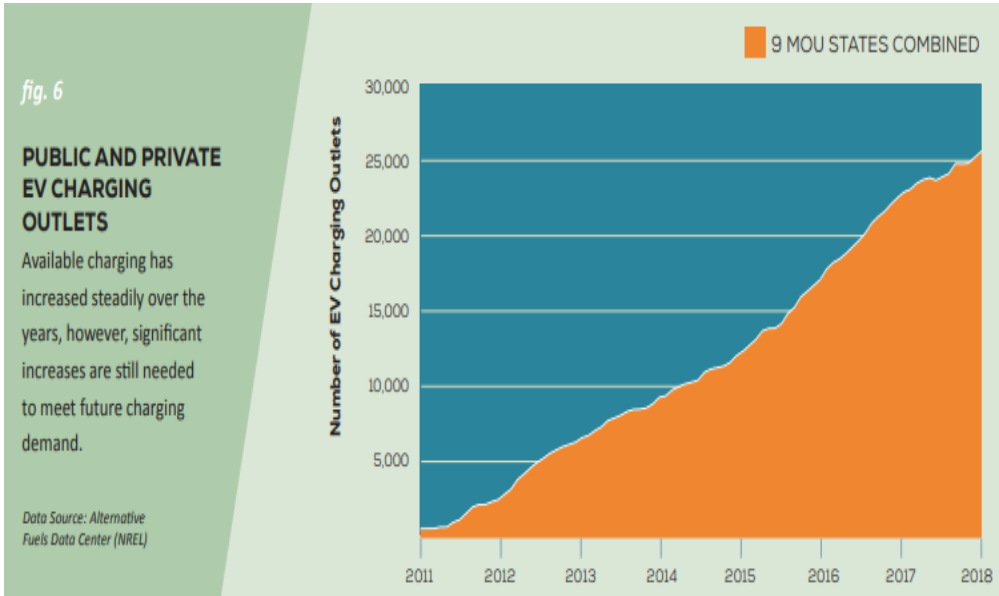
New ICC committee: Zero Carbon Code

- Net Zero emissions – during operation
- Low Embodied carbon – in construction materials

DOER
Massachusetts Department of Energy Resources

ELECTRIC VEHICLE PROGRAMS

- Multi state EV goal - 300,000 EVs on road by 2025 (up from 18,000) in MA
- 2018 ZEV Action Plan adopted by 9 states: education, infrastructure, incentives, fleets and collaboration with dealers
- 2018 Commission on the Future of Transportation in the Commonwealth report -- *Substantially reduce greenhouse gas (GHG) emissions from transportation sector in order to meet Commonwealth's Global Warming Solutions Act (GWSA) commitments*
- $60 million utility program approved to fund 100% of applicable EVSE infrastructure upgrades and some equipment incentives
- Targeting 3500+ stations



Energy Efficiency Opportunities for Massachusetts Businesses, Institutions, and Municipalities

Overview & Pathways

Presenters

Amit Kulkarni – Eversource Energy
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Margaret Song – Cape Light Compact
C&I Program Manager
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Peter Klint – Eversource Energy
Program Manager, Emerging Technology, Energy Efficiency
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Agenda

- What we do and why we do it
- How engage with customers
  - Pathways to save energy
- Common measures and examples
- Other clean energy initiatives

Why we “do” energy efficiency

Reduced energy & supply costs

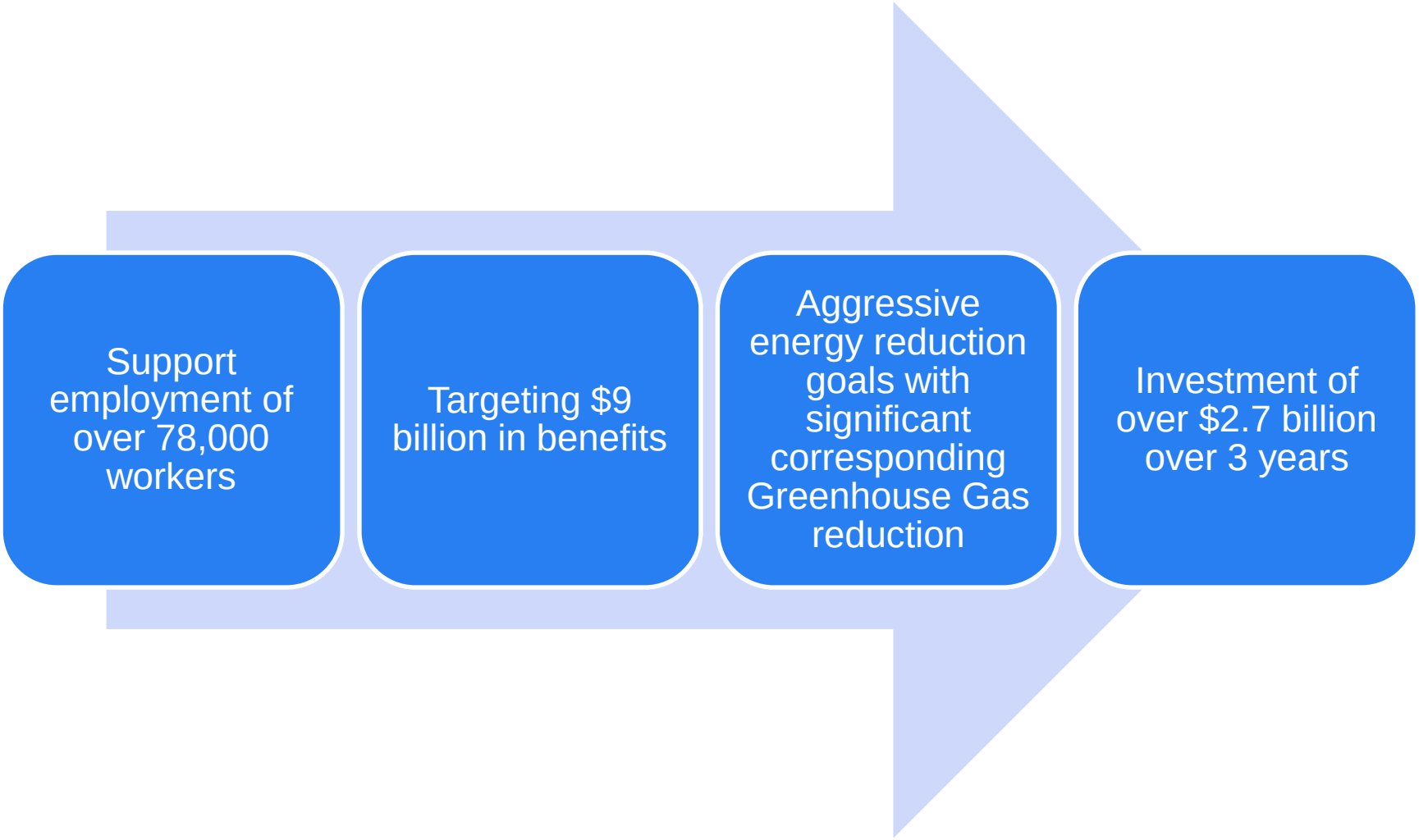
Lower O&M costs

Improved operations, comfort, and performance

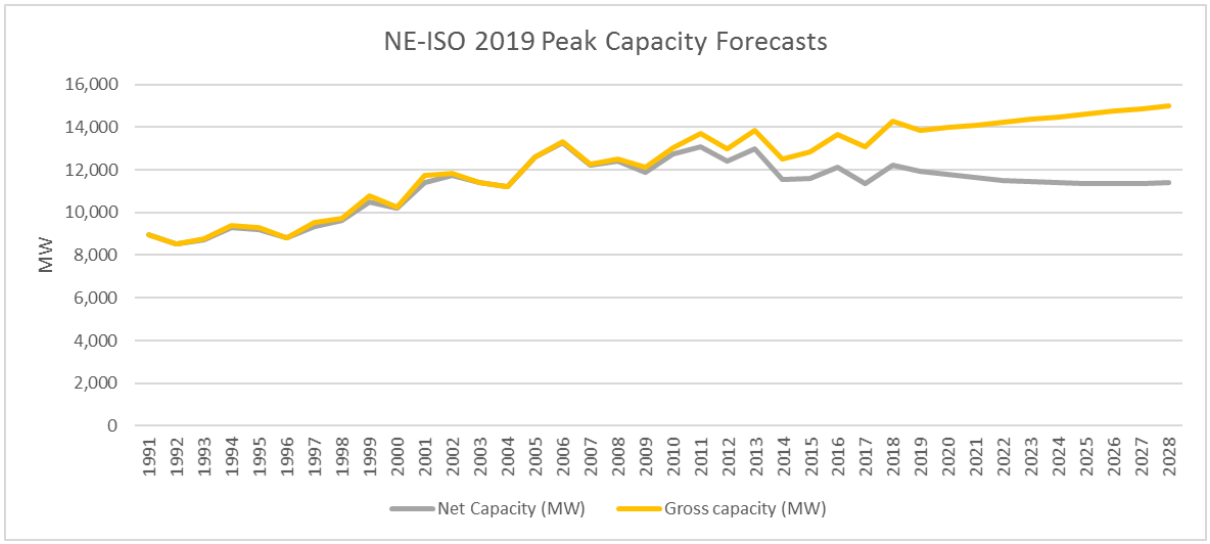
Economic benefits

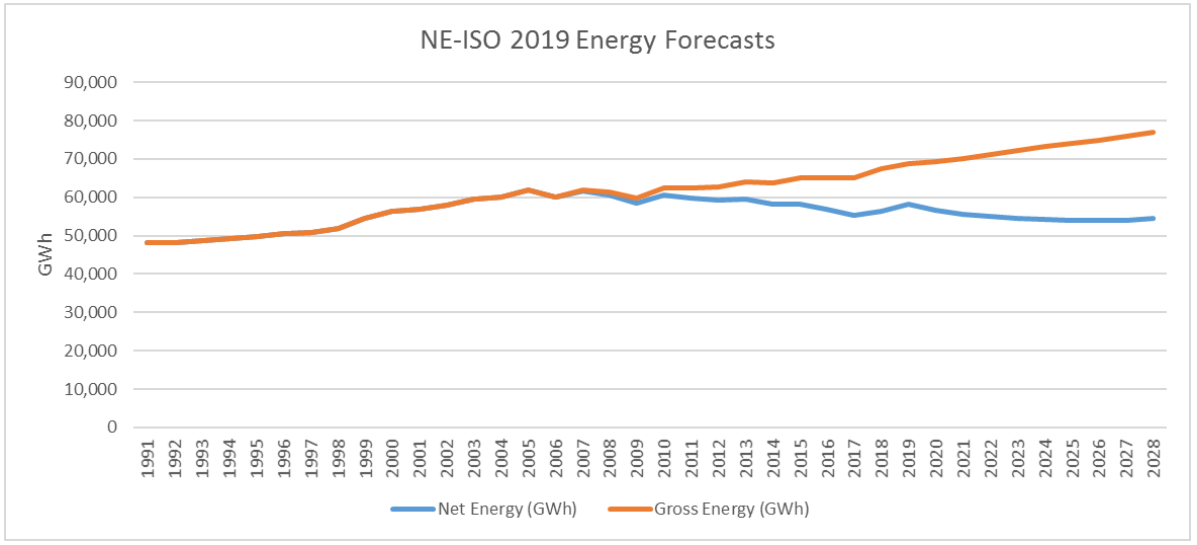
Improved system reliability

2019-2021 3YP- Overall Highlights



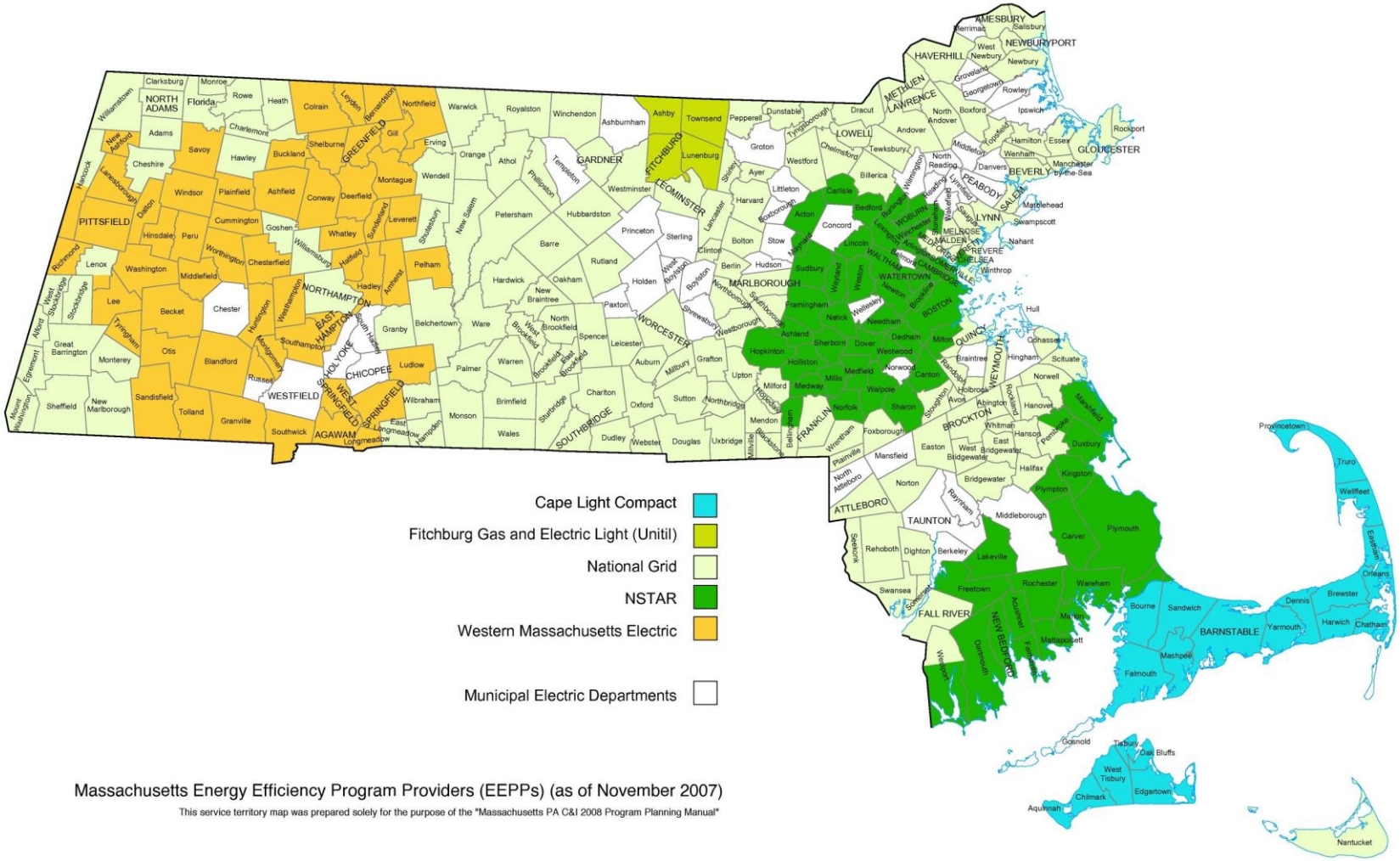
Cumulative impacts on energy & demand





Source: NE-ISO 2019 data forecast

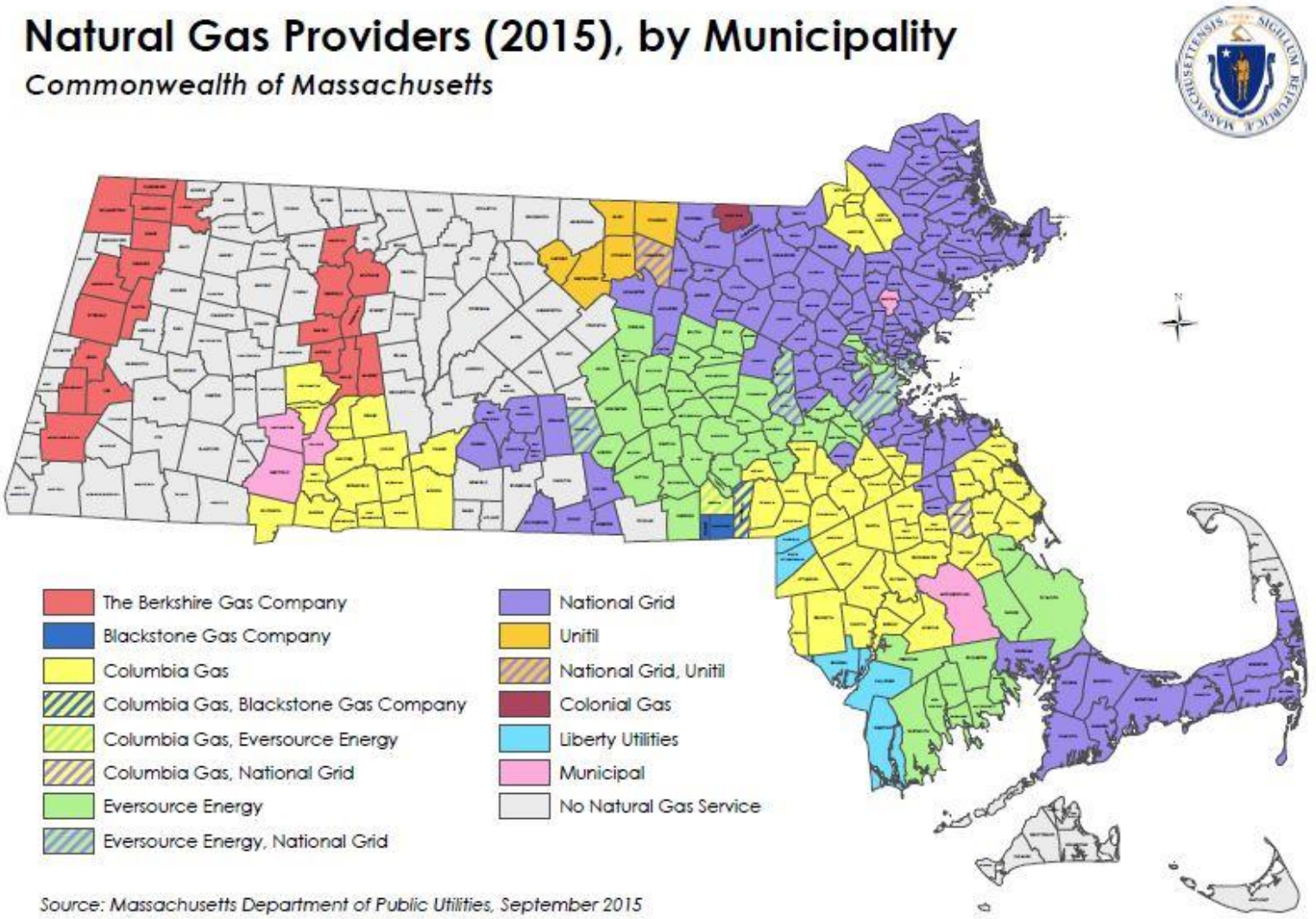
Massachusetts Program Administrators map (electric)



Massachusetts Energy Efficiency Program Providers (EEPPs) (as of November 2007)

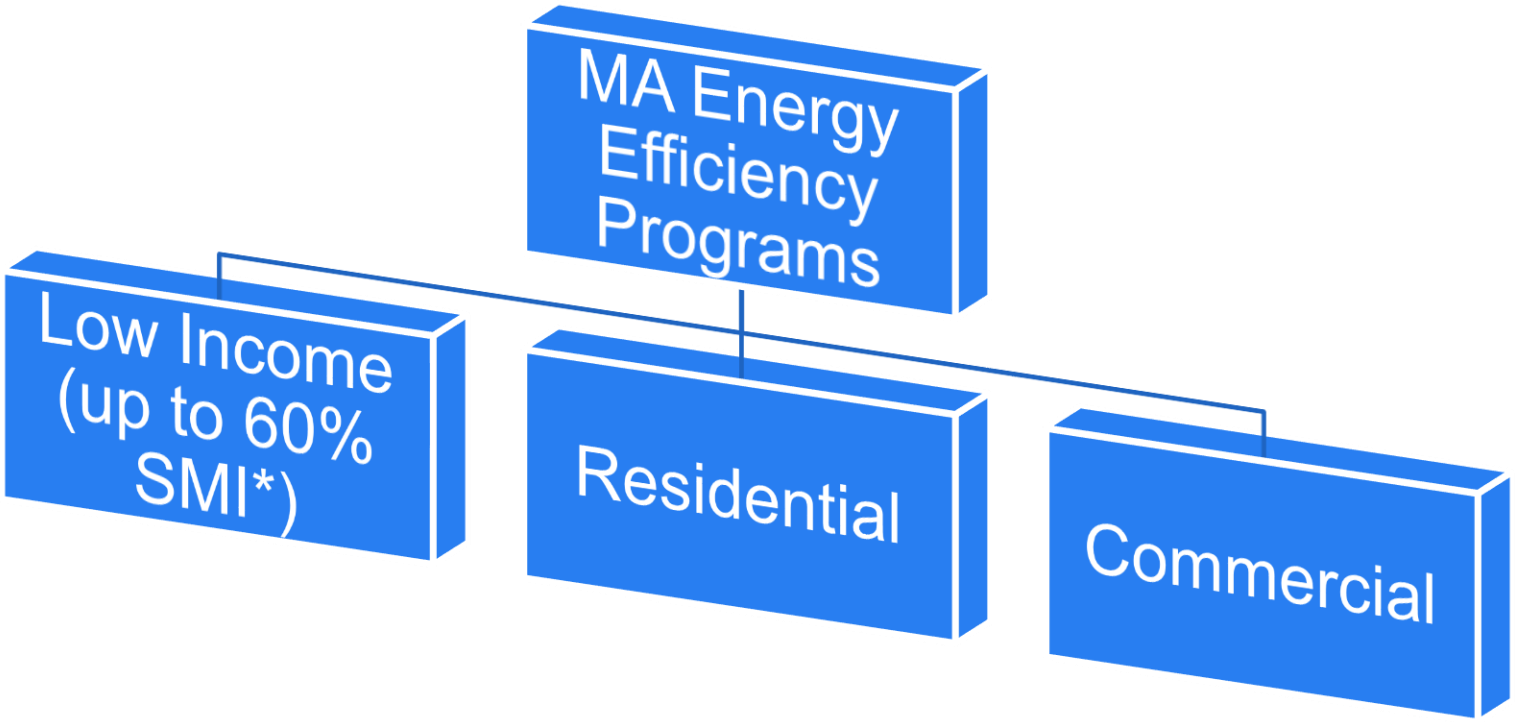
This service territory map was prepared solely for the purpose of the "Massachusetts PA C&I 2008 Program Planning Manual"

Massachusetts Program Administrators map (gas)



Program Structure

Overview



* SMI = state median income

C&I EXISTING BUILDINGS

Existing Building Retrofit

Customer considering retrofitting facility and/or pursuing energy savings

Customer offered varied financial incentives and resources

Small Customers

Turnkey Delivery Path for small business customers

Large Customers

Managed Account Approach offered to medium and large C&I

Customer provided expert technical assistance to identify opportunities

Customer Directed Option for customers with a preferred vendor

Largest C&I customers use MOU to facilitate longer-term energy efficient projects

New and Replacement Equipment

Customer replacing or expanding facility equipment

Upstream Channel

PA provide incentives directly to distributors and manufacturers

Customer receives significant reductions in cost for equipment

Downstream Channel

Customer utilizes Mass Save Application Portal ("MAP") to apply for incentives

C&I Active Demand Reduction

Customers may use any technology or strategy at their disposal

Customers agree to respond to an event call targeting conditions that typically result in system peak

Event called the day before curtailment is needed

Customer incentivized based on the performance of their curtailment

mass save

C&I NEW BUILDINGS & MAJOR RENOVATIONS

Whole Buildings Approach

BUILDINGS 20,000-100,000 sq ft

BUILDINGS 100,000+ sq ft

Developer, Design Team, and PA connect early on a project

Charette with design team and customer to understand customer goals

Technical assistance vendor models baseline and as designed

Construct building

Comission building

Systems Approach

BUILDINGS/MAJOR RENOVATIONS

New construction or major renovation project

Customer uses vendor of their choice

For custom application: Customer develops project with Technical Assistance

Project installed

Savings and project documentation submitted to program adminstrators for incentive payment

mass save

Common commercial energy efficiency end-uses

Lighting systems and controls

HVAC

- Boilers , furnaces, water heaters
- Chillers & air conditioners
- Controls / EMS installations

Variable frequency drives (VFD / VSD)

- Usually for more complex HVAC systems (pumps and fans)

Kitchen equipment

Retro-commissioning

CHP / fuel cells

Massachusetts Application Portal

mass save

mass save
Savings through energy efficiency

BERKSHIRE GAS

BLACKSTONE GAS COMPANY

Cape Light Compact

EVERSOURCE

Liberty Utilities

nationalgrid

Unitil

Welcome to the Mass Save Application Portal

The Mass Save Application Portal (MAP) is designed to help you understand what energy efficiency opportunities are available from the Sponsors (Program Administrators) of Mass Save* and enables you to create and submit Applications for financial incentives or services in support of your energy efficiency projects in Massachusetts. This new Portal greatly simplifies the process of creating and submitting applications by combining all offers and estimated incentive amounts in a single, simple to use, online system.

Business Incentives

GET STARTED

To work directly with your Program Administrator, contact information is available by clicking on the provider logo at the top of this page or click on any of the following to explore other opportunities.

Distributor Offers | Facility Assessments | Whole Building Models | Multi Family | Residential Rebates

** Mass Save® is a collaborative of Massachusetts' natural gas and electric utilities and energy efficiency service providers, including Berkshire Gas, Blackstone Gas Company, Cape Light Compact, Columbia Gas of Massachusetts, Eversource, Liberty Utilities, National Grid and Unitil. We empower residents, businesses, and communities to make energy efficient upgrades by offering a wide range of services, rebates, incentives, trainings, and information.*

Lighting Application Example

Lighting Systems & Sensors – Eligibility Requirements and Incentive Details

The following table lists the incentives available for energy efficient lighting improvements. Facility lighting must average a minimum of 2,000 hours per year.

- Projects requesting incentive consideration for lighting fixtures and controls must document MA Code compliance. The incentives outlined in the table below are limited to facilities 20,000 sqft. or less.
- Equipment that has received an incentive at the distributor level through the "Bright Opportunities" Upstream Lighting Program or through any other offering of the Massachusetts Program Administrators is not eligible for the incentives on this application.

DesignLights Consortium (DLC) qualified LED products list and technical requirements can be found at: www.designlights.org. Fixture Types that are not defined by the categories below or not included in the current Design Lights Consortium — Technical Requirements Table V4.4 may be eligible for incentives under a Custom application. Contact your Program Administrator for more details.

Table 1A: Lighting Systems Eligibility and Incentive Levels (Complete Table 1C for Lighting System Installations)

Product Code	Measure Description	Per Fixture Incentive		Eligibility Criteria	Image
		DLC Standard	DLC Premium		
Table 1A1: Commercial Interior Fixture Options					
88A	LED Interior Troffer: 1x4, and 2x2 Fixtures	**$30**	**$40**	LED Interior Surface or Recessed 1x4, and 2x2 Fixtures. Eligible fixtures are required to be listed by the Design Lights Consortium and must meet DLC Technical Requirements: #7 Only one incentive per 2x2 fixture or 4ft fixture length. ***Not eligible if distributor-level incentives have been received.***	
88B	LED Interior Troffer: 2x4 Fixtures	**$40**	**$50**	LED Interior Surface or Recessed 2x4 Fixtures. Eligible fixtures are required to be listed by the Design Lights Consortium and must meet DLC Technical Requirements: #7. ***Not eligible if distributor-level incentives have been received.***	
88C	Adaptive LED Interior Troffer: 1x4, 2x2, 2x4 Fixtures compatible with integral occupancy, photocell sensors and network controls, **measure code 63A**	**$45**	**$55**	Smart LED Interior Fixtures with integral occupancy, photocell sensors and network controls that are wirelessly configurable and adapt to use patterns. These systems require a remote control or a phone app to initialize, configure and commission., Must fill out table 1C & 1D. Eligible fixtures must meet DLC Technical Requirements: #7. ***Not eligible if distributor-level incentives have been received.***	
89	LED Linear Ambient: Direct or with Indirect Components	**$40**	**$50**	LED Linear Ambient: Direct or with Indirect Components. Eligible fixtures are required to be listed by the Design Lights Consortium and must meet DLC Technical Requirements: #8	
91	LED Interior Directional: Wall Wash/Wall Grazing Fixture	**$30**	**$40**	LED Linear Ambient Wallwash/Wall Grazing Fixture, surface or recessed mounted. Eligible fixtures are required to be listed by the Design Lights Consortium or must meet DLC Technical Requirements: #5	
84	LED Track or Mono-Point Directional Fixtures	**$15**	**$25**	Integral LED track fixtures, replacement LED lamps are not eligible. Eligible fixtures are required to be listed by Design Lights Consortium and must meet DLC Technical Requirements: #5	
80B	LED Down Light Fixtures – Hard Wired or GU-24 base (≥25W-49W)	**$40**	**n/a**	Eligible LED Down Lights are required to be hardwired or GU-24 base fixtures greater than or equal to 25 watts* up to a maximum of 49 watts and listed as a Commercial LED product by Energy Star. (for more information see www.energystar.gov) * *For Down Light fixtures less than 25 watts, visit our website http://www.masssave.com/en/professionals/incentives/upstream-lighting*	

Lighting Application Example

Table 1C: New Construction Lighting Systems Inventory Worksheet

Building and Room Identification (Installation Site): _____

		Proposed Fixtures							
	Location	Product Code (Table 1A)	Qty	Fixture Description	DLC Premium or Standard	Proposed Watts per Fixture/Device	*Annual Operating Hours	Unit Incentive $	Total Incentive $
Ex.	Lobby-East Entrance	88A	4	LED Interior 2x2 Fixture	Standard	35	3,200	$30	$120
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
If necessary, use embedded Excel file to document additional inventory.				Open File				Total Requested Incentive (this page):	

NOTE: An electronic version (Excel) of this sheet must be submitted for inventories exceeding this page.

* Facility lighting must average a minimum of 2,000 hours per year, except Municipal Facilities who must contact their Program Administrator for more information on eligibility requirements.

Engagement & resources

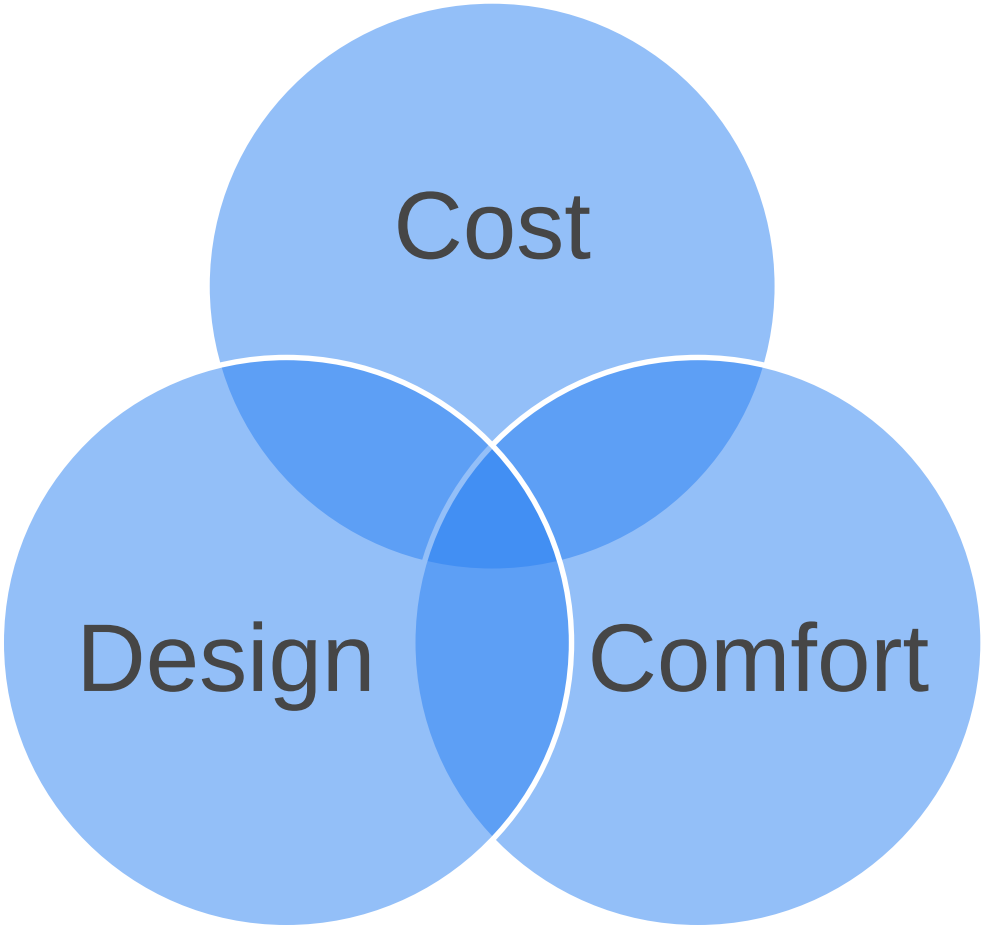
- Mass Save website
  - www.masssave.com
- Mass Save Application Portal (MAP)
  - https://www.masssaveapplicationportal.com/mapstart
- Energy Efficiency Offerings & Incentives (pdf quick-reference)
  - https://www.masssaveapplicationportal.com/resource/1560378049000/BusinessIncentives
- Mass Save Data
  - https://www.masssavedata.com/public/home

Other Initiatives & Clean Energy Solutions

Energy Optimization

- Optimize energy use without focus fuel type
- Strategic electrification with focus on oil and propane heat to heat pumps
  - First approach – Custom analysis
  - In development – prescriptive rebates and other pathways

Considerations



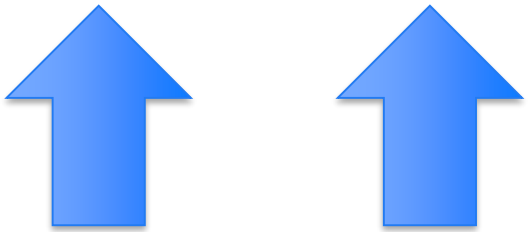
Heat Pump Customer Example

Building Usage: Small municipal building used during regular business hours + some evenings
Existing Equipment: Oil boiler 181 MBH capacity + existing AC
New Equipment: Two air-source heat pumps, (2-ton and 5-ton)

Outdoor Air Temperature	65 F	40 F	20 F	0 F
Oil Heat %	100%	65%	12%	0%
Fuel Cost	$3,388	$3,321	$2,581	$2,470

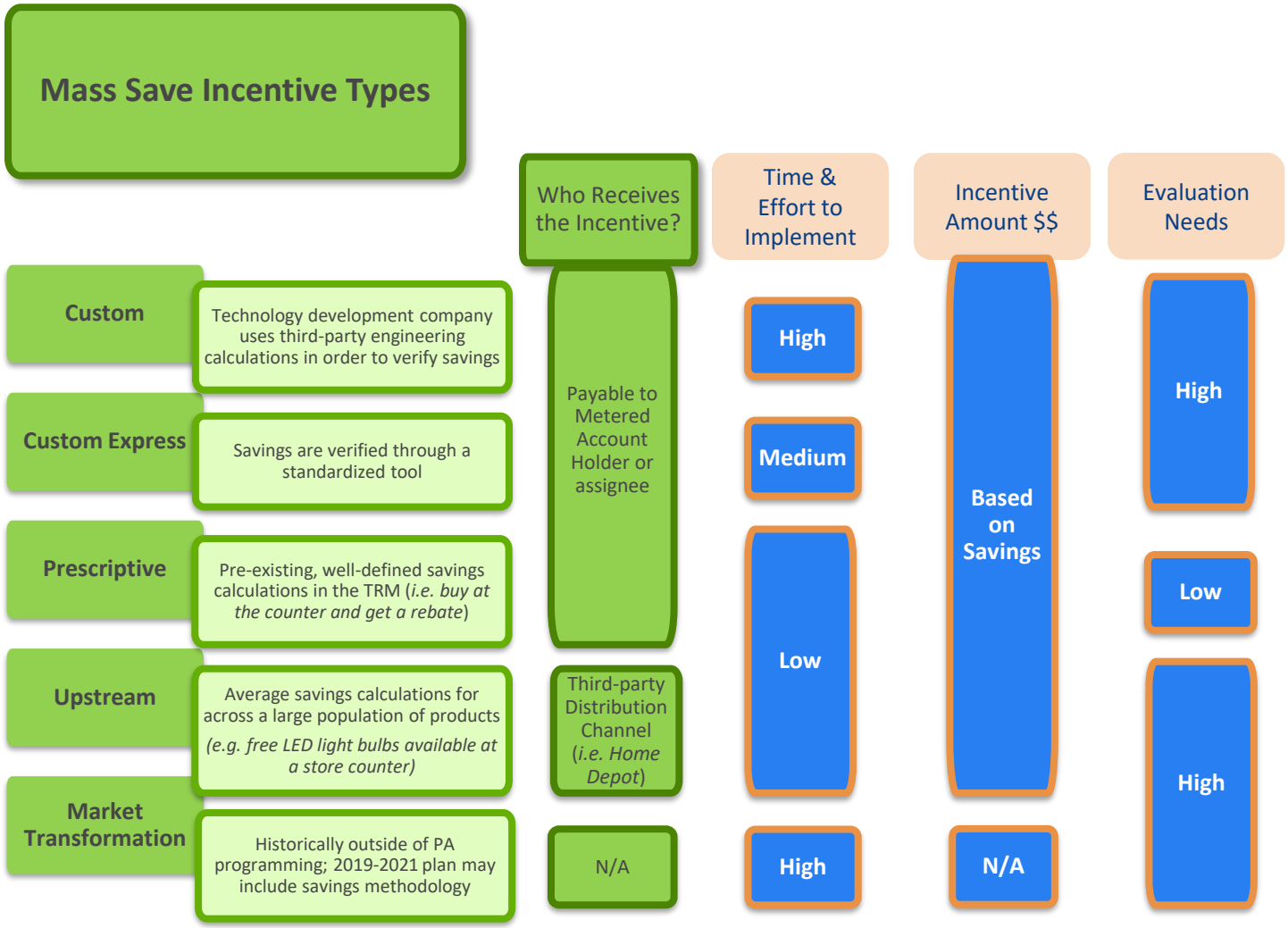
Energy Results

-14,005 kWh
1,185 gal oil saved
Net MMBTU: 118



Integrated controls allows customer to automatically utilize both heat pump and oil boiler

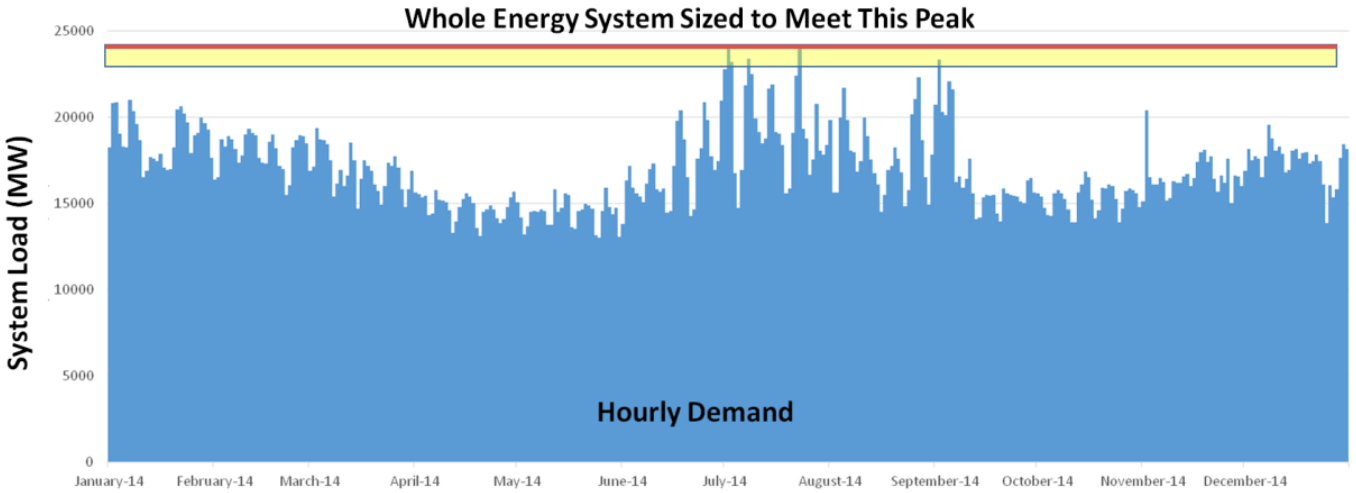
Pathways to participation

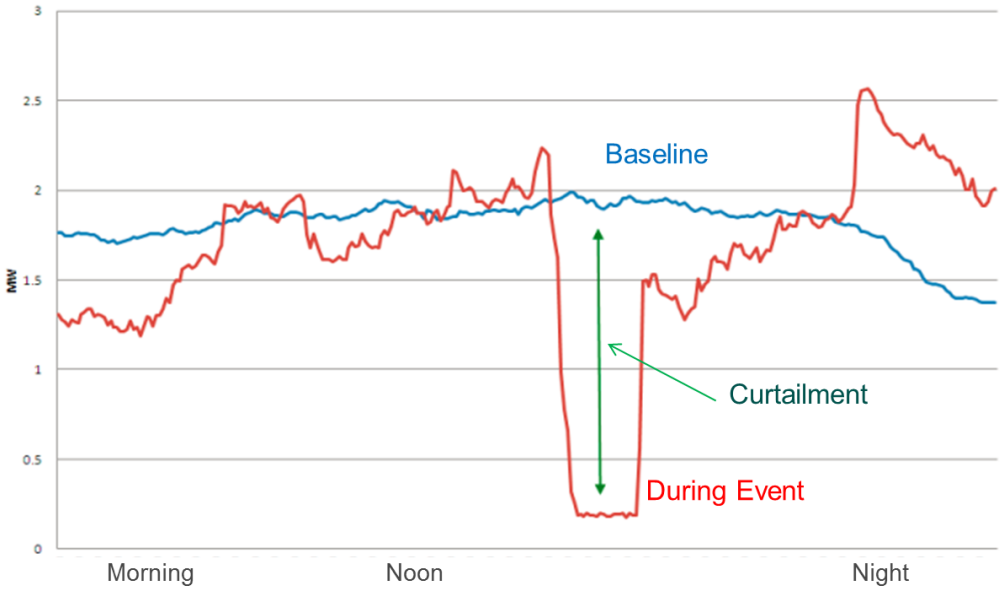


Pathways to Participation

Mass Save Incentive Types		Residential	Commercial and Industrial
Custom	Technology development company uses third-party engineering calculations in order to verify savings	Rare	Larger projects
Custom Express	Savings are verified through a standardized tool	Rare	Common
Prescriptive	Pre-existing, well-defined savings calculations in the TRM (*i.e. buy at the counter and get a rebate*)	Common	Common
Upstream	Average savings calculations for across a large population of products *(e.g. free LED light bulbs available at a store counter)*	Common	Common
Market Transformation	Historically outside of PA programming; 2019-2021 plan may include savings methodology	?	?

Active Demand Response





Three Options to Curtail

Targeted Summer

- June – September
- 8 Events Maximum
- 24 Total Hours Max
- 3 Hour Event Duration
- Weekday / Non-Holiday
- Day Ahead Notifications
- $35/kW-avg. for season

Daily Summer

- June - September
- 3 Hour Event Duration
- Dispatch window 2–7p
- Weekday / Non-Holiday
- Day Ahead Notifications
- $200/kW-avg. for season

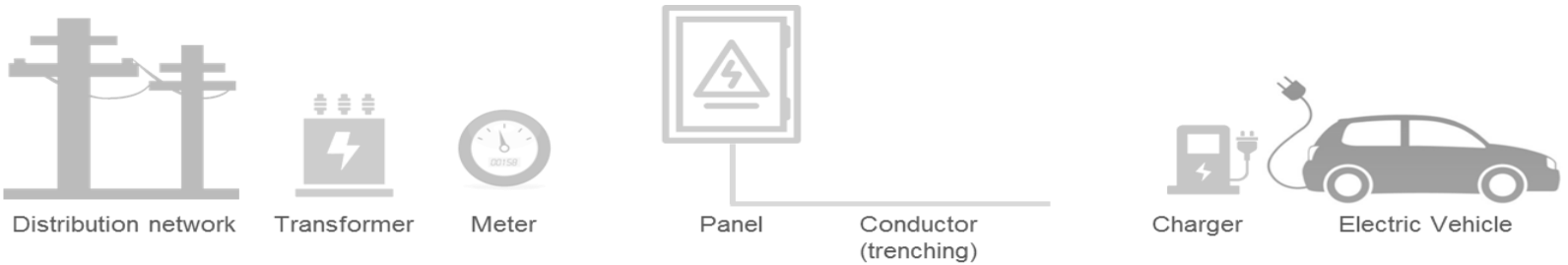
Targeted Winter

- December – March
- 5 Events Maximum
- 15 Total Hours Max
- 3 Hour Event Duration
- Weekday / Non-Holiday
- Day Ahead Notifications
- $25/kW-avg. for season

*Options may vary by service territory

Electric Vehicles / Transportation

- For approved projects, the utility:
  - Funds 100% of the electric service to the charging stations (“EVSE”)
  - New meter and account required (Eversource) or, only when required to serve stations (National Grid)
  - Provides a rebate for the charging stations (National Grid only)
- Site Host:
  - Selects charging stations from Qualified List
  - Installs and maintains stations, responsible for energy and fees for minimum of 5 years
  - Owns and maintains the Customer Equipment electrical infrastructure
  - Shares station usage data with the utility



Take Action

Questions?

Contact Information

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Margaret Song, Cape Light Compact
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Program Manager, Emerging Technology, Energy Efficiency
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Massachusetts Department of Energy Resources

II: Strategic Electrification: Technologies and Applications

Low Emissions Buildings in Massachusetts

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Low Emission Buildings in Massachusetts

Electrification of Heating

Load Reduction

PV, EV, Storage

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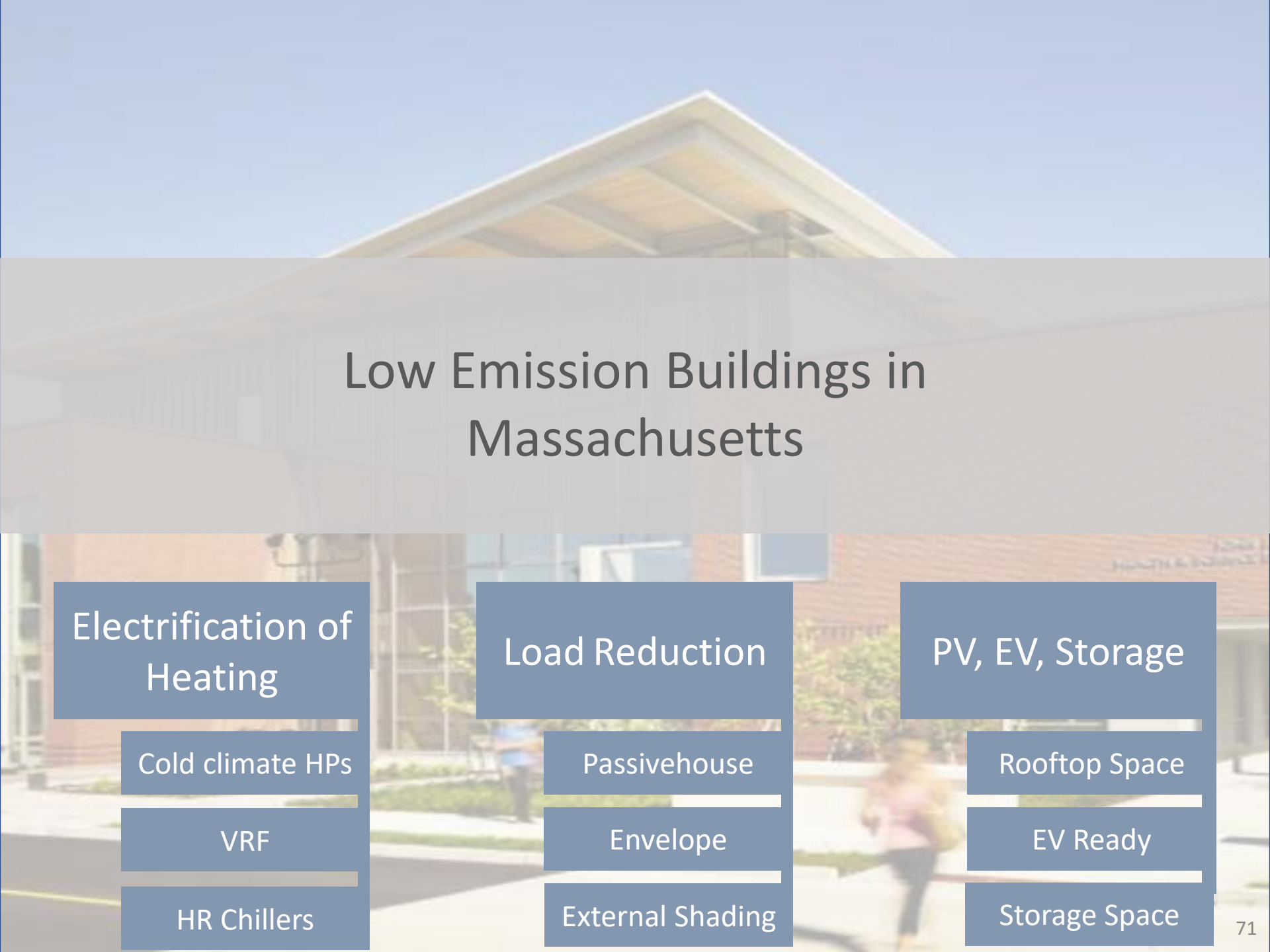
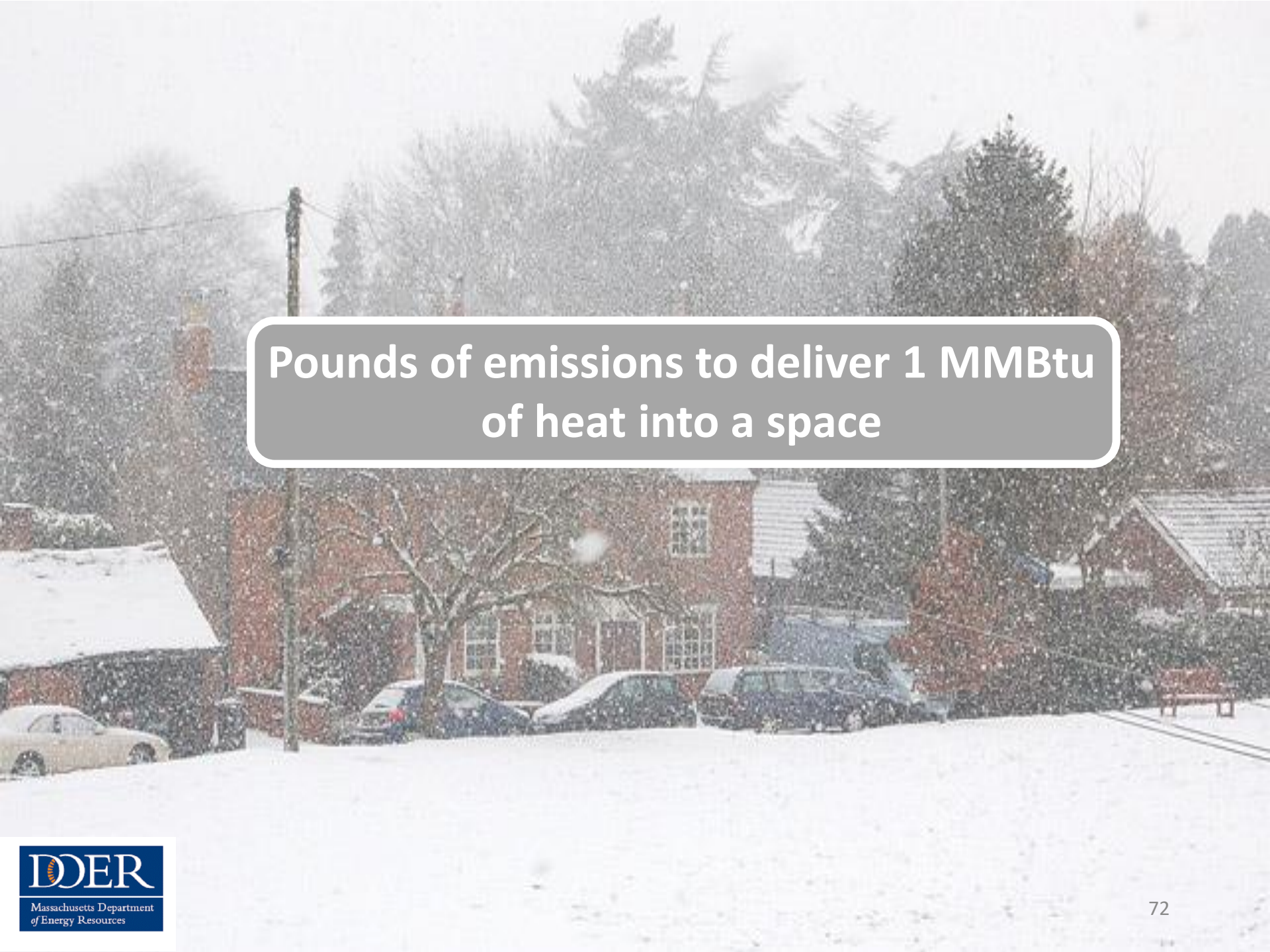
Low Emission Buildings in Massachusetts





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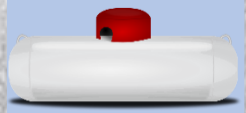
OIL	PROPANE	GAS	ELECTRIC RESISTANCE	ELECTRIC COLD CLIMATE AIR SOURCE HEAT PUMP
				

Pounds of emissions to deliver 1 MMBtu of heat into a space

2020
(700 lbs/MWhr)

170	145	120	205	65

45% Less

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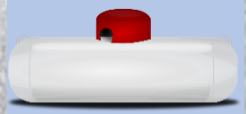
	OIL	PROPANE	GAS	ELECTRIC RESISTANCE	ELECTRIC COLD CLIMATE AIR SOURCE HEAT PUMP
					

Pounds of emissions to deliver 1 MMBtu of heat into a space

2020 (700 lbs/MWhr)	170	145	120	205	65
				45% Less	
2050 (200 lbs/MWhr)	170	145	120	60	20
				83% Less	

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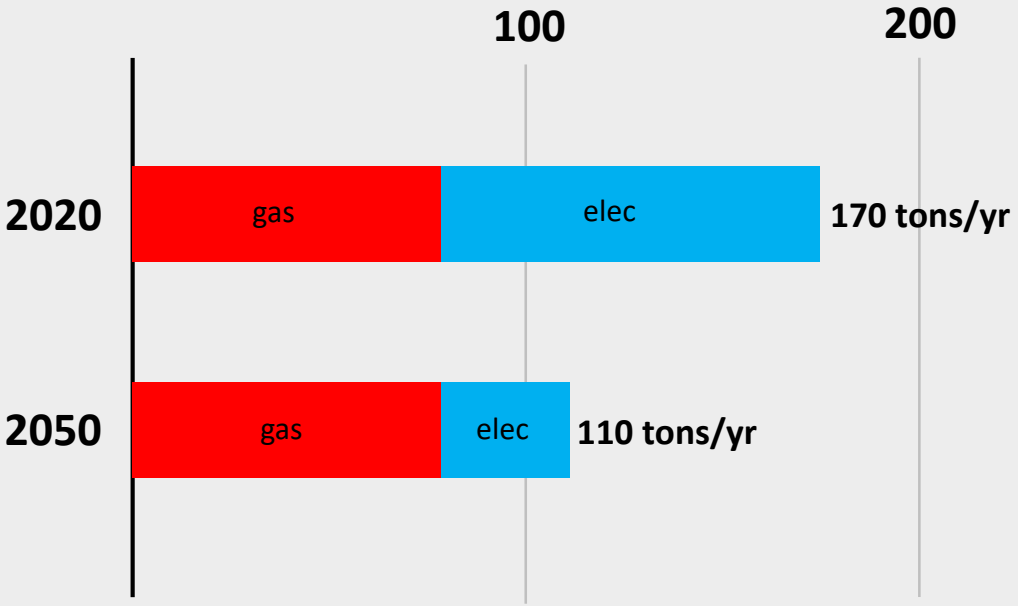
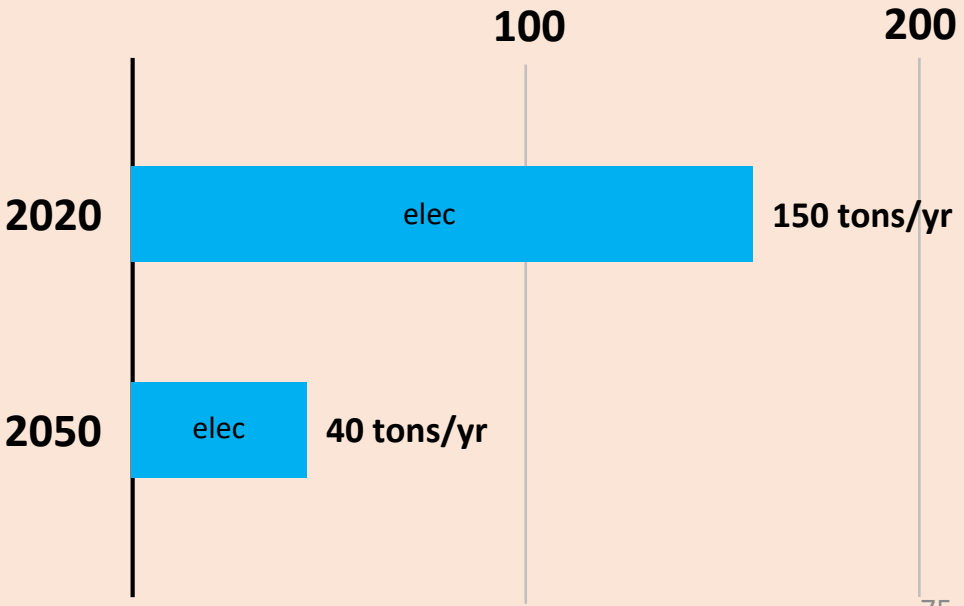
50,000-sf multifamily

- 95% natural gas space heating
- 95% natural gas water heating



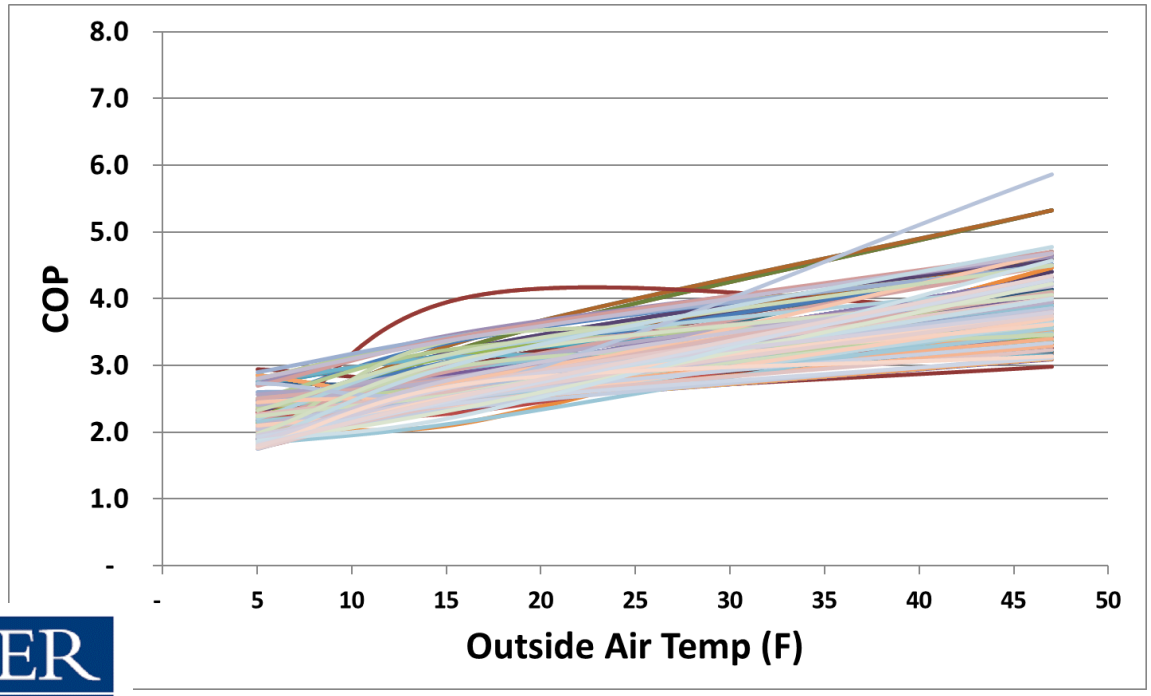
50,000-sf multifamily

- 320% air source heat pump space heating
- 250% air source heat pump water heating



Electrification – cold climate heat pumps

- One-to-one
- COP > 2 at 5F
- Seasonal winter COP: 3.2



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Electrification – vrf

- One-to-many
- Cold climate
- Heat recovery
- Scalable to any size

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Electrification – heat recovery chiller

- Hot/cold water production
- Heat recovery
- Scalable to any size

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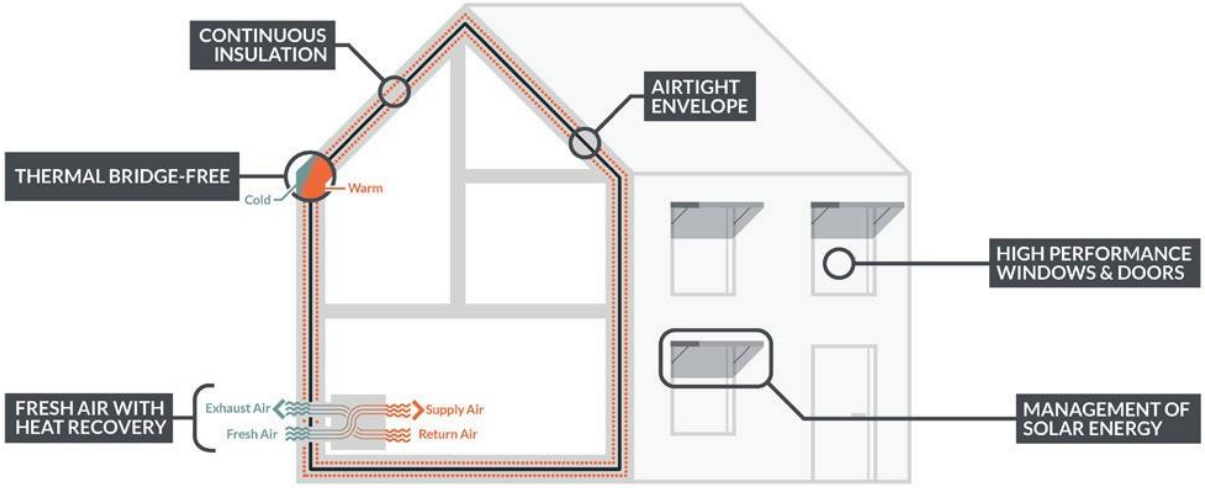
Load Reduction – Passivehouse

- 90% reduction in heating and cooling loads
- HVAC downsizing/elimination
- Cost swap HVAC to envelope
- Well suited to electrification

90% lower demand



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Passivehouse: Makes Electrification Easy

These 1500+ sf apartments have just a single 1-2 ton heating/cooling system and no perimeter systems – making it very easy to electrify space heating

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All Buildings can be Passivehouse

Carnegie Library
Pittsburgh

268,000-sf office building
Chicago

170-bed dormitory
Wheaton College

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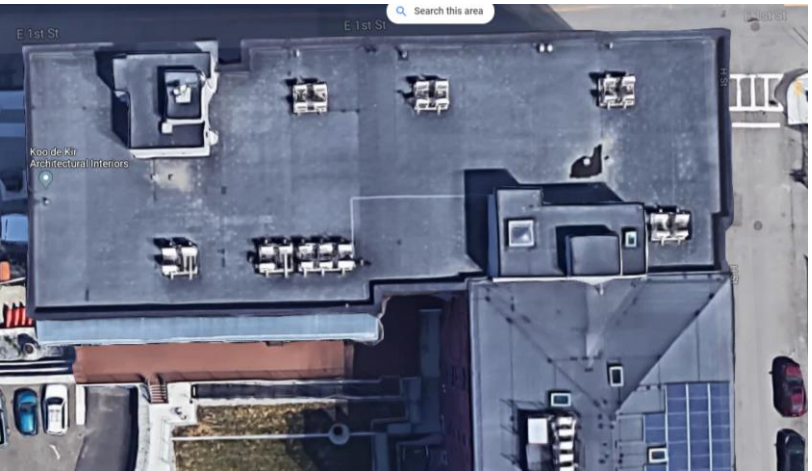
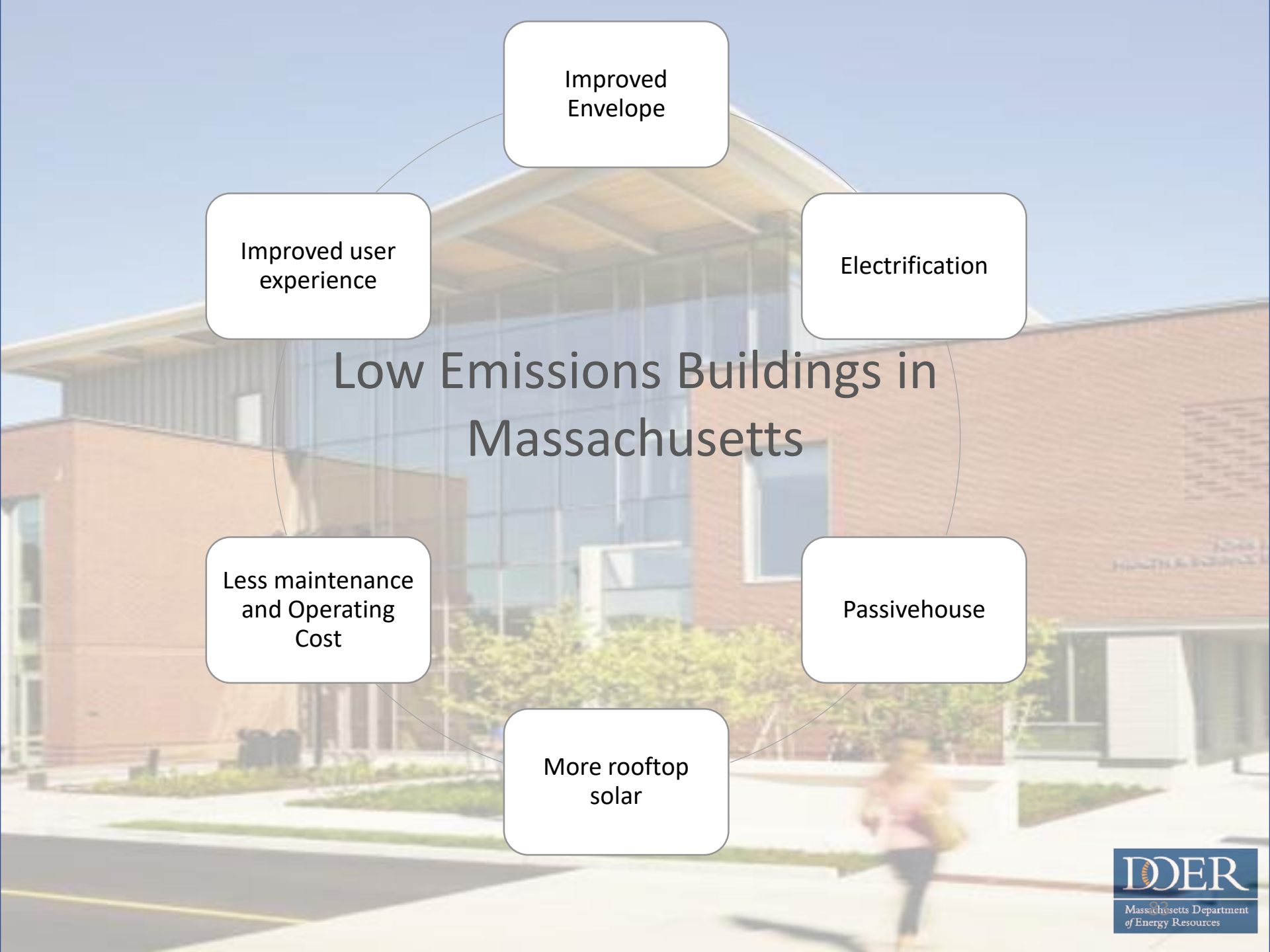
PV, EV, and Storage – Planning for the Future

- Rooftop Solar and Battery Storage
- EV and EV ready

5 years ago, this building minimized HVAC with Passivehouse and consolidated rooftop units. Today the building owner is now building rooftop amenities and solar PV



Consider EV charging stations for some spaces AND consider EV-readiness (buried conduits) to anticipate more stations in future



Low Emissions Buildings in Massachusetts

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On the Path to Decarbonization: Examples of Electrification and other Strategies

Net Zero Energy in New Buildings

Jacob Knowles, BR+A

Preparing for a Low-carbon Future: Harvard and Dartmouth

Harvard District Energy Facility (DEF)

- New gas CHP operational as of summer 2019
- Replaced steam with more efficient water system
- 1.3 mil. gallon water tank to reduce summer peak
- Designed for growth and transition to alternatives
- Fossil Fuel-Neutral by 2026, -Free by 2050

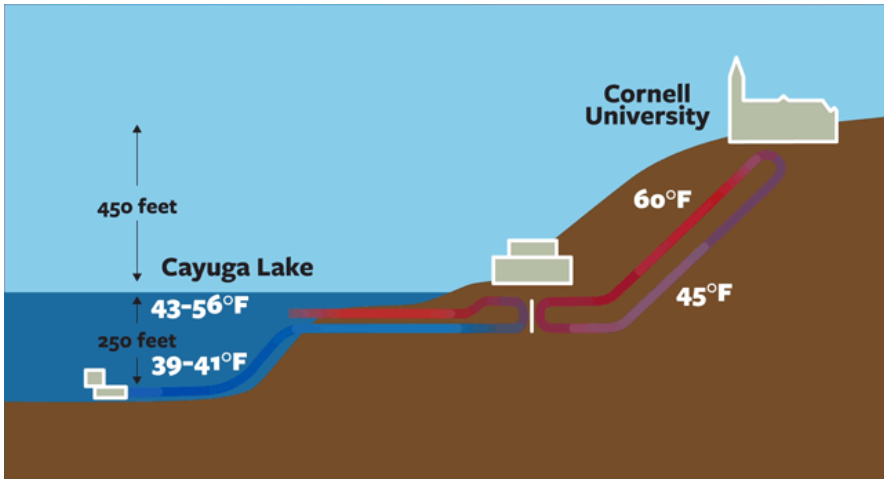
Dartmouth College Power Plant Retrofit

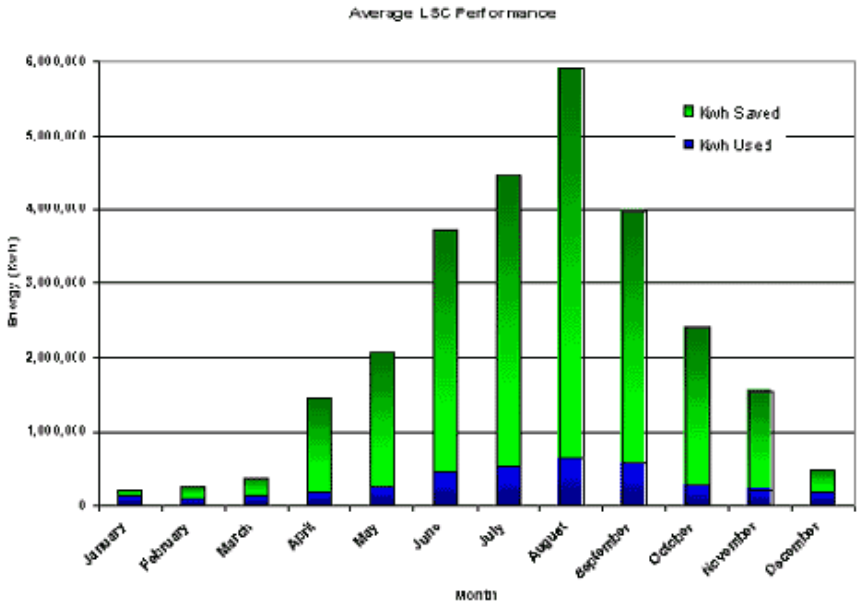
- Reduce emissions in half by 2025, 80% by 2050
- Water to replace steam in 110 buildings
- New plant will replace #6 oil with cleaner energy source TBD
- New plant designed to transition to a fully clean electrically powered campus in 30 years

Sources: Harvard, Dartmouth

Case Study: Cornell's Lake Source Cooling System

- $58.5 million project completed in 2000 harnesses lake water for cooling from 250 feet below surface
  - ~30-year payback, will last 75-100 years
  - Electricity use reduced 25 million kwh/year
  - Eliminates refrigeration equipment

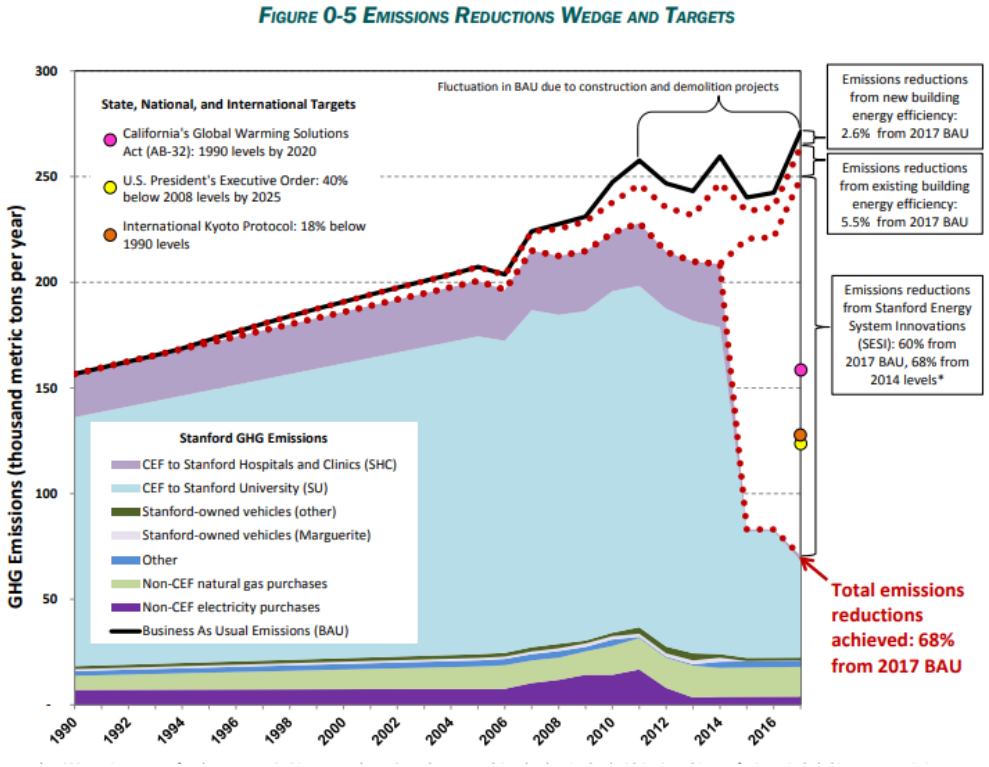




Sources: Medium.com, Cornell

Case Study: Stanford District Energy Facility

- Since 1986, natural gas-fired CHP plant provided virtually all of Stanford's energy demand
- Energy and Climate Action plan launched 2009
- New Central Energy Facility replaced CHP plant in 2015
- 25-year PPA for on- and off-campus solar supplies 53% of electricity



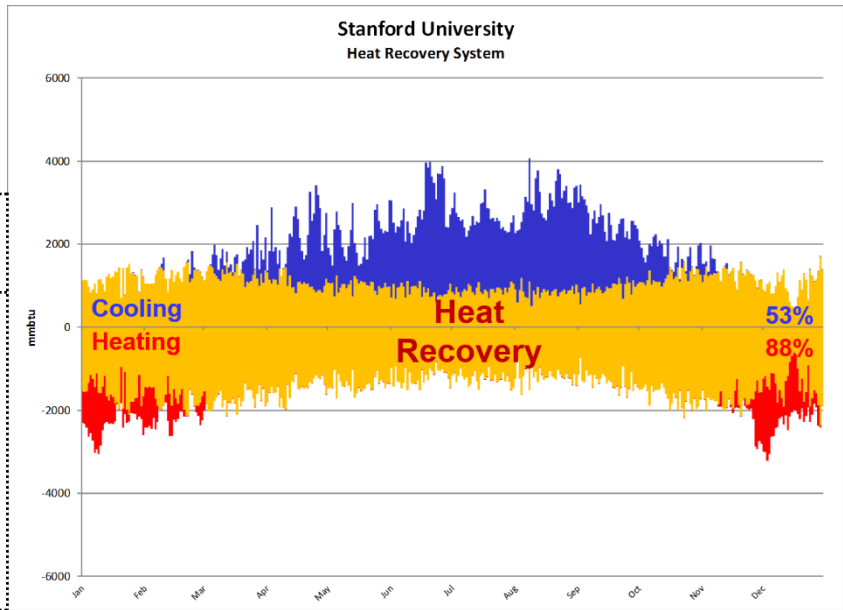
Sources: Sustainable Stanford, EPRI Journal, EDF Innovation Lab, E&C Plan

Transitioning to Electricity: Stanford's District Energy Facility

- Heat recovery chillers cool water, waste heat provides 88% of campus thermal demand
- Electric chillers and NG boilers back-up
- Water tanks for thermal storage
- Steam pipes converted to water
- System meets overlapping heating and cooling needs (70% of time)
- Advanced automated modeling software ensures electricity used efficiently, off-peaks

System Performance & Efficiency

53%	88%	70%
Waste heat recovered from cooling	Campus heating load met by waste heat	Real-time overlap campus heating & cooling demands



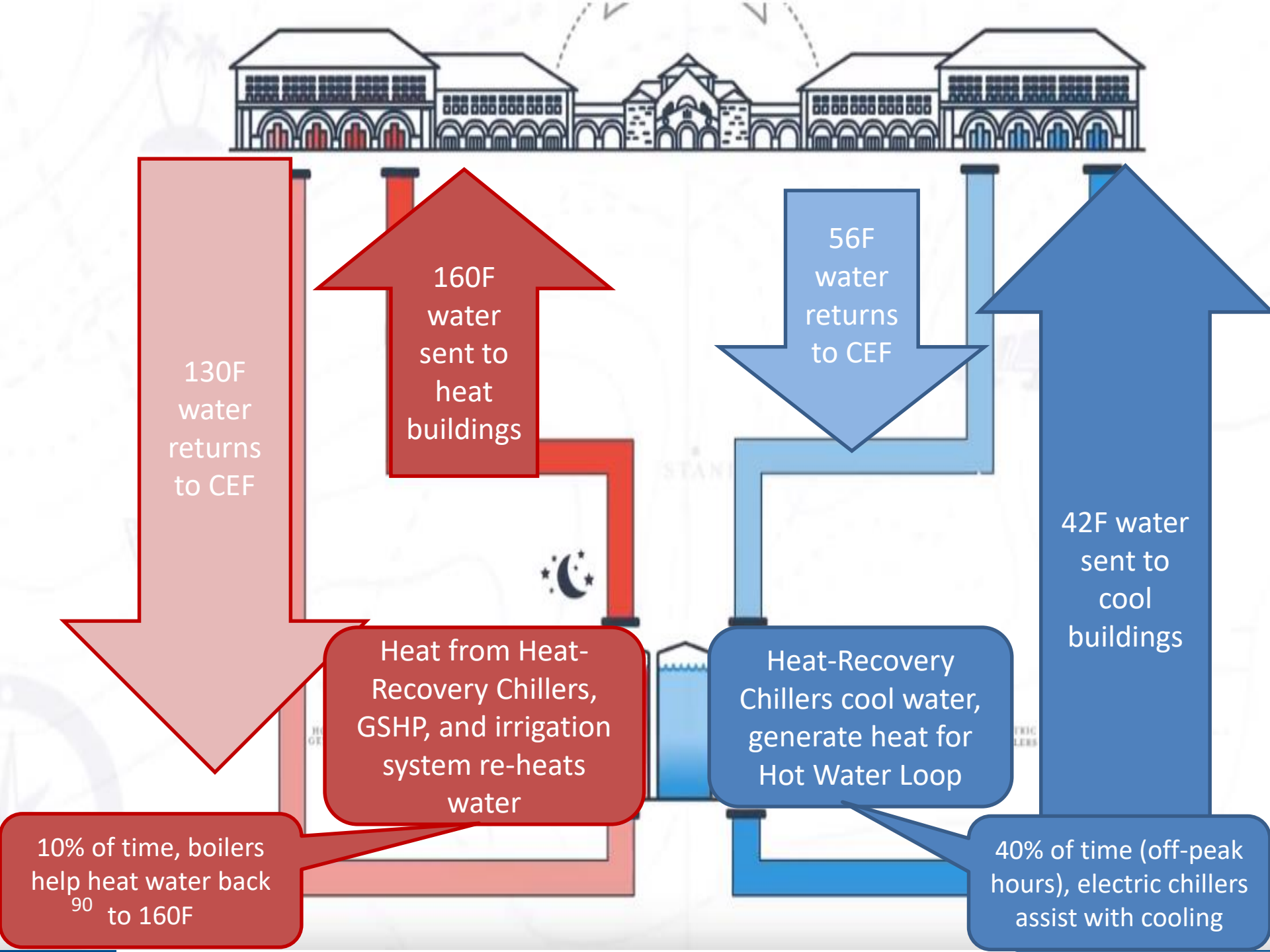
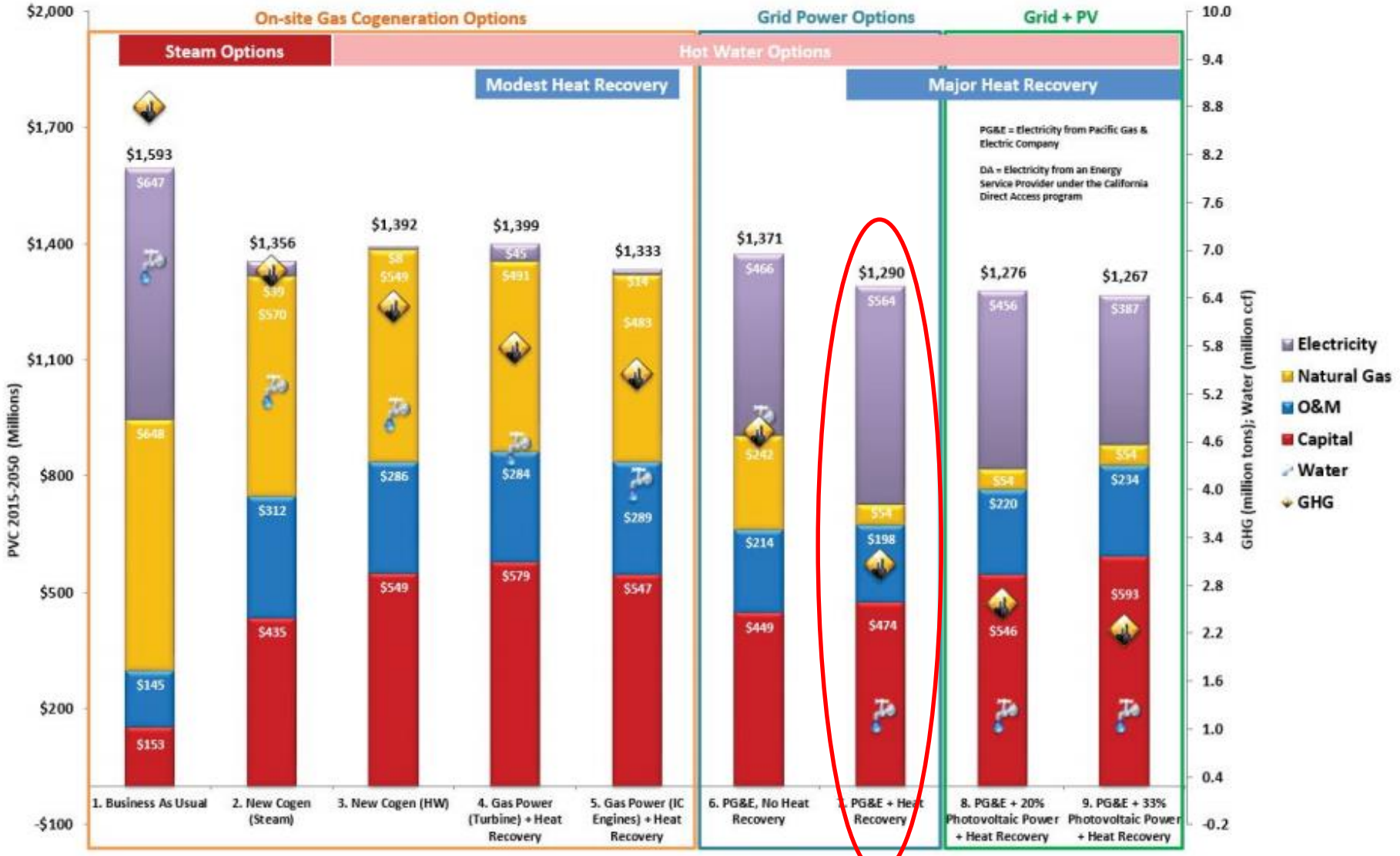

130F water returns to CEF
160F water sent to heat buildings
56F water returns to CEF
42F water sent to cool buildings
Heat from Heat-Recovery Chillers, GSHP, and irrigation system re-heats water
Heat-Recovery Chillers cool water, generate heat for Hot Water Loop
10% of time, boilers help heat water back to 160F
40% of time (off-peak hours), electric chillers assist with cooling

FIGURE 6-5 COMPARATIVE COST, GHG, AND WATER USE OF ENERGY SUPPLY OPTIONS



Summary of comparative costs, carbon emissions, and water use across various energy generation options. Life-cycle cost decision criteria are shown in bars. The segments include: initial capital investment in red, operations and maintenance cost in blue, cost of purchasing electricity in purple, and cost of purchasing natural gas in yellow. Net present value (NPV) of each energy generation option is shown in the $ figure above the composite bars. Environmental attributes are shown in bubbles via total GHG and water use icons.

Source: Energy and Climate Plan (2015)

Stanford's District Energy Facility Costs and Savings

- **Total Capital Cost: $485 million**
  - 10% below original estimate
- **Estimated savings: $420 million** (Over 35-year period)
  - Relative to the costs of the previous cogeneration system

Environmental Benefits	
68% Reduction in annual carbon emissions	**15%** Increased efficiency due to automated control software
18% Reduced annual campus potable water consumption	**15%** Reduced annual peak demand (2016)
50% Energy efficiency increase over previous system	

Herriman Utah First Community to Go Fully Electric

- All-electric residential community with on-site energy storage in every unit and 100+ EVSE
- 600+ individual batteries, totaling 12.6 mWh of solar energy storage
- Residents began moving in this past September

Photo credit: Abraham Mardanlou

Source: Energy Manager Today, Curbed.com

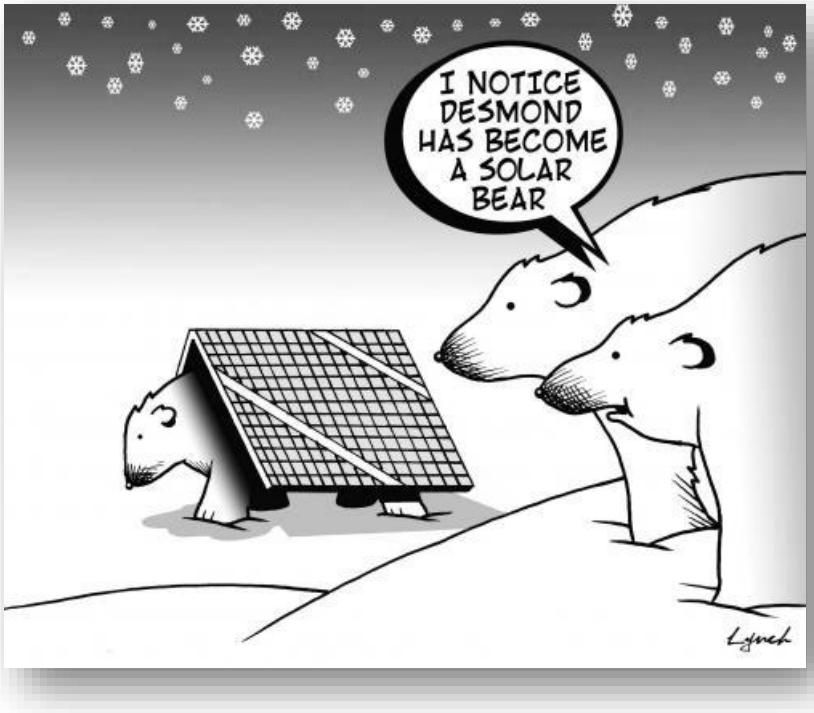
Next LBE Council Meeting

Save the Date!

January 14, 2020

10:00 am–12:00 pm

Location TBD



2020 Tentative Meeting Dates:

March 10
May 12
July 14
Sept 8
Nov 10