MA Leading by Example Council Meeting

DOER Massachusetts Department of Energy Resources

March 10, 2020

Fitchburg State University

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP. STEWARDSHIP. COMMITMENT

State Government Progress – as of March 2020

Greenhouse Gas (GHG) Emissions

↓ 26%

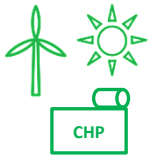
2004 -2018

Energy Use Intensity per Square Foot

↓ 13%

2004-2018

Electricity via Renewable & Onsite Generation



19%

In 2018

Heating Oil Consumption at State Facilities

↓ 85%

2006-2019

27.2 MW Installed Solar PV at State Sites

19.1 MW

Since 2015

87 LEED Certified State Buildings

50

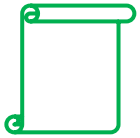
Since 2015

160 EV Charging Stations at State Sites

96

Since 2015

Leading by Example Grants Awarded

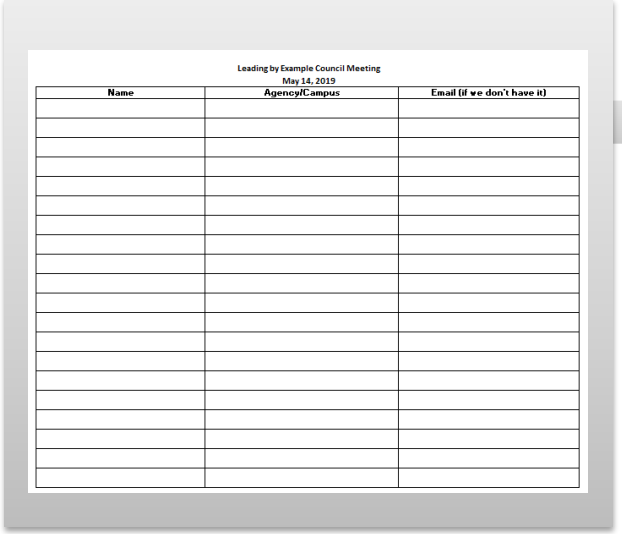


$12.3 M

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

Fitchburg State University Sustainability Efforts

Joe LoBuono
Assistant VP of Capital Planning & Maintenance

DOER
Massachusetts Department of Energy Resources

Meeting Agenda

This year, April 22nd will mark the 50th anniversary of Earth Day.

- This year's national theme is *"Climate Action."*
- In MA, the theme is "*Honoring Our Past, Shaping Our Future."*

Today's spotlight is meant to:

- Take stock of progress across the region and within LBE Partners
- Assess current climate crisis, global/regional response
- Initiate high-level discussions around what innovation might look like

Welcome and Introductions

LBE Updates

Lessons from the Past: Progress in the Commonwealth

Understanding the Present: Is 2020 a Tipping Point?

Innovating Toward the Future

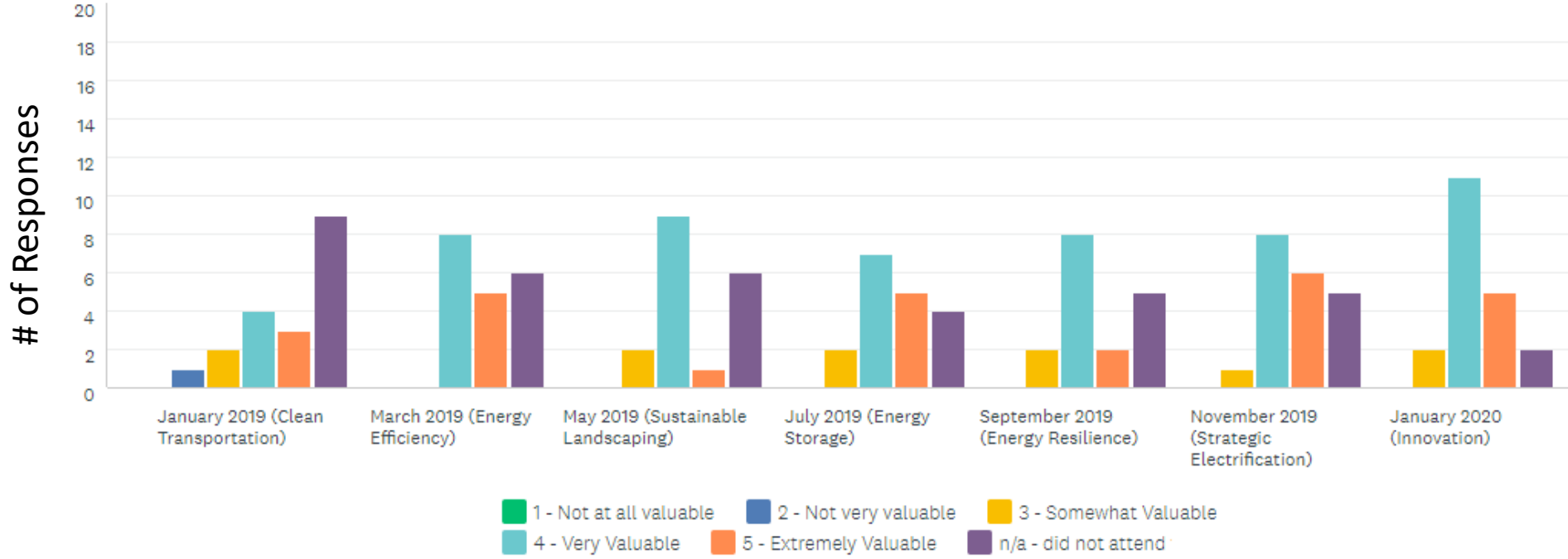
LBE Updates

LBE Council Feedback Survey

- Goal of the survey was to:
  - Evaluate the impacts and benefits of various elements and topics of LBE Council meetings
  - Understand partner priorities and interests for future discussion
- Sent to 66 individuals that attended at least one LBE Council Meeting between Jan 2019-Jan 2020
- 20 responses collected between Feb 5-Feb 25
  - 30% response rate
- If you haven't yet responded to the survey and would like to, please email Ryan.Kingston@mass.gov

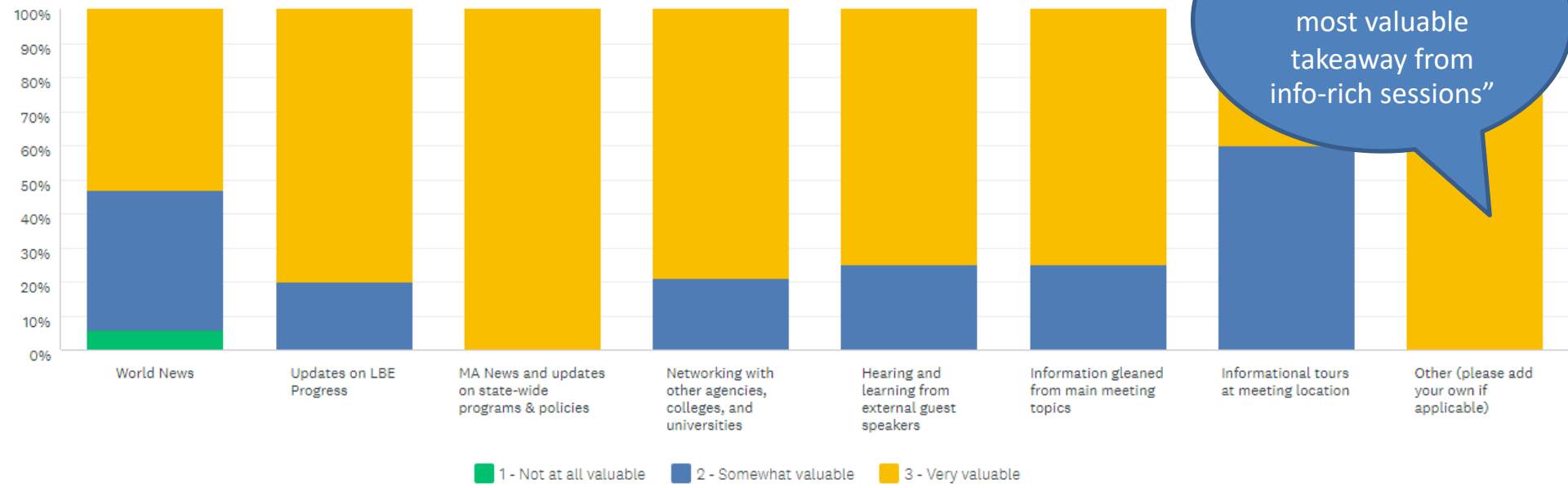
Mark any meetings you have attended below, and how valuable you found the information presented:

- 75-100% of respondents rated meeting topics they attended as “Very” or “Extremely Valuable”
- The meeting topics with the highest percent of “Very” and “Extremely Valuable” ratings from attendees were Energy Efficiency (100%) and Strategic Electrification (93%)



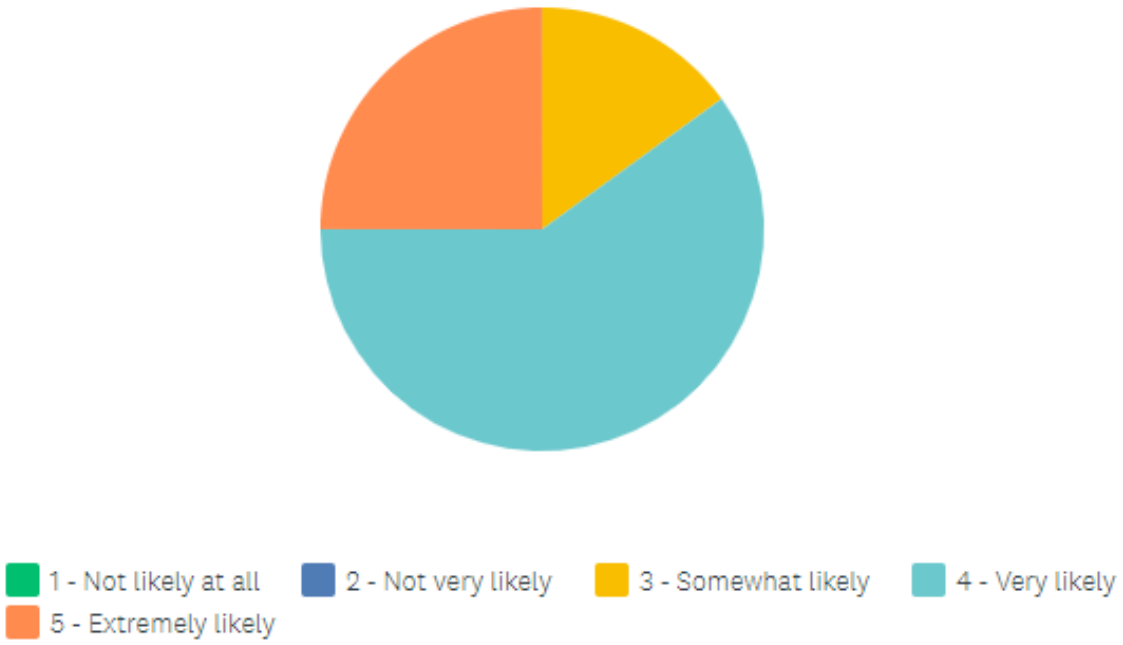
How valuable do you find the following parts of LBE Council meetings?

- 100% of respondents rated “MA News and updates on state-wide programs and policies” as Very Valuable
- 40% of respondents ranked informational tours as Very Valuable, 53% ranked world news as Very Valuable
- 75-80% ranked the remaining meeting elements as “Very Valuable”



How likely is the information you receive from LBE Council Meetings to support, bolster, or enhance your efforts?

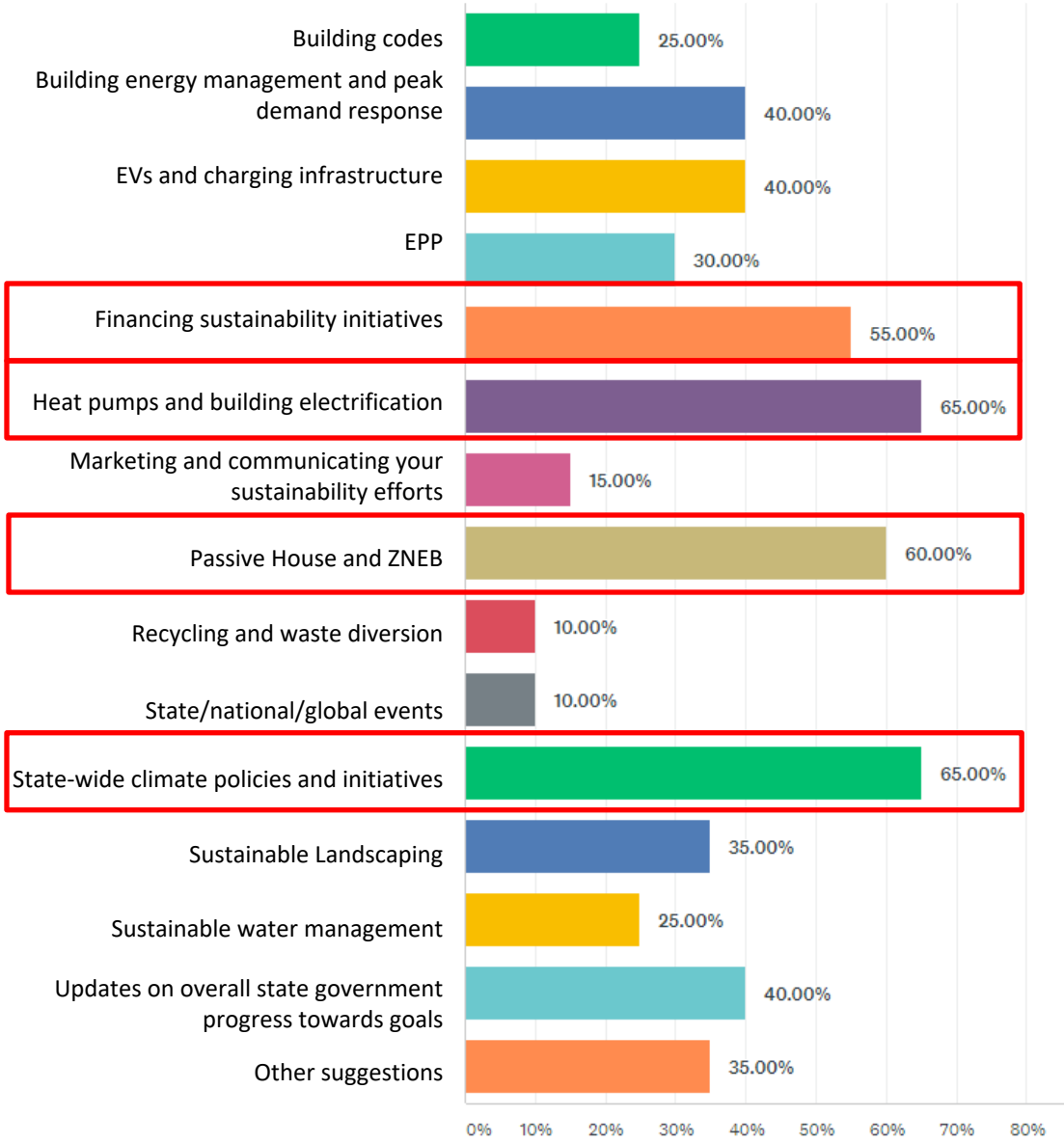
85% responded “Very” or “Extremely Likely”, with
15% responding “Somewhat Likely”



What topics are you most interested in learning about at a future LBE Council Meeting?

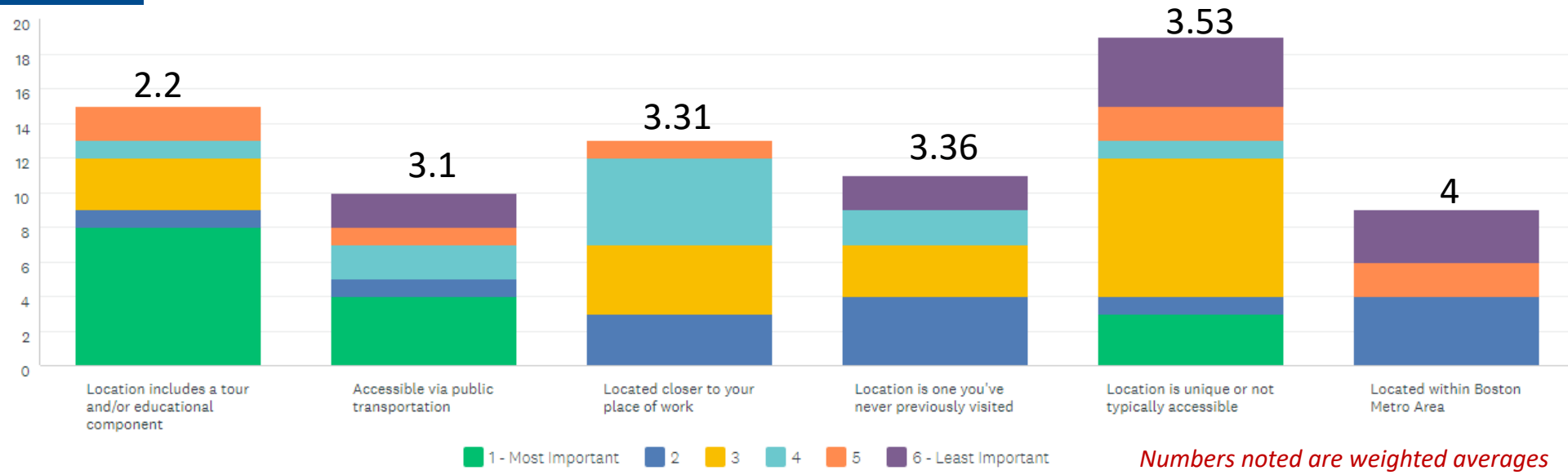
Other suggestions included:

- Updates on state regulations and new programs
- Marketing and getting stakeholders more involved
- Biomimicry
- Best practices around energy efficiency and resilience
- How to motivate decision makers to focus on life-cycle costs over up-front costs



When it comes to the location of LBE Council Meetings, please rank how important these factors are when considering if you will attend a meeting:

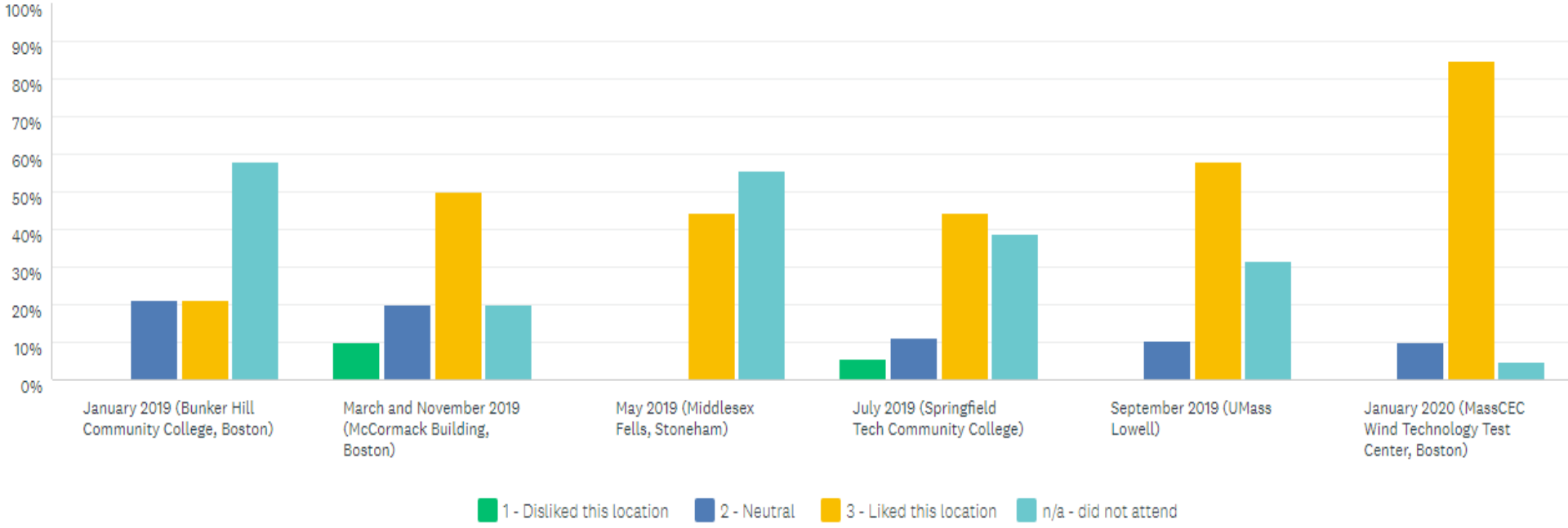
- Based on overall weighted averages, “locations with a tour and/or educational component” were rated most important
- Locations within Boston Metro Area were considered the least important



Numbers noted are weighted averages

How would you rate the locations of previous LBE Council Meetings?

- Overall, between 50-100% of respondents liked the meeting locations
- 100% of respondents liked Middlesex Fells, 89% liked the MassCEC Wind Technology Test Center



General Feedback and Comments

- Commenters generally noted meetings are helpful and informative
- Regulatory updates and news on funding sources were noted as most important topics
- Several respondents requested more time to network
- Several comments suggested lengthening current meetings and/or organizing additional meetings
- Comments on guest speakers varied, some suggesting giving more time, others noting short talks are fine

Key LBE Take-aways

Take-aways LBE Team has committed to:

- Continue meetings focused on key priorities
  - Select topics identified by survey respondents
- Keep world news topics relevant
- Continue to host meetings at interesting, unique locations across state that include educational components and innovative features
- Continue to provide updates on relevant state programs

Take-aways for discussion:

- Extend length of meetings by 30 minutes?
- Set aside time for discussion?
  - Networking?
  - Breakout Groups?
  - Other?
- Incorporating guest speakers: multiple speakers vs one or two?

SMART MASSACHUSETTS SOLAR PROGRAM Program Expansion Proposal

Proposed Block Expansion

Distribution Company	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10	Block 11	Block 12	Total
Unitil	3.947	3.947	3.947	3.947	3.947	3.947	N/A	N/A	N/A	N/A	N/A	N/A	**23.682**
National Grid (Massachusetts Electric)	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	**1,080.266**
National Grid (Nantucket Electric)	3.021	3.021	3.021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**9.063**
Eversource (East)	91.514	91.514	91.514	91.514	91.514	91.514	91.514	91.514	107.249	107.249	107.249	107.249	**1,286.988**
Eversource (West)	15.735	15.735	15.735	15.735	15.735	15.735	15.735	15.735					
Total Capacity	204.239	204.239	204.239	201.218	201.218	201.218	197.271	197.271	197.271	197.271	197.271	197.271	**2,400.000**

- Proposed key changes for public projects:
  - Increase public adder from $0.02/kWh → $0.04/kWh
  - Enable applicants to earn a statement of qualification upon contract signing with an 18-month reservation period
  - Require energy storage (must discharge at least 52 complete cycle equivalents each year or participate in a demand response program)
- Emergency regulation is under final review and expected to be finalized in Q2 or Q3 2020

Clean Peak Standard

CPS is a market mechanism designed to **shift clean energy to peak and reduce demand at peak**, thereby decreasing emissions and costs

Any eligible resources that generate, dispatch or discharge energy during a seasonal peak period will generate Clean Peak Energy Certificates (CPECs)

CPECs can be sold to retail electricity suppliers, which are required to purchase a certain amount each year to meet the minimum standard obligation

- Proposed regulation available for review on DOER website
- DOER held public hearings in September and accepted through October
- Expected next steps:
  - Amended regulations now with Joint Committee on Telecommunications, Utilities, and Energy for first of two 30-day comment periods
  - Final regulations potentially to be filed Q2 or Q3 2020

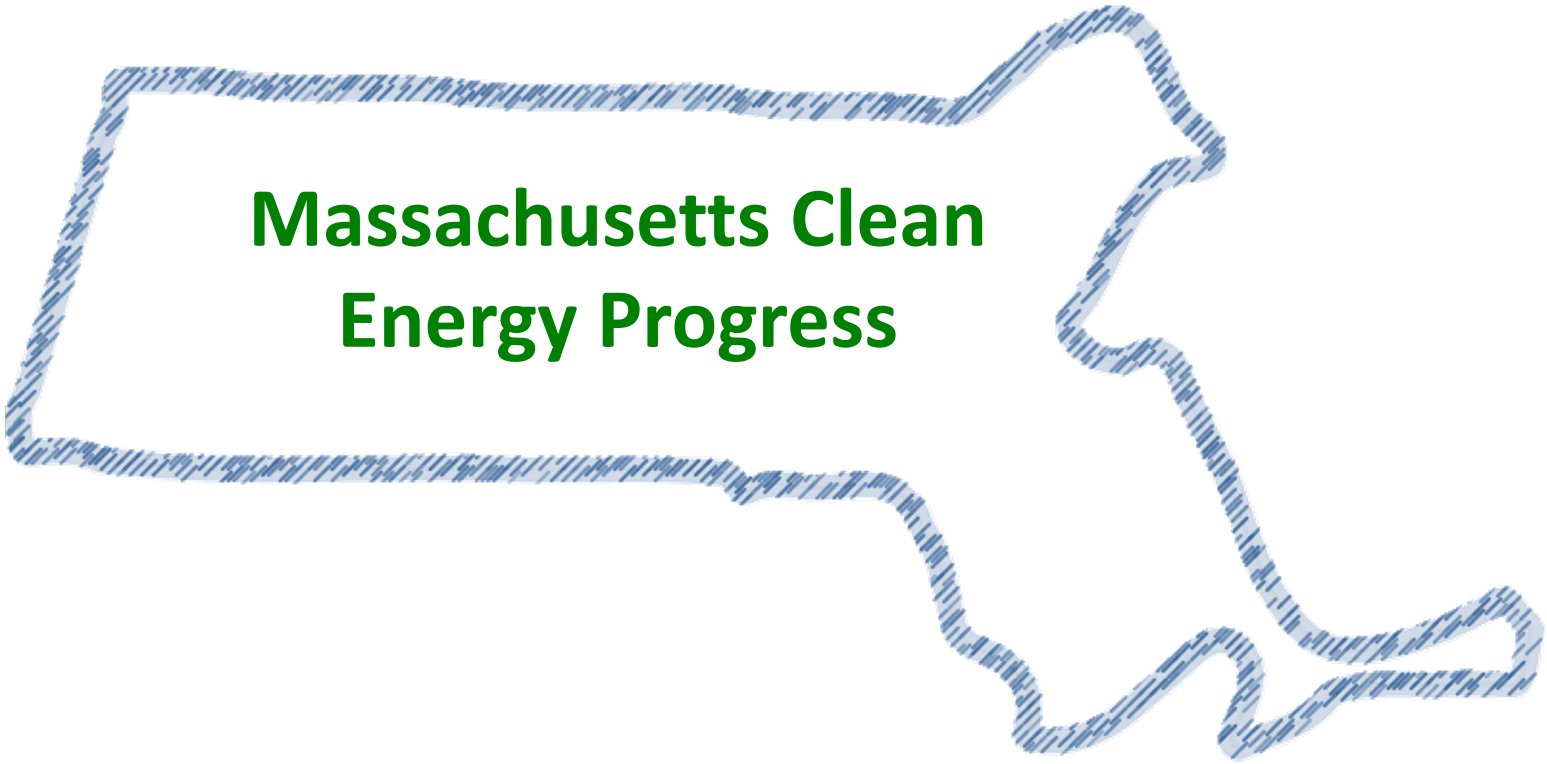
OVM Quarterly Outreach Meeting

- Tentatively scheduled for early-mid May
- Focus on electric vehicles & charging:
  - EV models on contract
  - Costs
  - Maintenance
  - Resources
- Ride and Drive
- Info to come…

Massachusetts Department of Energy Resources

LBE Council Spotlight:
Lessons from the Past
Understanding the Present
Innovating Toward the Future

Massachusetts Clean Energy Progress

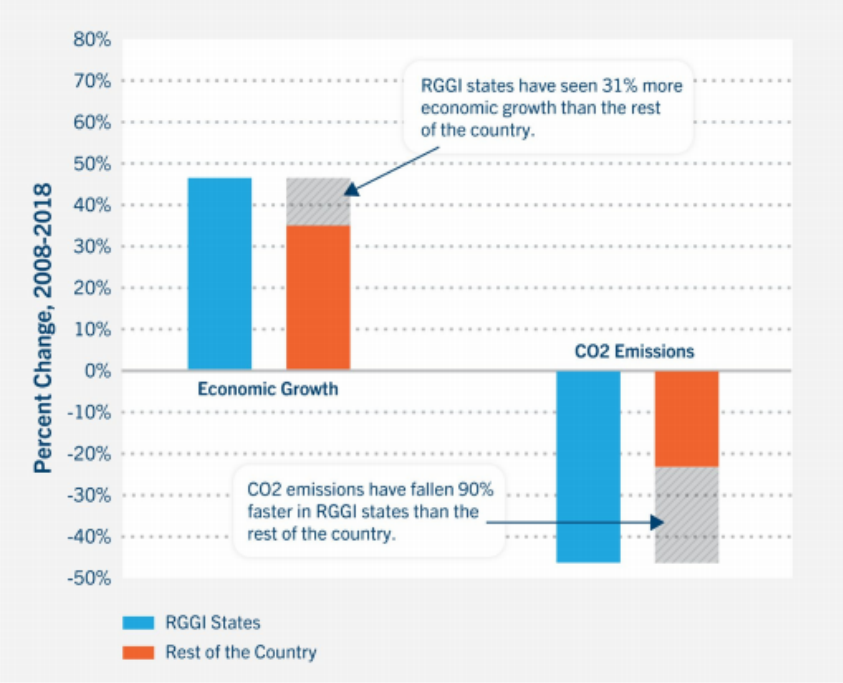


Creating A Clean, Affordable and Resilient Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

Regional Greenhouse Gas Initiative Contributing to Reduced Emissions

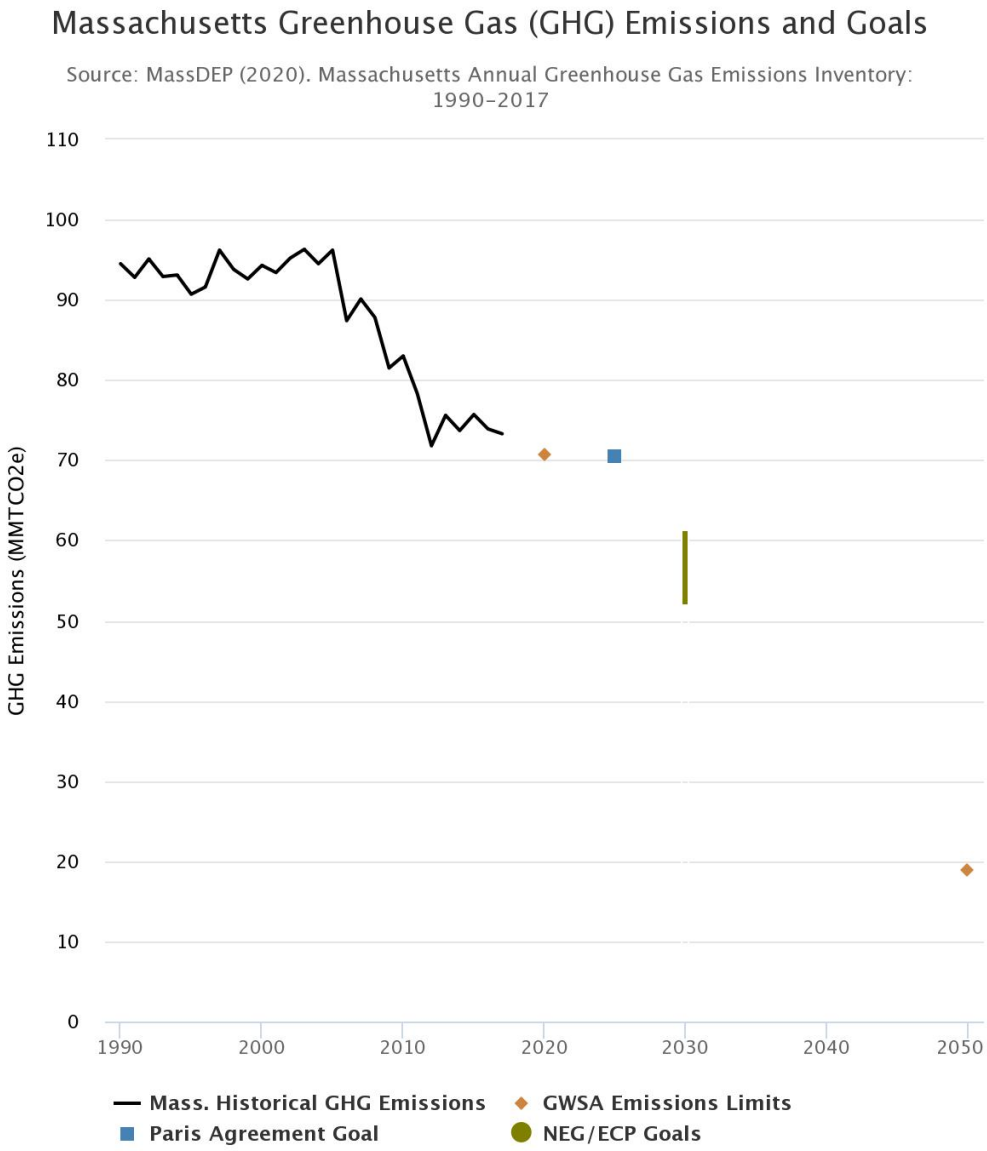
- CO2 emissions from RGGI power plants have fallen by 47%, exceeding the national rate by 90%
- Electricity prices have fallen by 5.7%, rest of US prices increased by 8.6%
- Economies grew by 47%, outpacing growth in rest of country by 31%



Source: EnergyNews, Acadia Center

MA Greenhouse Gas Emissions Progress

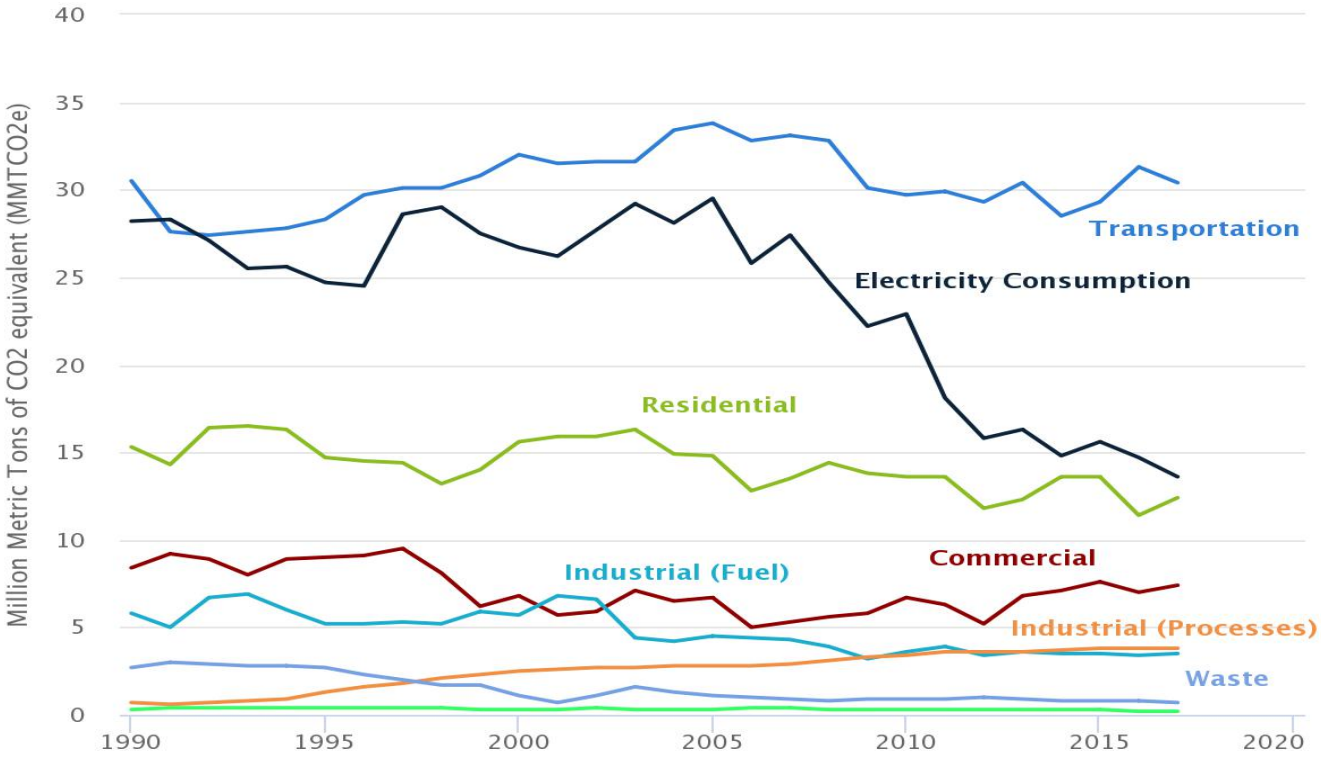
- MA 2017 GHG emissions were 22.4% below 1990 baseline
- Reduction occurred despite 14% population growth and 24% growth in vehicle miles traveled



Source: Mass.gov

MA GHG Emissions by Sector

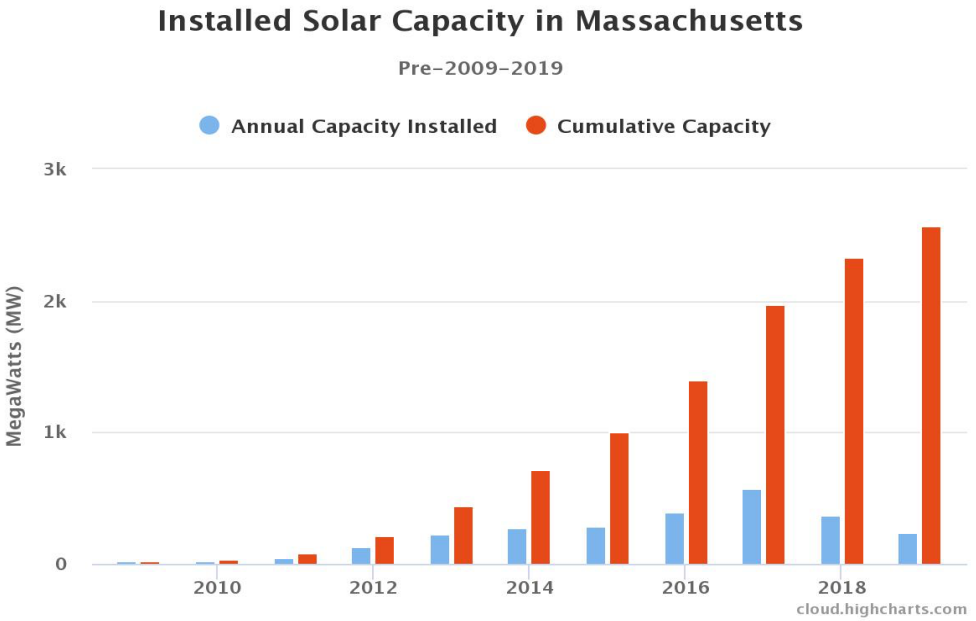
- Clean energy and improved efficiency have contributed to reduced emissions from electricity
- Transportation remains largest source of GHG

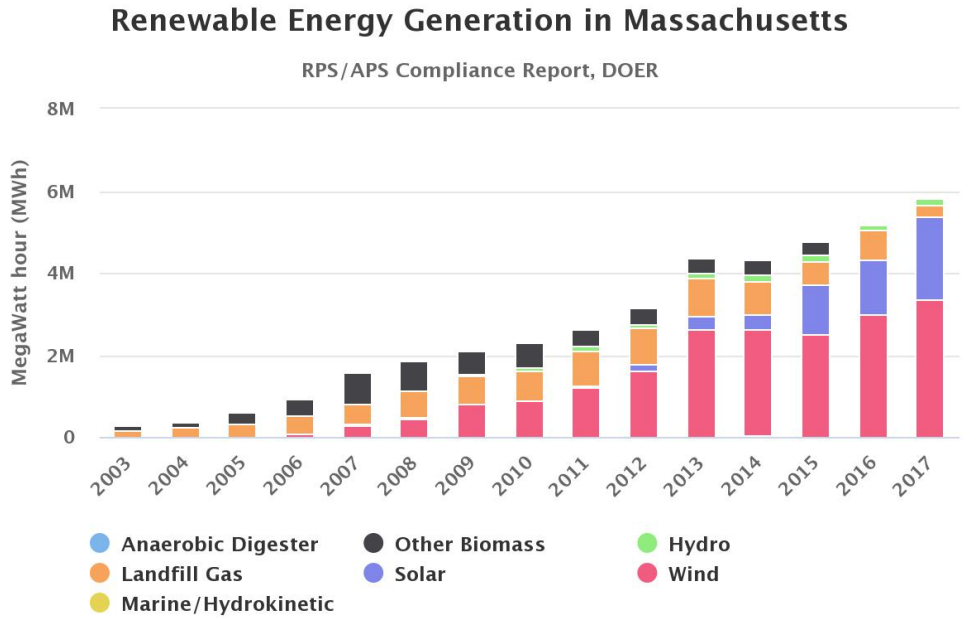


Source: Mass.gov

Growth of Solar & Renewable Capacity in MA

- By the end of 2019, about 10% of electricity generated in MA came from Solar
- As of 2017, over 20% of electricity in MA comes from Solar and Alternative Energy





Source: EnergyNews, Mass.gov, RPS/APS Compliance Report

2019 MASSACHUSETTS Clean Energy Industry Highlights

MASSACHUSETTS CLEAN ENERGY CENTER®

9 CONSECUTIVE YEARS OF JOB GROWTH

There are **111,836** clean energy workers in MA in 2019, a **1%** increase from 2018

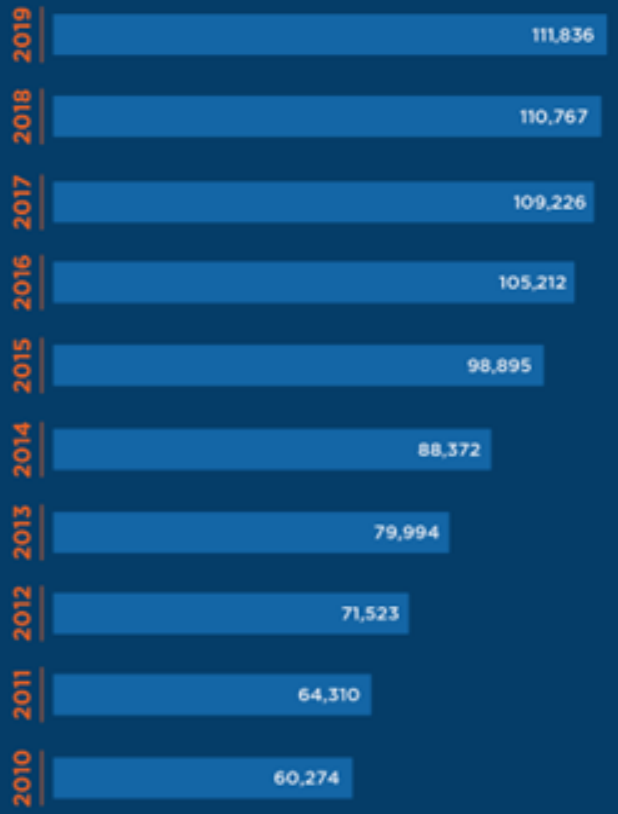
Clean energy companies represent nearly **$14 billion** in MA Gross State Product, up **$4.8 billion** since 2013

Clean energy jobs make up **3.1%** of all jobs in MA

61% of clean energy workers in MA are employed by small businesses

Total Clean Energy Jobs

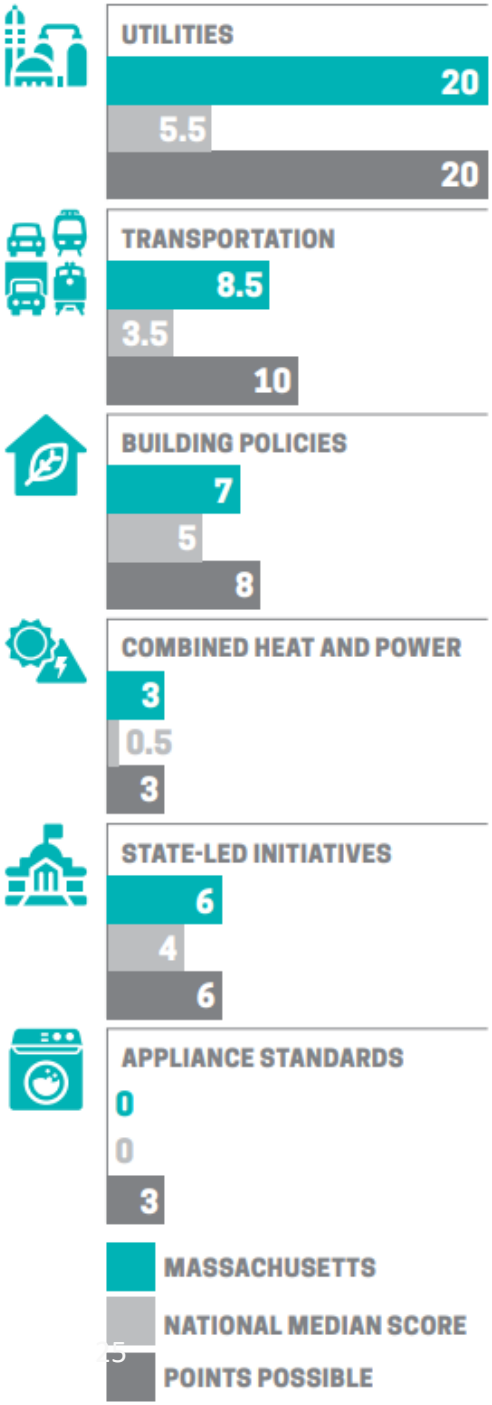
2010-2019

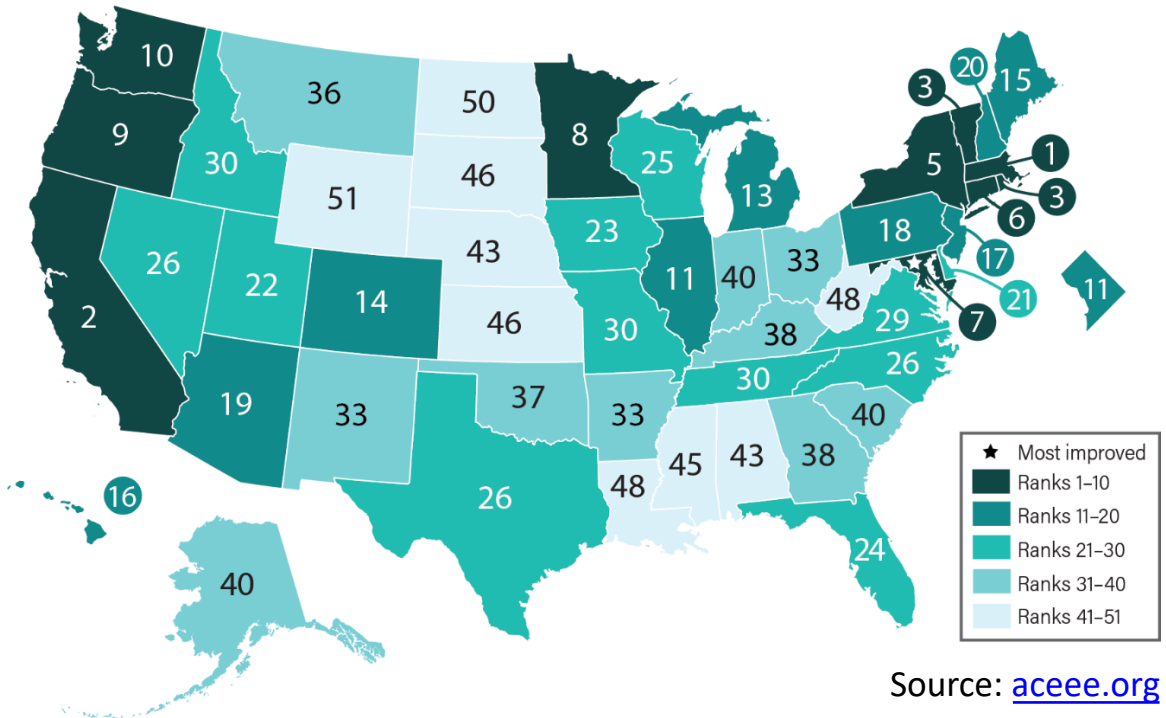


Source: MassCEC

MA Leads Country in Energy Efficiency

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

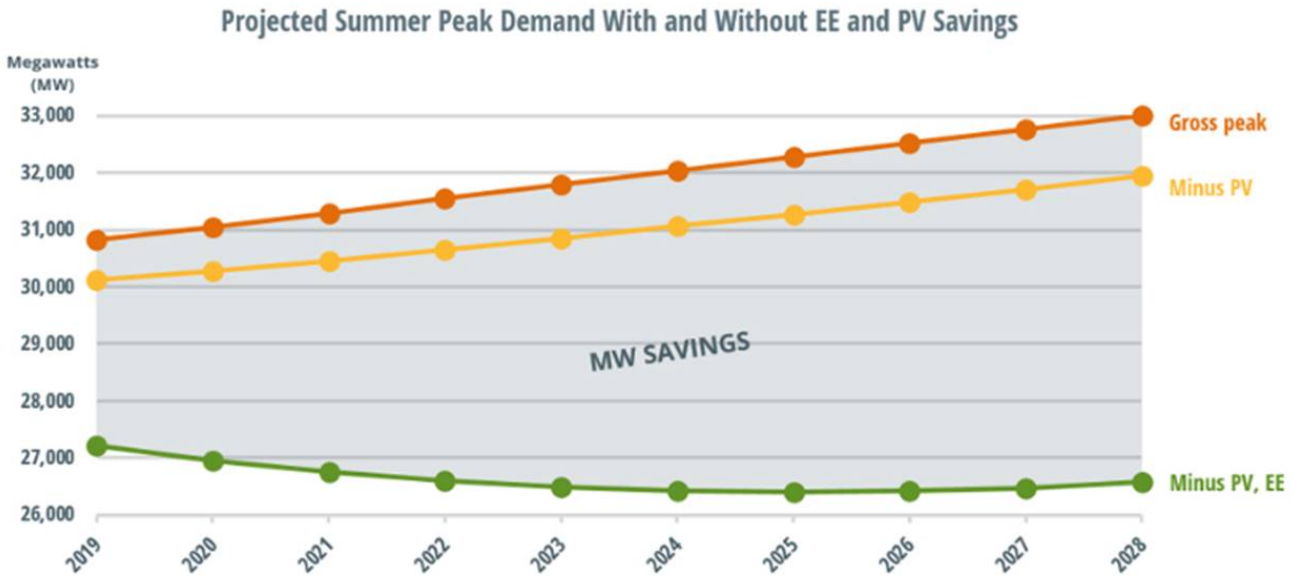




Source: aceee.org

Energy Efficiency Impact on Peak Demand

- Three Year Energy Efficiency Plans in MA consistently have the most aggressive goals in U.S.
  - $9.3 billion in benefits
  - Electric savings goals to reflect expansion in programs like fuel switching and peak demand
  - Highest gas savings goals to date



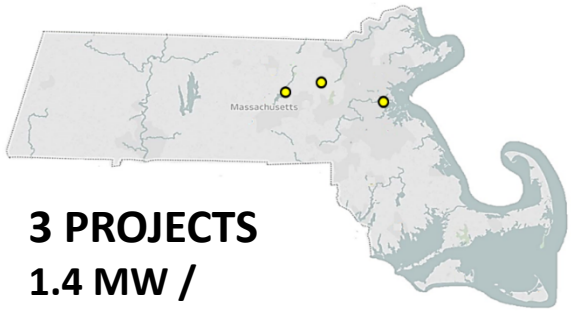
Note: Summer peak demand is based on the "90/10" forecast, which accounts for the possibility of extreme summer weather.

Source: ISO New England, *2019 CELT Report* (May 1, 2019)

Energy Storage Across MA

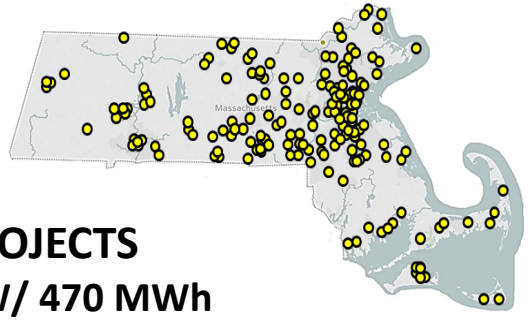
- Energy Storage Initiative
  - 2016 State of Charge Study
  - $20M Advancing Commonwealth Energy Storage (ACES) Grant
  - 26 projects for 32 MW / 85 MWh
  - Goal of 1,000 MWh energy storage by end of 2025
- On 2/15/20, Energy Distribution Companies reported 108 MWh of installed energy storage with an additional 1,086 MWh in the pipeline

2015



3 PROJECTS
1.4 MW /
0.45MWh

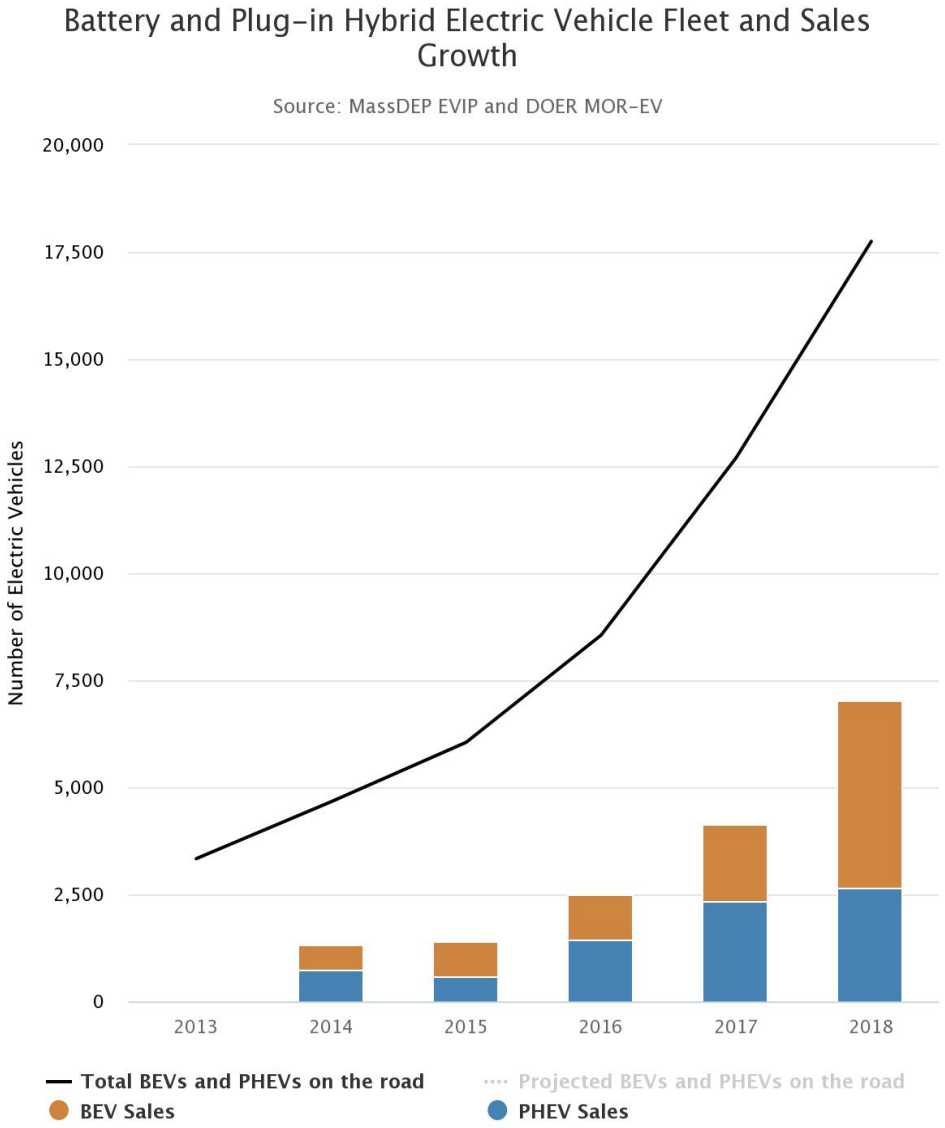
2019



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

EVs on the Road

- State goal to have 300,000 EVs on road by 2025
- Number of EVs on road grew from 3,333 in 2013 to over 17,700 in 2018
- Over 15,000 rebates totaling over $31 million have been issued through MOR-EV since 2014

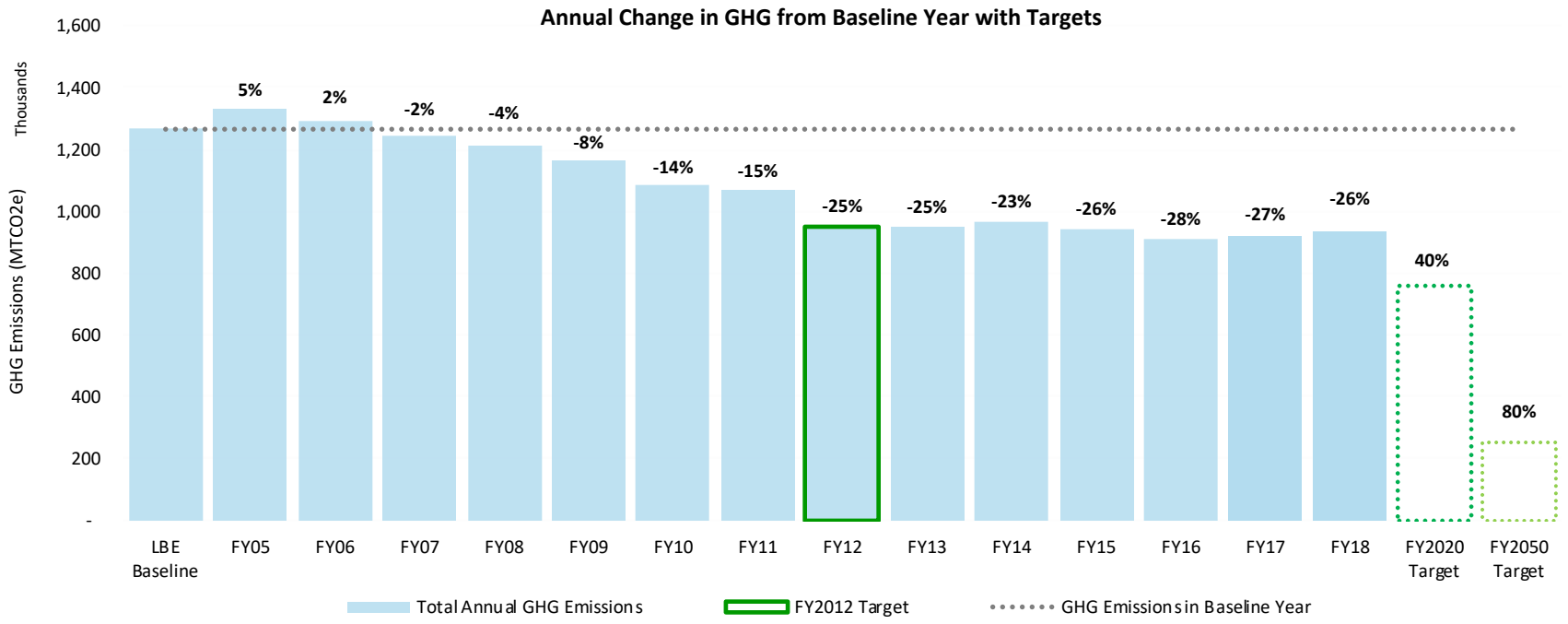


Sources: MOR-EV, Mass.gov

Tracking LBE Progress

LBE Progress Tracking: GHG Emissions

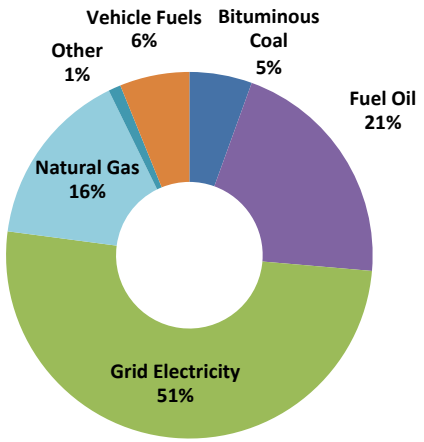
- Overall GHG emissions associated with state operations decreased by 330,690 metric tons, equivalent to a **26%** reduction



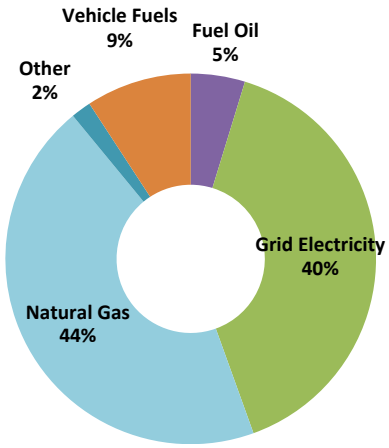
Annual Emissions by Fuel

- **Emissions from fossil fuel combustion increased from 37 to 49 % of total**
- Emissions from grid electricity decreased from 51 to 40% of total
- Natural gas is now the largest source of emissions while fuel oil now only constitutes 5% of the total
- Emissions from **vehicle fuels** are **<10% of total**

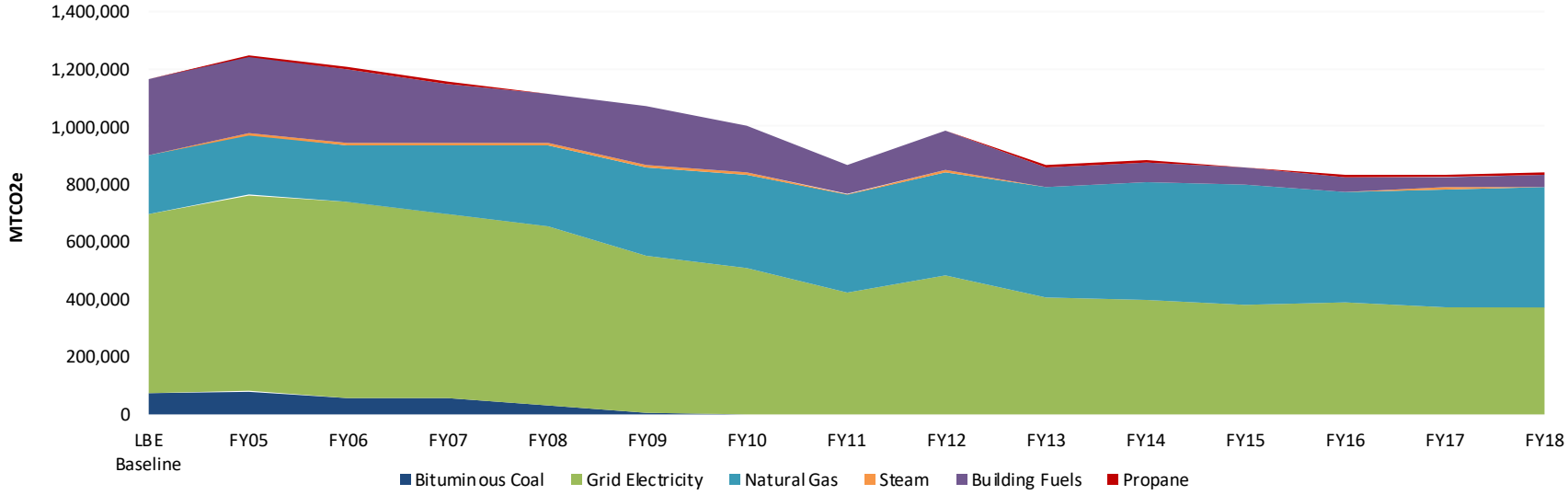
Emissions Contribution by Fuel --LBE Baseline



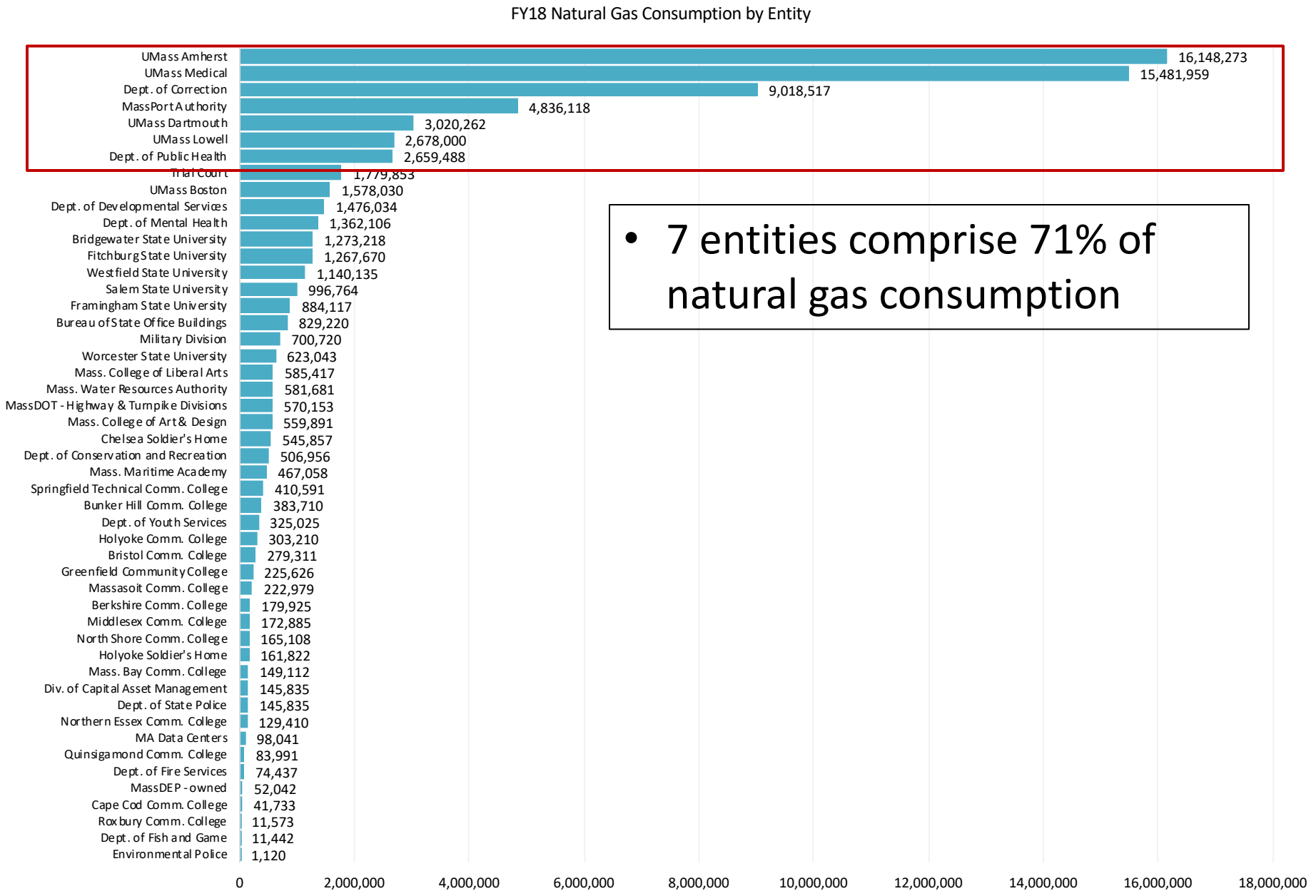
Emissions Contribution by Fuel -- FY18



Annual Emissions from Building Fuels



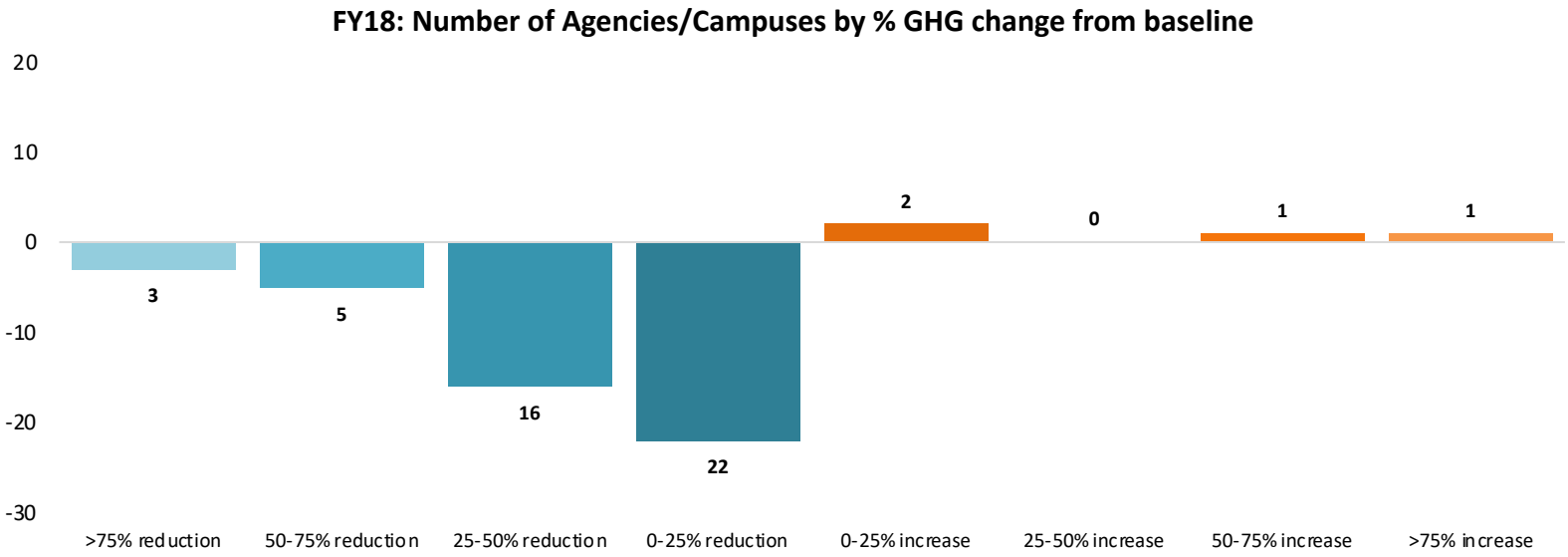
LBE Progress Tracking: Largest Natural Gas Users



- 7 entities comprise 71% of natural gas consumption

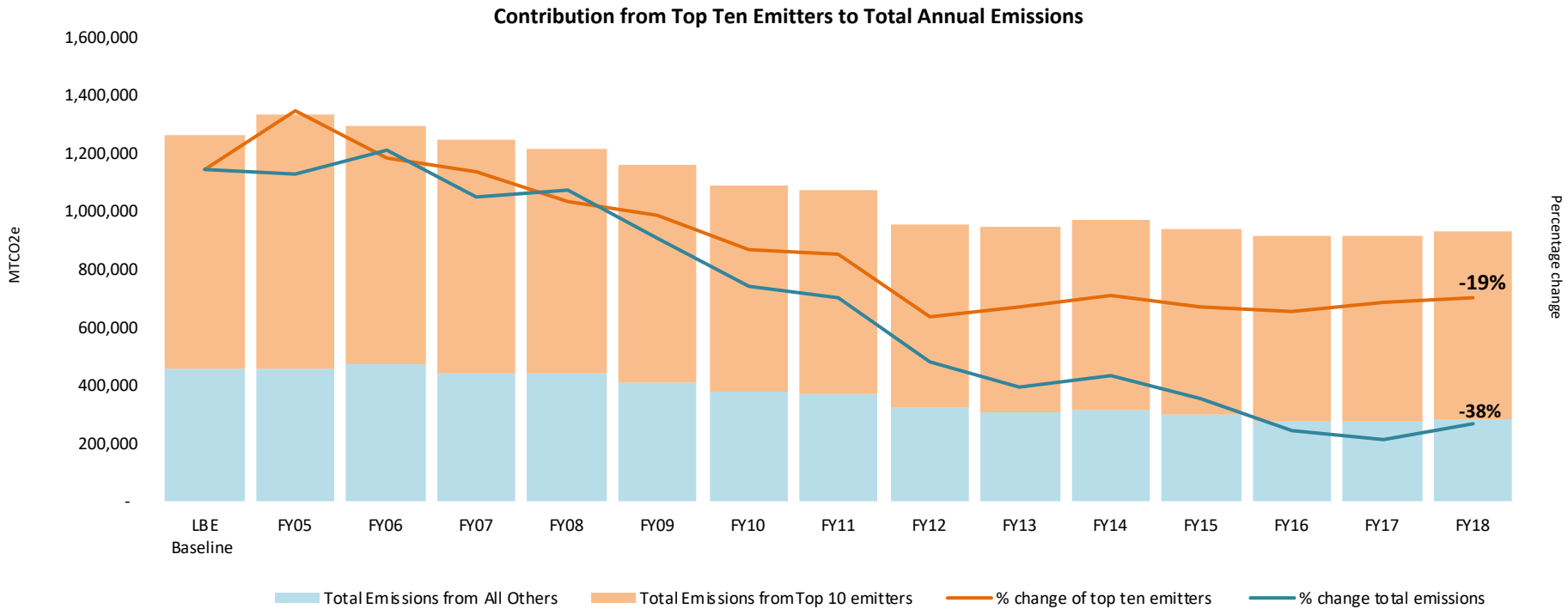
LBE Progress Tracking: GHG Emissions

- **46 of 50 (92%)** of LBE partners reduced emissions from the LBE baseline
- **2/3** of partners reduced emissions between **1-50%**
- **6 partners** reduced emissions by **more than 50%**
- **4 partners increased** emissions, varying between **3% and 119 %**



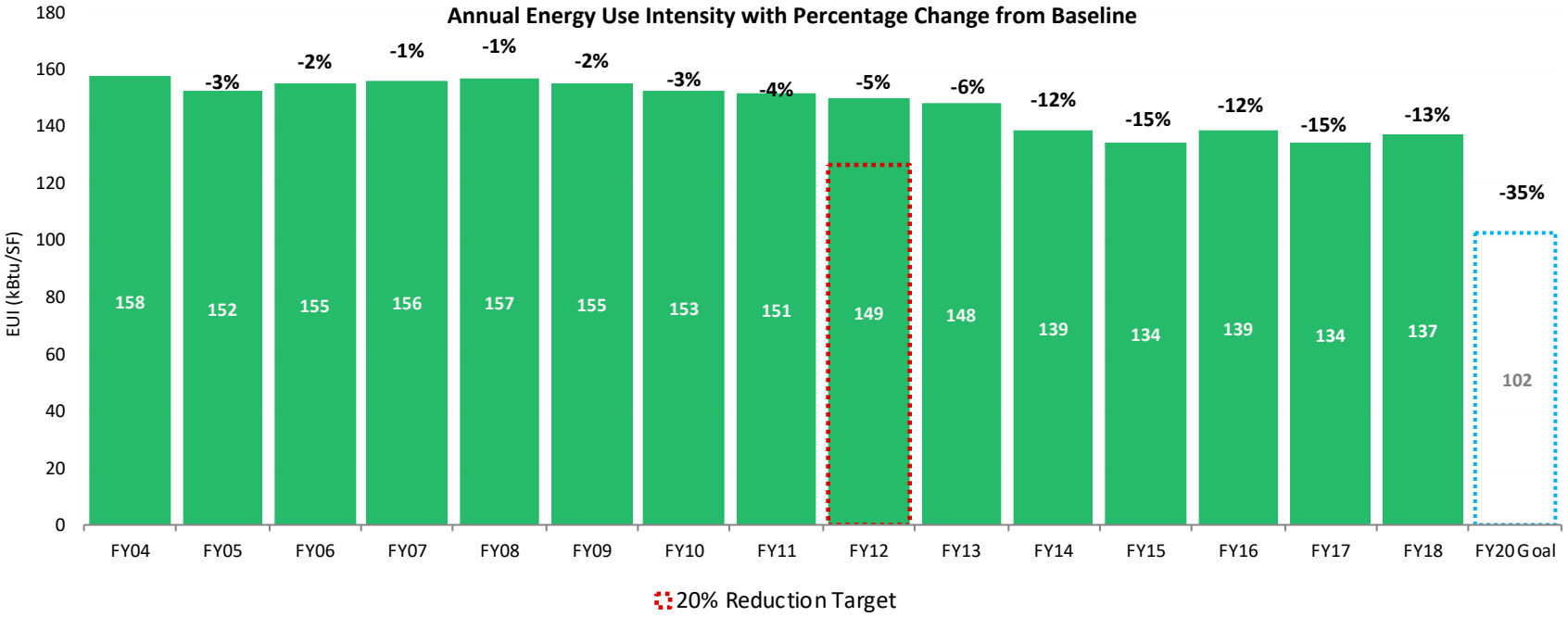
LBE Progress Tracking: GHG Emissions

Emissions from **non-top emitters have declined 38**%, while emissions from the **top 10 have declined 19%,** resulting in overall portfolio progress of a 26% reduction



LBE Progress Tracking: Energy Use Intensity

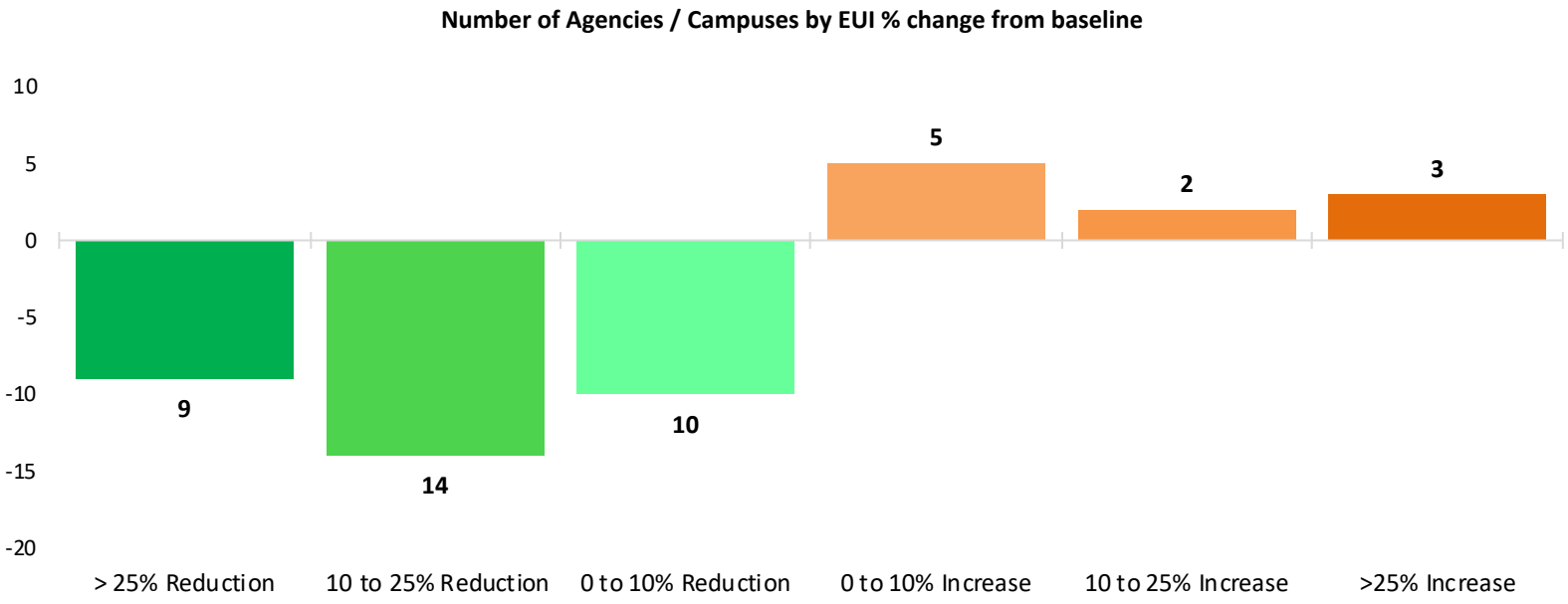
- As of FY18, overall portfolio EUI was 137 kBtu per square foot
- EUI reduction of 13% from 2004 baseline



*LBE does not track square footage or EUI for 5 of the 49 state agencies/campuses, due to the nature of energy and facility use at these sites.

LBE Progress Tracking: Energy Use Intensity

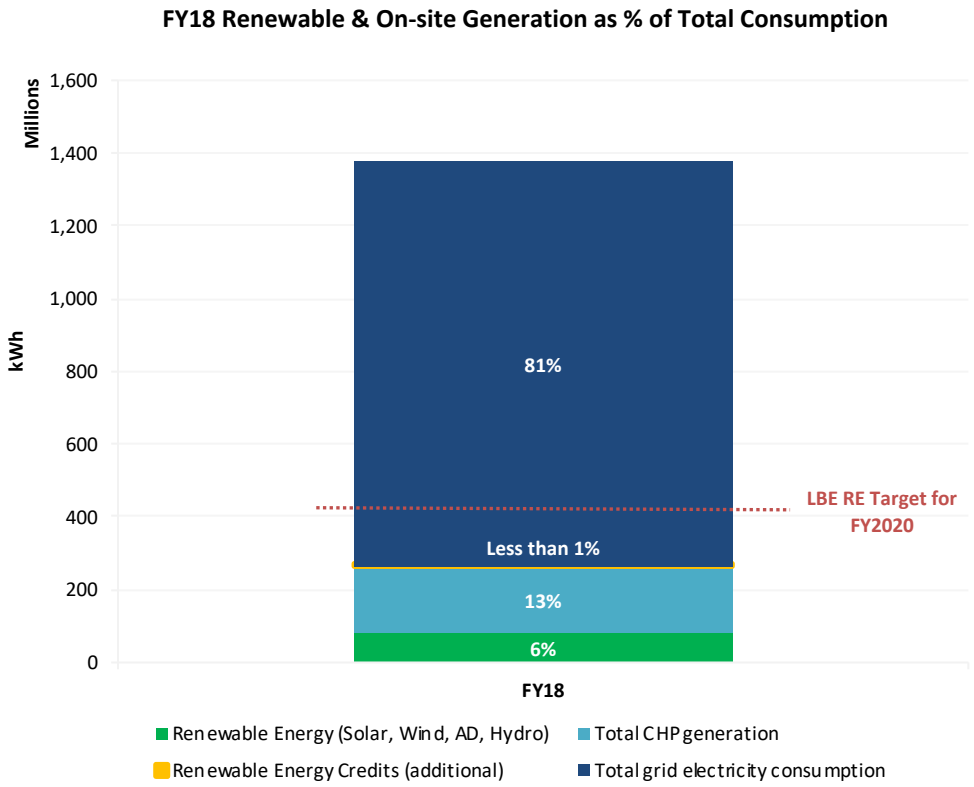
- **33 of 43 (76%)** of LBE partners reduced EUI from the 2004 baseline
- **Roughly ½** of partners reduced EUI between **1-25%**
- **9 partners** reduced EUI by **more than 25%**
- **10 partners increased** EUI, varying between **1% and 88 %**



LBE Progress Tracking: On-site Generation

Of the roughly **1.4 billion kWh of electricity consumed**,
79 million kWh (equivalent to 6% of total) was generated by **onsite renewable power**
& **185 million kWh** (equivalent to 13% of total) was generated by **onsite clean CHP**.

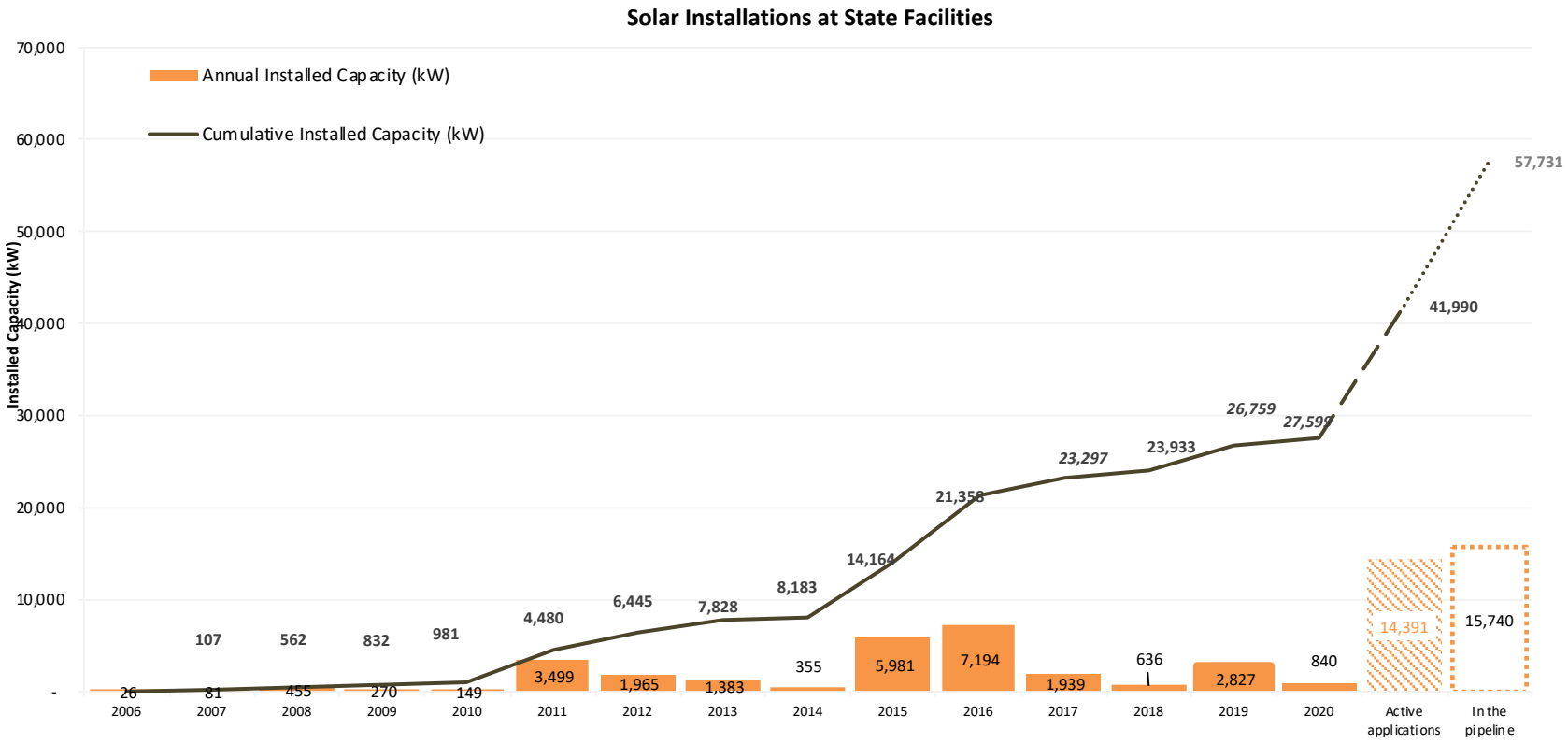
* this data does not account for the renewable attributes and total percentages are based on equivalencies



LBE Progress Tracking: Solar

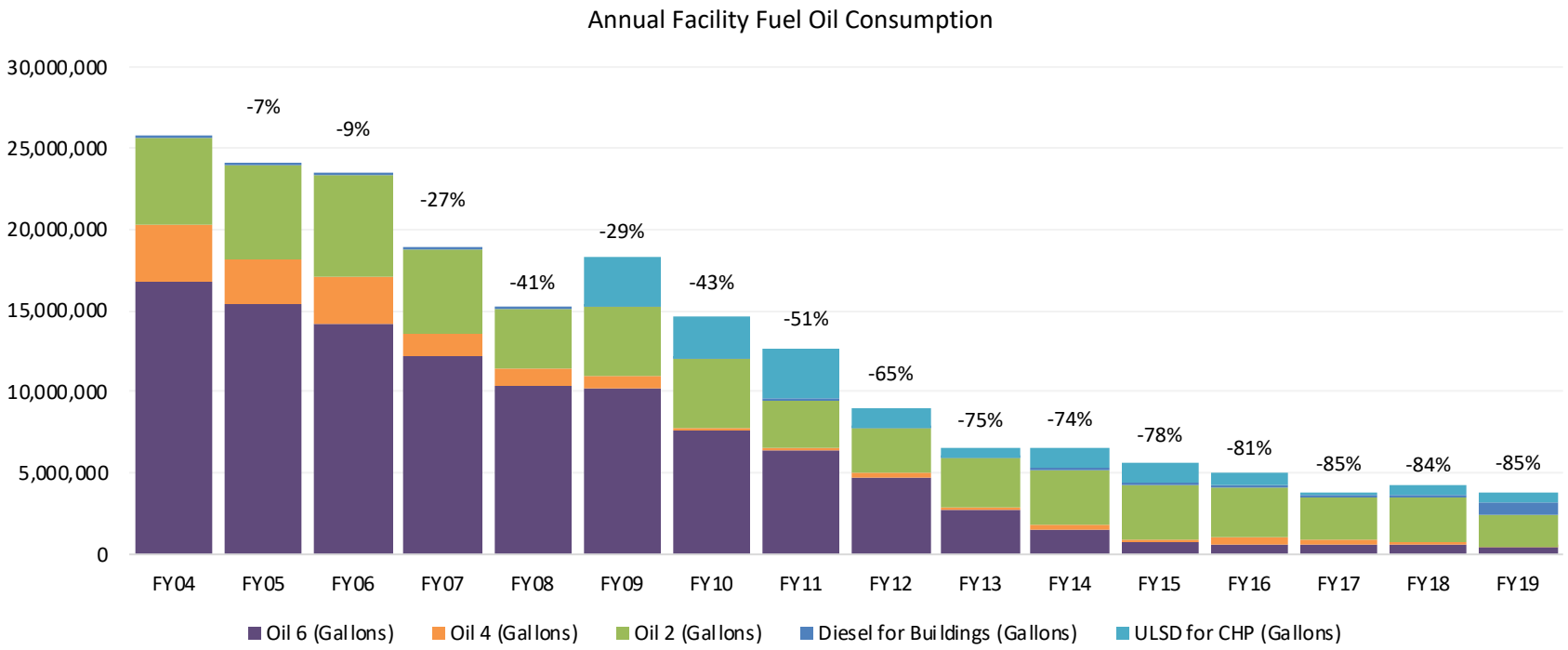
Over **27 MW of solar capacity** has been installed at state facilities

- 12.7 MW of solar canopy (47% of total capacity)
- Installed capacity could double with planned and potential projects



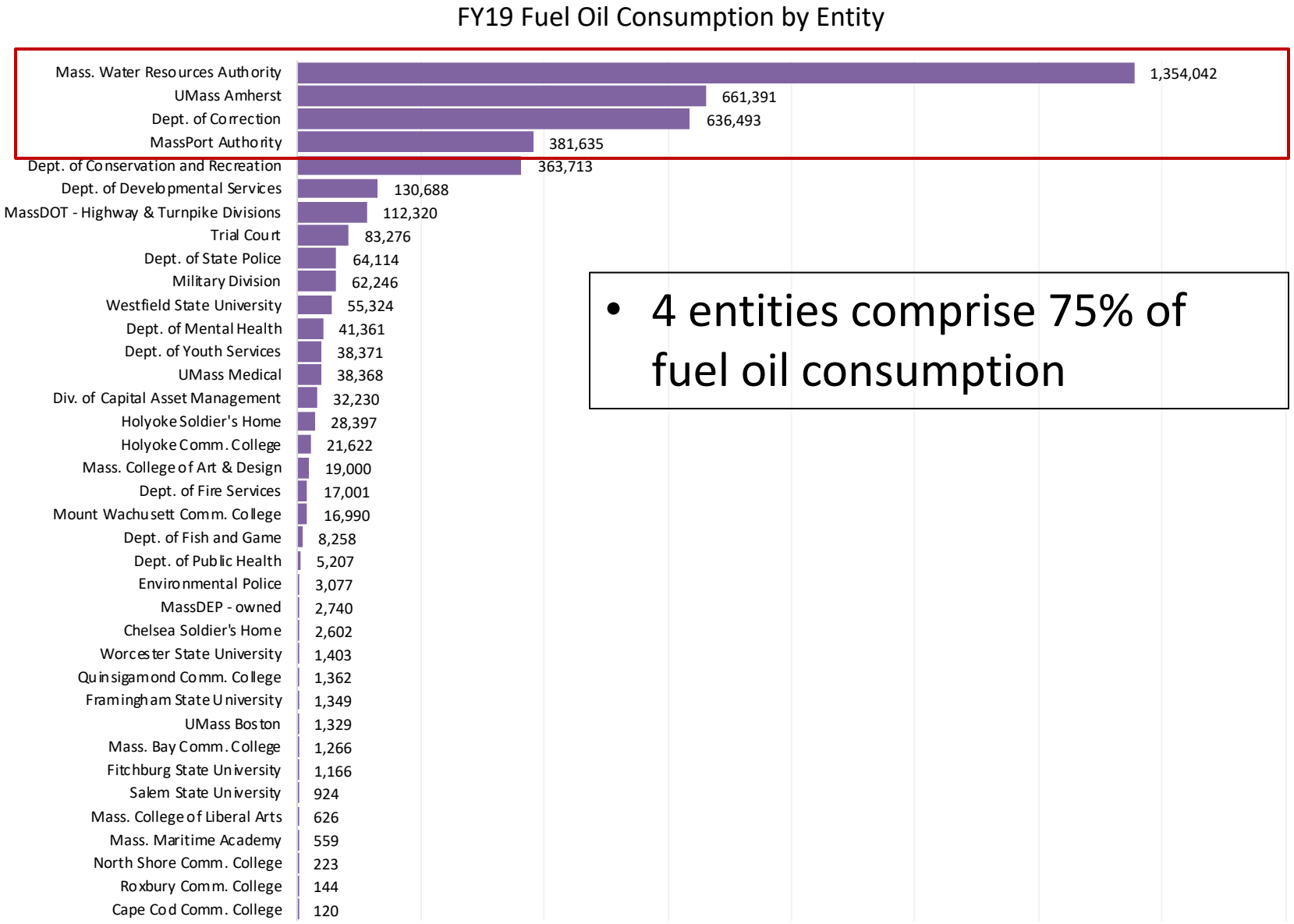
LBE Progress Tracking: Facility Fuel Oil

Overall fuel oil consumption at facilities has **decreased 85%**, a reduction of nearly **22 million gallons**.



*Oil consumption for vehicles and maritime vessels not included

LBE Progress Tracking: Largest Oil Users

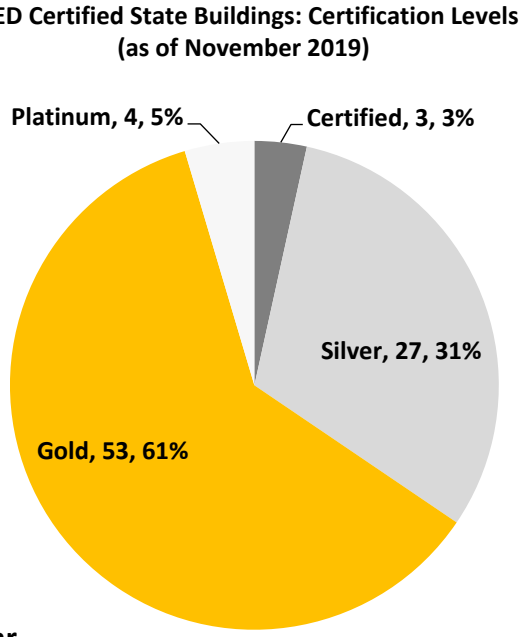


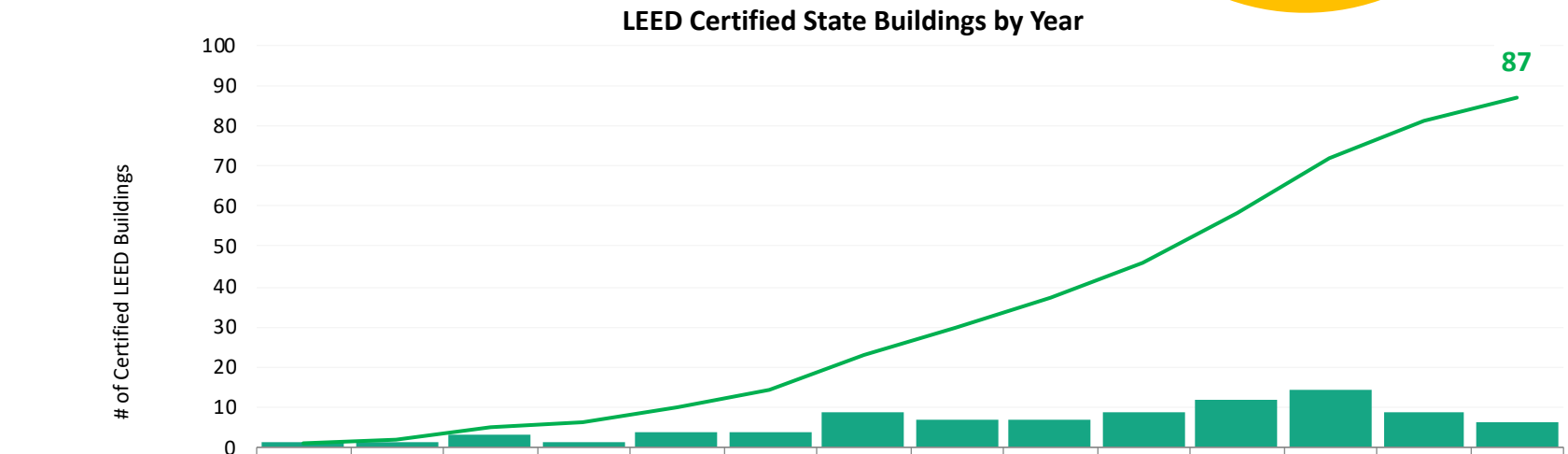
- 4 entities comprise 75% of fuel oil consumption

LBE Progress Tracking: Green Buildings

87 LEED certified state-owned buildings, 65% at the **Platinum & Gold** levels

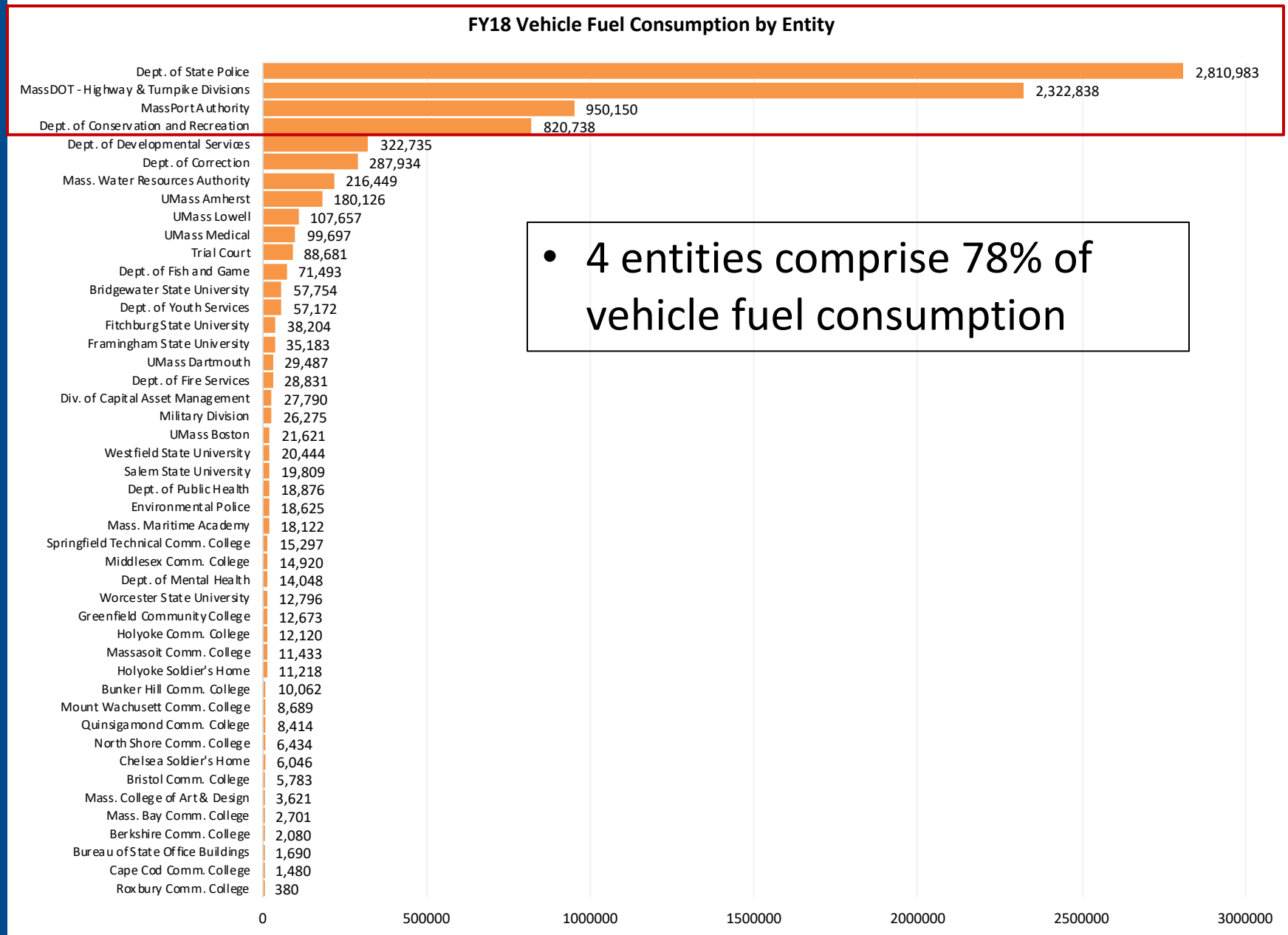
- 5 buildings designed to zero-net energy, with 3 achieving ZNE in 2018





	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 (to date)
# Certified by Year	1	1	3	1	4	4	9	7	7	9	12	14	9	6
Cumulative Certified	1	2	5	6	10	14	23	30	37	46	58	72	81	87

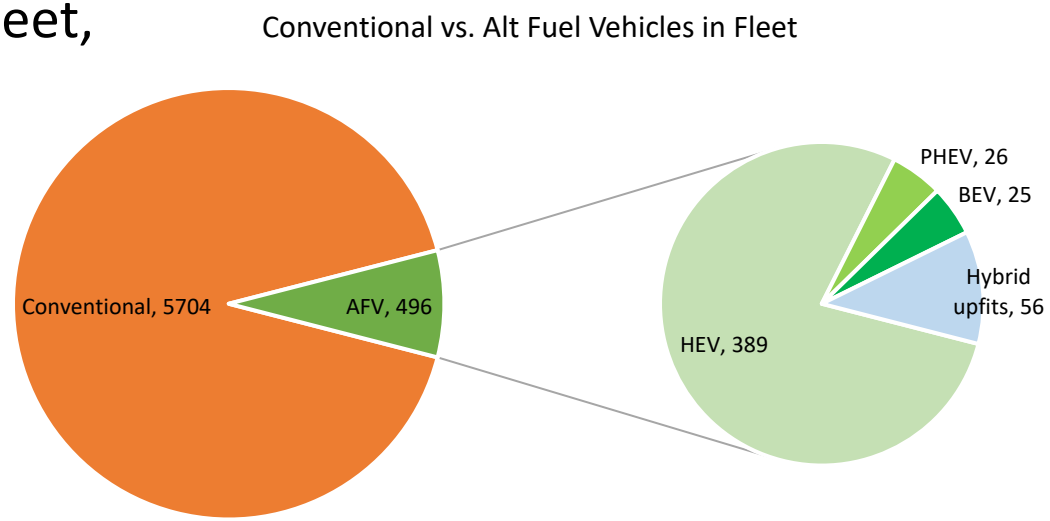
Clean Transportation: Vehicles



- 4 entities comprise 78% of vehicle fuel consumption

Clean Transportation: Vehicles

- Out of ~6,500 vehicle fleet, **550 (8%) are AFV**
  - 434 HEV
  - 28 PHEV
  - 32 BEV
  - 56 hybrid upfits



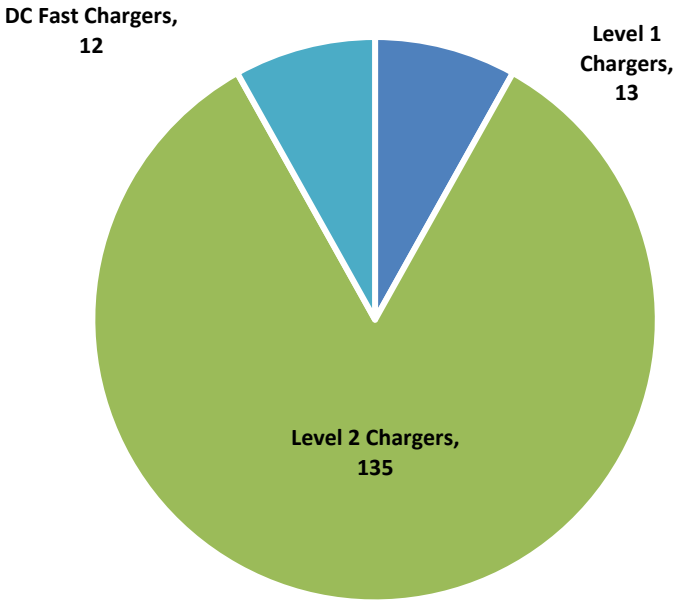
	Total Entities Included	Light-Duty Fleet Total	AFV Total	% of Fleet
Agencies	58	3,550	278	8%
Higher Ed	21	1,300	110	8%
MassDOT, MassPort & MWRA	3	1,650	162	10%
TOTAL	82	6,500	550	8%

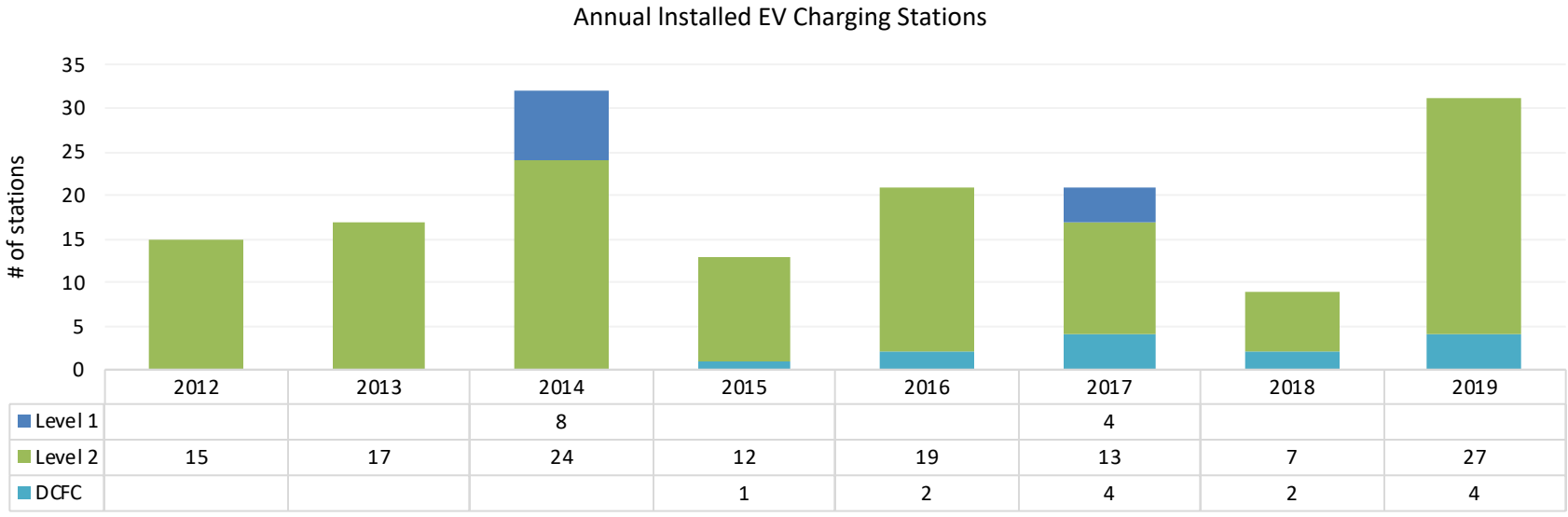
AFVs included in this total: HEV, PHEV, and BEVs

Clean Transportation: EV Charging Stations

As of January 2020, **160 EV charging stations are installed** across state facilities

- More than half installed since 2015
- 85 percent Level 2 chargers





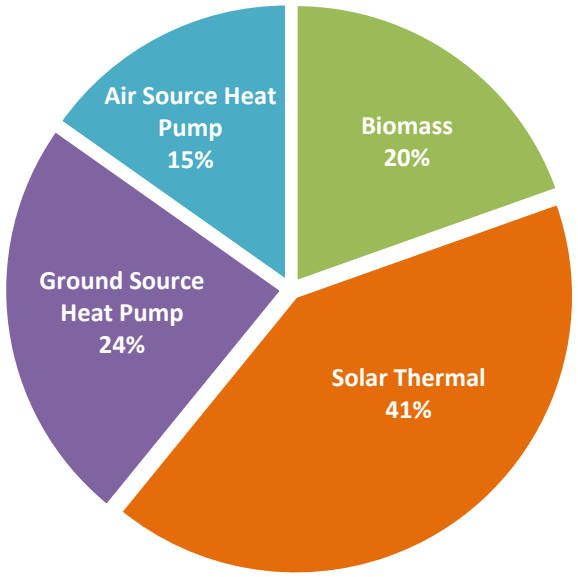
	2012	2013	2014	2015	2016	2017	2018	2019
Level 1			8			4		
Level 2	15	17	24	12	19	13	7	27
DCFC				1	2	4	2	4

Renewable Thermal

46 renewable thermal systems have been installed at state facilities

- 19 solar thermal systems
- 11 ground source heat pumps
- 9 biomass systems
- 7 air source heat pumps

Renewable Thermal Installations



Sustainable Landscapes

Massachusetts Leading by Example

State Government Progress Data: Sustainable Landscapes

260

Total Acres of Sustainable Landscaping & Green Roofs at MA State Sites

221	29	0.8	89
Acres of Limited Mow Zones at MA State Sites	Acres of Managed Wildflower Meadow and Pollinator Gardens at MA State Sites	Acres of Green Roofs at MA State Sites	Number of Pollinator Habitats on State Lands
39 Acres Since 2015	*23 Acres Since 2015*	*0.1 Acres Since 2015*	*59 Habitats Since 2015*

- Ongoing additions to LBE Interactive Map
- Pollinator habitat working group convened in May and September
- Development of Guidance, Calculator, and seed sources

MassDOT – Brookfield Wildflower Meadow

UMass Lowell Pollinator Garden

Agency and Campus Success Stories and Lessons Learned

Mass Department of Transportation
The Past and Future of Solar Projects and Public Charging Stations

Don Pettey
Program Manager for Strategic Initiatives
MassDOT-Highway

Public DCFC Charging Stations

2017-2018

- Installed six 50 KW DCFC Dual Port (CHAdeMO and Universal) stations at six Service Plazas on I-90
- Started charging a $0.30/minute fee for charging sessions
- Quickly discovered that monthly demand costs far exceed revenue from charging sessions

2019

- Submitted Applications to Eversource Make Ready Program
  - Nine Sites
  - Approximately 10 DCFC stations, 20 -dual port Level-II at Service Plazas and Park & Rides
- Assigned CMAQ funds for installation of EV Charging Stations
- Posted RFR for vendor to supply and install stations under Make Ready

2020-2021

- Expect to award contract to vendor in May or April
- Complete site host agreements for Make Ready Program in April-May
- Begin/Complete station installations.

MassDOT Public Charging Station Use

Usage Summary

12M

Name	Value
DC Sessions	3,798
DC Minutes	108,838
DC kWh	54,689.798
L2 Sessions	0
L2 Minutes	0
L2 kWh	0
Total Sessions	3,798
Minutes	108,838
kWh	54,689.798
EV Miles Powered	170,906
GHG Avoided (MT)	38.8
Gas Avoided (Gal)	7,033

Totals And Vehicle Avgs By Market

12M

Market	Vehic	Tot Sess	Tot Min	Tot kWh	Avg Sess	Avg Min	Avg kWh
ALBANY-SCHENECTADY-T	322	805	25,822	13,252.044	2.5	80.19	41.16
BOSTON (MANCHESTER)	886	2,993	83,016	41,437.754	3.38	93.7	46.77

Top Properties by Sessions List

Records: 10 Filter 12M

Rank	Property	Prop Ref	Market	City	State	Vehicles	Sessions	Minutes	kWh	% of Tot Util	% of Station Sat
1	Framingham Service Plaza		BOSTON (MANCHESTER)	Framingham	MA	273	861	26,270	12,986.963	24.14%	5.00%
2	Natick Service Plaza		BOSTON (MANCHESTER)	Natick	MA	329	860	22,187	11,142.702	20.39%	4.22%
3	Charlton Service Plaza Westbound		BOSTON (MANCHESTER)	Charlton	MA	381	705	18,963	9,544.943	17.42%	3.61%
4	Charleston Service Plaza Eastbound		BOSTON (MANCHESTER)	Charlton	MA	332	567	15,596	7,763.146	14.33%	2.97%
5	Lee Service Plaza Westbound		ALBANY-SCHENECTADY-TROY	Lee	MA	211	416	13,670	7,138.907	12.56%	2.60%
6	Lee Service Plaza Eastbound		ALBANY-SCHENECTADY-TROY	Lee	MA	216	389	12,152	6,113.137	11.17%	2.31%

Sessions By Weekday Hour

12M

Week Day	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM
Monday	4	2	6	2	4	15	13	11	22	31	30	33	38	41	36	30	46	25	23	21	13	20	6	5
Tuesday	4	3	3	7	2	3	19	30	28	37	24	35	20	28	24	29	37	46	32	24	21	17	11	5
Wednesday	3	7	3	2	4	4	14	26	22	28	26	25	30	30	26	34	35	43	23	26	16	21	10	5
Thursday	7	3	3	4	2	9	14	16	14	28	28	25	31	34	40	34	38	29	25	24	17	12	17	11
Friday	10	6	6	6	3	7	19	22	21	38	25	34	38	36	40	38	47	50	57	30	25	18	29	8
Saturday	11	3	3	4	6	7	12	22	24	38	40	51	51	41	58	48	48	45	23	25	27	18	27	11
Sunday	9	8	4	1	5	4	8	10	18	24	46	49	50	39	55	56	51	55	49	35	33	17	15	7

MassDOT Solar Projects

- Installed 4.3 MW of PV on eight sites under SREC-II
- Seven sites are ground mounted systems.
  - Systems came online between Aug 2015 – Oct 2017
- Hopkinton Research & Materials Facility, 550 kW, 500 kW Canopy, 50kW rooftop.
  - System operation began February 2018
- To date these sites have combined production of 18,160,000 kWh
  - Estimated savings of $1.7 million dollars

Future of MassDOT Solar

- Seeking to install another 1.2 MW of PV (Canopy) at three Park & Rides in Eversource territory under SMART.
- Install approximately 500kW system on a section of noise barrier as a pilot study.

Electric Vehicle Charging

Suzanne Wood, UMass Medical School

University of Massachusetts Medical School
umassmed.edu

Program Overview

Infrastructure

- West Garage
  - 2 Level II, single head Eaton chargers
  - 3 Tesla Wall Chargers
  - 6 level I, 120V outlets
- Planation Street Garage
  - 4 Level II, dual head Charge Point Charger

Payment

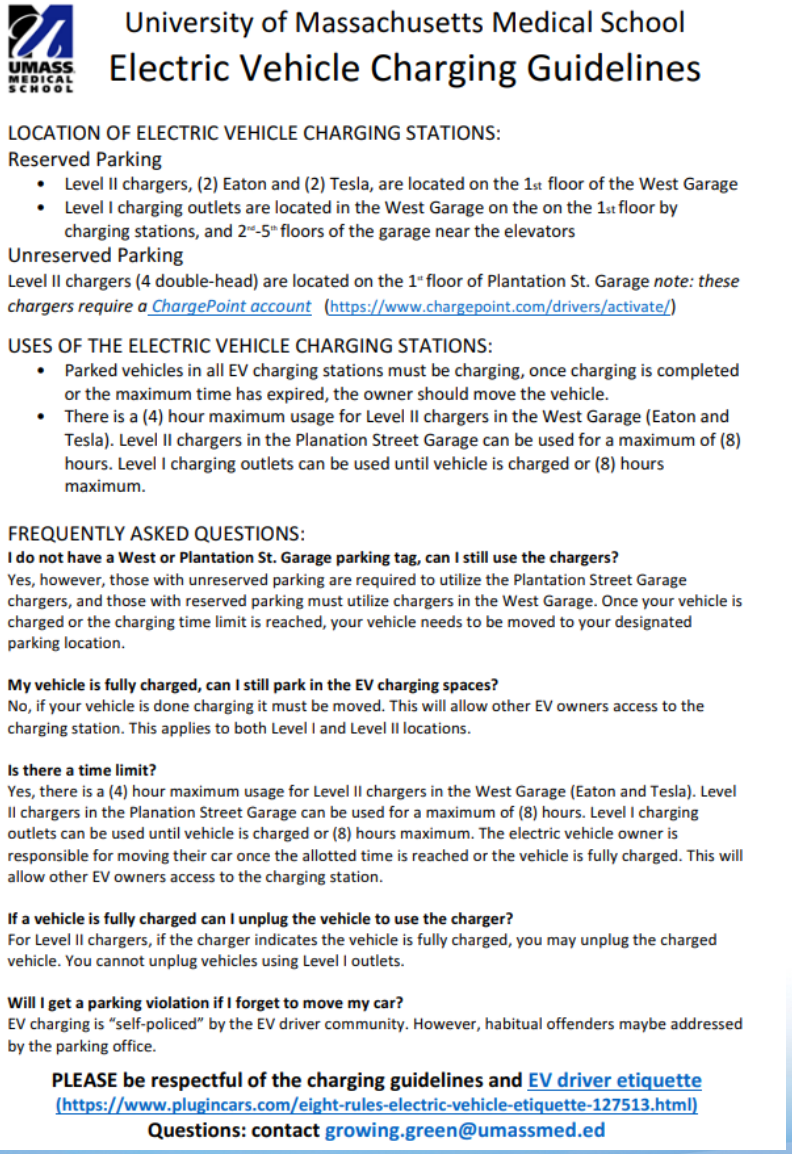
- FREE with parking pass

Time limit

- Level II, Easton & Tesla Charger – 4 hours
- Level I & ChargePoint dual heads – 8 hours

Enforcement

- "self-policed"



University of Massachusetts Medical School

Electric Vehicle Charging Guidelines

LOCATION OF ELECTRIC VEHICLE CHARGING STATIONS:

Reserved Parking

- Level II chargers, (2) Eaton and (2) Tesla, are located on the 1st floor of the West Garage
- Level I charging outlets are located in the West Garage on the on the 1st floor by charging stations, and 2nd-5th floors of the garage near the elevators

Unreserved Parking

Level II chargers (4 double-head) are located on the 1st floor of Plantation St. Garage *note: these chargers require a ChargePoint account* (https://www.chargepoint.com/drivers/activate/)

USES OF THE ELECTRIC VEHICLE CHARGING STATIONS:

- Parked vehicles in all EV charging stations must be charging, once charging is completed or the maximum time has expired, the owner should move the vehicle.
- There is a (4) hour maximum usage for Level II chargers in the West Garage (Eaton and Tesla). Level II chargers in the Planation Street Garage can be used for a maximum of (8) hours. Level I charging outlets can be used until vehicle is charged or (8) hours maximum.

FREQUENTLY ASKED QUESTIONS:

I do not have a West or Plantation St. Garage parking tag, can I still use the chargers?
Yes, however, those with unreserved parking are required to utilize the Plantation Street Garage chargers, and those with reserved parking must utilize chargers in the West Garage. Once your vehicle is charged or the charging time limit is reached, your vehicle needs to be moved to your designated parking location.

My vehicle is fully charged, can I still park in the EV charging spaces?
No, if your vehicle is done charging it must be moved. This will allow other EV owners access to the charging station. This applies to both Level I and Level II locations.

Is there a time limit?
Yes, there is a (4) hour maximum usage for Level II chargers in the West Garage (Eaton and Tesla). Level II chargers in the Planation Street Garage can be used for a maximum of (8) hours. Level I charging outlets can be used until vehicle is charged or (8) hours maximum. The electric vehicle owner is responsible for moving their car once the allotted time is reached or the vehicle is fully charged. This will allow other EV owners access to the charging station.

If a vehicle is fully charged can I unplug the vehicle to use the charger?
For Level II chargers, if the charger indicates the vehicle is fully charged, you may unplug the charged vehicle. You cannot unplug vehicles using Level I outlets.

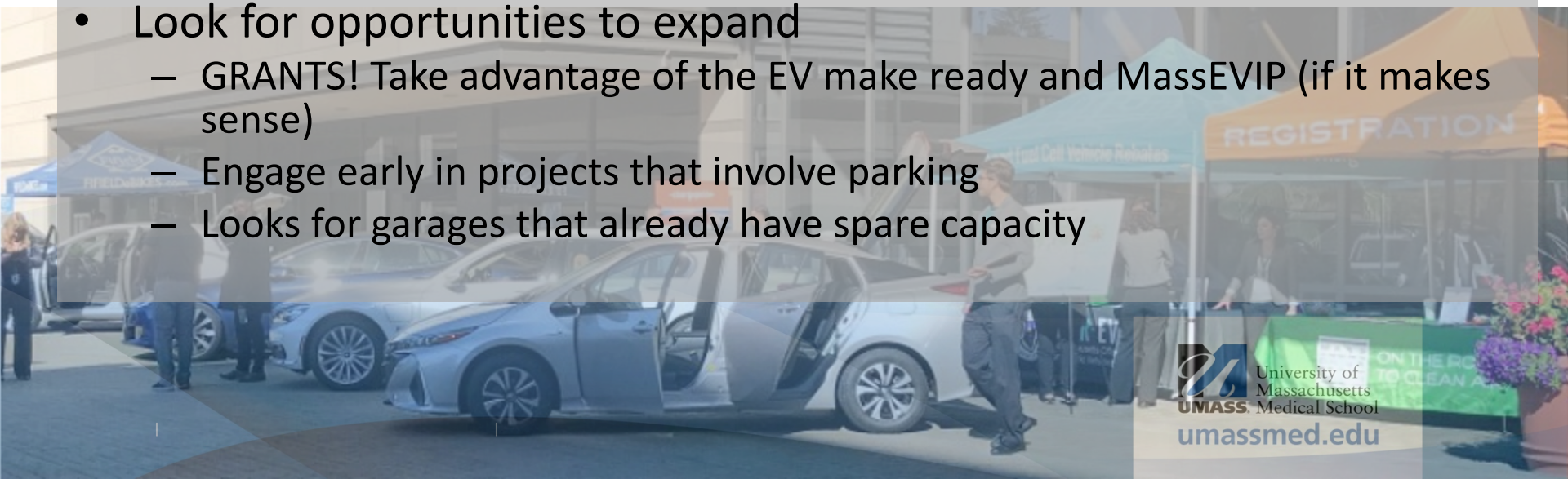
Will I get a parking violation if I forget to move my car?
EV charging is "self-policed" by the EV driver community. However, habitual offenders maybe addressed by the parking office.

PLEASE be respectful of the charging guidelines and EV driver etiquette (https://www.plugincars.com/eight-rules-electric-vehicle-etiquette-127513.html)

Questions: contact growing.green@umassmed.ed

Best Practices

- Engage stakeholders
  - Meet at least annually with EV Drivers on campus to revise charging policy and improve charging program
  - Host Ride & Drives
- Track EV drivers
  - Register with parking office and get a sticker for their parking tag
- Audit/track utilization
  - Interns audit during the summer to check utilization of chargers and if guidelines are being followed
- Look for opportunities to expand
  - GRANTS! Take advantage of the EV make ready and MassEVIP (if it makes sense)
  - Engage early in projects that involve parking
  - Looks for garages that already have spare capacity



Challenges & Lesson Learned

- Inconsistent infrastructure
  - This makes is challenging to have a pay-for-charge program
  - Hard/impossible to track utilization data
- Equity issues
  - Tesla chargers vs “the rest”
- Enforcement
  - Balance between not wanting to enforce the charging policy with ticketing and justifying additional infrastructure
- What does the future of EV charging really look like?
  - Where will people charge in the future
  - How many chargers to install with new construction projects – is 10% enough?

Future Plans

- Move to consistent infrastructure
  - Opportunity with NERB and the loss current EV charging in the West Garage
- Additional Charger
  - Patient Visitor Garage – 18 dual head chargers
  - Plantation Street – capacity for 4 add't dual head chargers
- Pay-for-charge program
  - Support charging program

Sustainability in the Executive Office of Health and Human Services (EOHHS)

Successes and Lessons Learned over the Years

Asya Rozental, EOHHS Facilities
Joe Hogan, Dept. of Youth Services

EOHHS Overview

EOHHS owns 29 campuses for six agencies:

- DDS
- DMH
- DPH
- DYS
- Chelsea Soldiers' Home
- Holyoke Soldiers' Home

Over 2,000 acres of land and 6,000,000 SF of buildings distributed throughout the state (much of it aging)

- 24/7 hospitals, mental health centers and long-term care
- Group homes
- DYS facilities
- Administrative offices

Populations vary greatly with unique needs

- Co-occurring disorders
- Children
- Staff and clients
- Veterans
- Residents with varying abilities

A Few Projects over the Years

- Energy design builds at many of our facilities, including Pappas Hospital, Jamaica Plain Lab, DYS Western and Metropolitan, Taunton State Hospital and Holyoke Soldiers Home
- Biomass Boiler at DYS Connelly
- DDS group homes heating and thermal improvements, including studies for thermostatic control valves
- New facilities and major opportunities:
  - Worcester Recovery Center and Hospital 2013
    - LEED Gold
  - Chelsea Soldiers' Home CLC 2022
  - Shattuck Hospital to Newton Pavilion
- Looking at the future:
  - Sustainable landscapes, including pollinator habitats and no/low mow zones
  - Utilizing energy resilience assessments

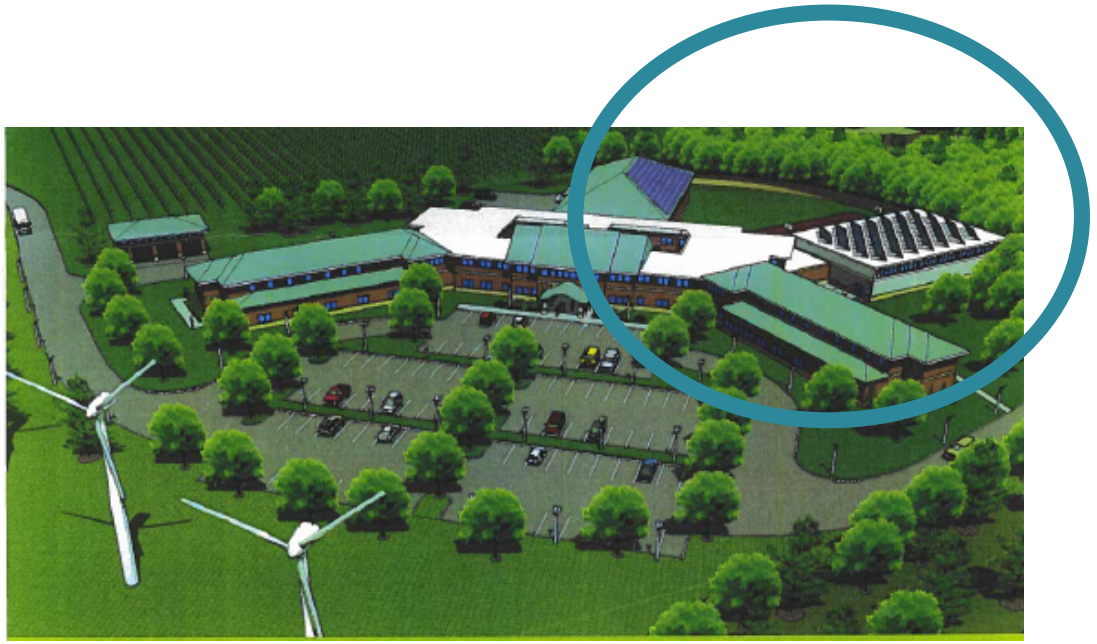
Highlighting Department of Youth Services (DYS)

Middleton

- Case Study: DYS 33 Gregory Street, Middleton, MA
  - LEED Certified
  - Completed in 2016
  - Project cost: $47 million
- Designed to have photovoltaic arrays, but project cost caused this to be value engineered out
- DCAMM and DYS put infrastructure in place for photovoltaic project in the future

Department of Youth Services (DYS)

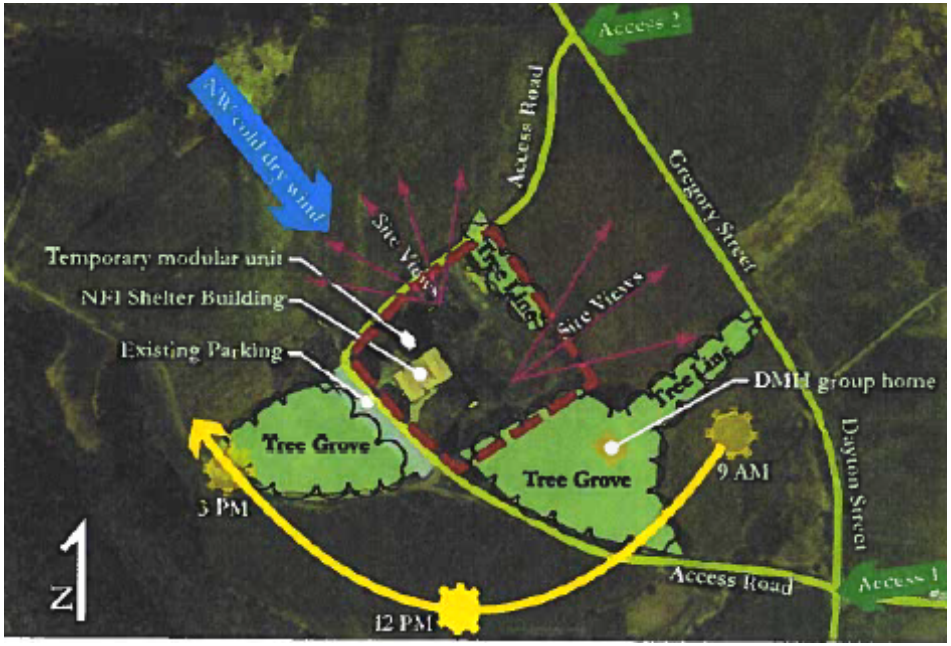
Middleton



Photovoltaic included in 2008 study
(Building main axis: due east/west)

Department of Youth Services (DYS)

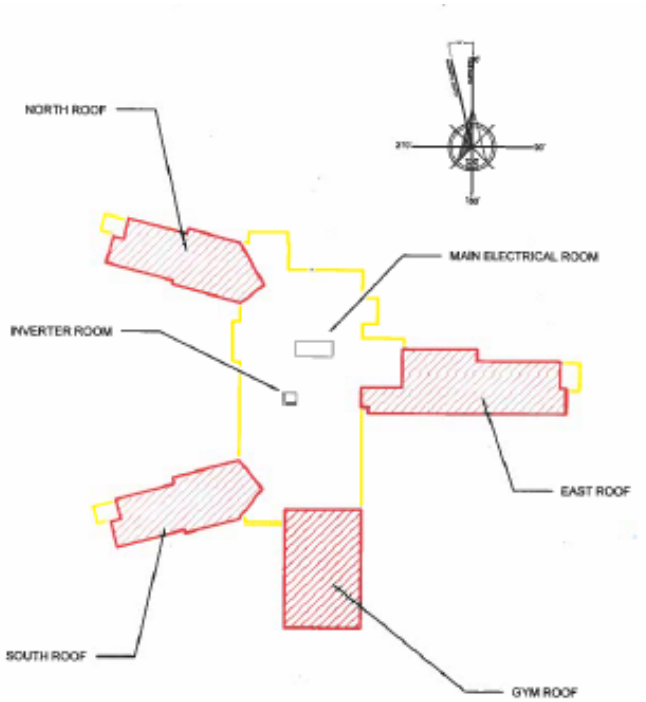
Middleton



Physical conditions assessment from original 2008 study

Department of Youth Services (DYS)

Middleton



New 100.44 kW Rooftop Solar Photovoltaic System

Department of Youth Services (DYS)

Middleton

- A partnership with DOER ($65,000 grant), DYS capital investment ($285,000) and DCAMM project management has brought us to the point of finishing the system that was originally intended. Bid process is currently underway.
- Lessons learned:
  - Include infrastructure into design and construction when energy solutions are value engineered out
  - Not always a negative to delay installation due to new technologies
  - Need to continue conversations so infrastructure is not forgotten

Success with Aging Buildings

Lessons Learned

How do we provide modern services in aging facilities? Tips from Chelsea Soldiers' Home:

- Take advantage of rebate programs and matching fund offers from utilities
- Through Eversource, the Home was able to complete several energy-efficient projects totaling $80,000 with annual savings of $24,000, including:
  - Aging lighting fixtures changed to more energy-efficient fixtures
  - Incandescent and compact fluorescent exit signs were retrofitted to LED
  - Compact fluorescent screw-in bulbs replaced older inefficient incandescent bulbs and lighting controls were installed
  - Installed more efficient motors in air handling units

More Lessons Learned

- Involve DOER and DCAMM Energy Group in the beginning of any potential project to see how to include energy-efficient and sustainable options
- Seek out facilities staff and stakeholders staff in planning process
- Network with other agencies and secretariats to learn more about their experiences with grants, new technologies and contractors

Questions?

The Greening of the Department of Correction

Jeffrey J. Quick, A.I.A
Director Division of Resource Management
Department of Correction
Milford, Massachusetts 01757

- How Did This All Start?
- Small Steps, Big Leaps
- Energy Projects and Energy Conservation
- Renewable Projects
- Changing the Way we Work
- Take Advantage of All Opportunities
- Lessons Learned

Background

- 16 Prisons; 10,000+ inmates; 5,300+ acres; 6,100,000+ square feet of buildings.
- **Division of Resource Management** – Involved with all capital projects; new construction, upgrades, renovations, improvements, mission changes, emergency response, utilities, Intra/Inter Agency representation.
- Mission - Excellent Stewardship of the Commonwealth's Physical Resources.

In the Beginning…

- Conservation Program 2000 – Waste Disposal, Electrical and Fuel Savings
- ESCOs 2002 – 2005 and again in 2010-2013
  - Lighting, Water Conservation, Replaced Various Equipment –Boilers, Laundry, Installation of Cogeneration Facilities
- Recycling / Pilot Programs 2002-ongoing
- Demand Response / Forward Capacity 2002 -ongoing
- Available Funding Sources –Massachusetts Technology Collaborative 2004, CREBs (2005 Energy Bill), CREBs 2009
- Driven by Executive Order 484

Cogeneration Electricity and Heat Recovery

Norfolk & Cedar Junction
Cogeneration units w/
heat recovery

Lighting Projects

Lighting is on 24 hours per day at some locations.

Wind Turbines and Photovoltaics

Sustainable Concepts

- Evaluate current uses and how we can make more what we do more efficient.
- How we purchase and follow the material cradle to grave to reduce final disposal costs
- Compare up-keep costs versus a new piece of equipment use and less maintenance.
- Independence and self sufficiency- making what you use – generating electricity.

Lessons Learned

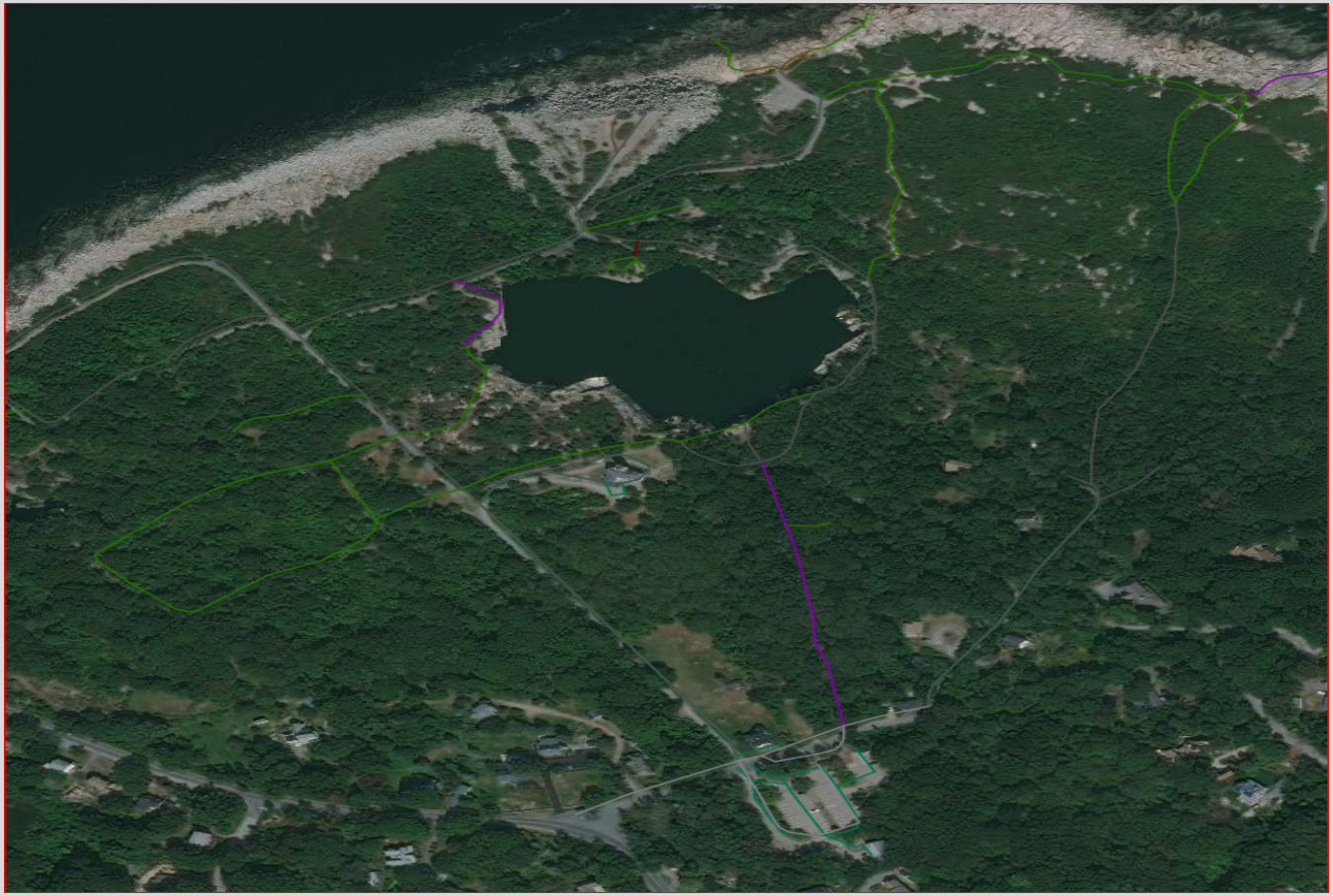
- Don’t Say No…Explore All Opportunities.
- Make sure things are working – Wind turbines meter calibration.
- As the PV systems gets older more time is needed to maintain and operate.
- An important part of our culture is compliance requirements/reporting/ operational issues needs to be done from the first day a person is hired.
- Periodic revisiting and educating staff on various programs that include resource conservation, energy reduction, EPP purchasing etc.

Moving Forward

- Continue with having people to “buy” into what is trying to be accomplished.
- Implement changes decisively (but not drastic change of culture).
- Communicate ideas –brain storming.
- Be realistic in expectations.

Halibut Point State Park

Rockport, MA



Jessica A. Rowcroft
Office of Cultural Resources
Department of Conservation & Recreation

Background

- 1860s – 1929 – Babson Farm Quarry
- WWII era Fire Control Tower
- 1950s radar gap filler station in the SAGE air defense network
- 1981 – state park established

Site conditions

- Ledge visible 6” – 12” to bedrock
- Sandy soil
- Original building – crawlspace only
- Well no longer potable
- Wind speeds – avg 14 – 18mph

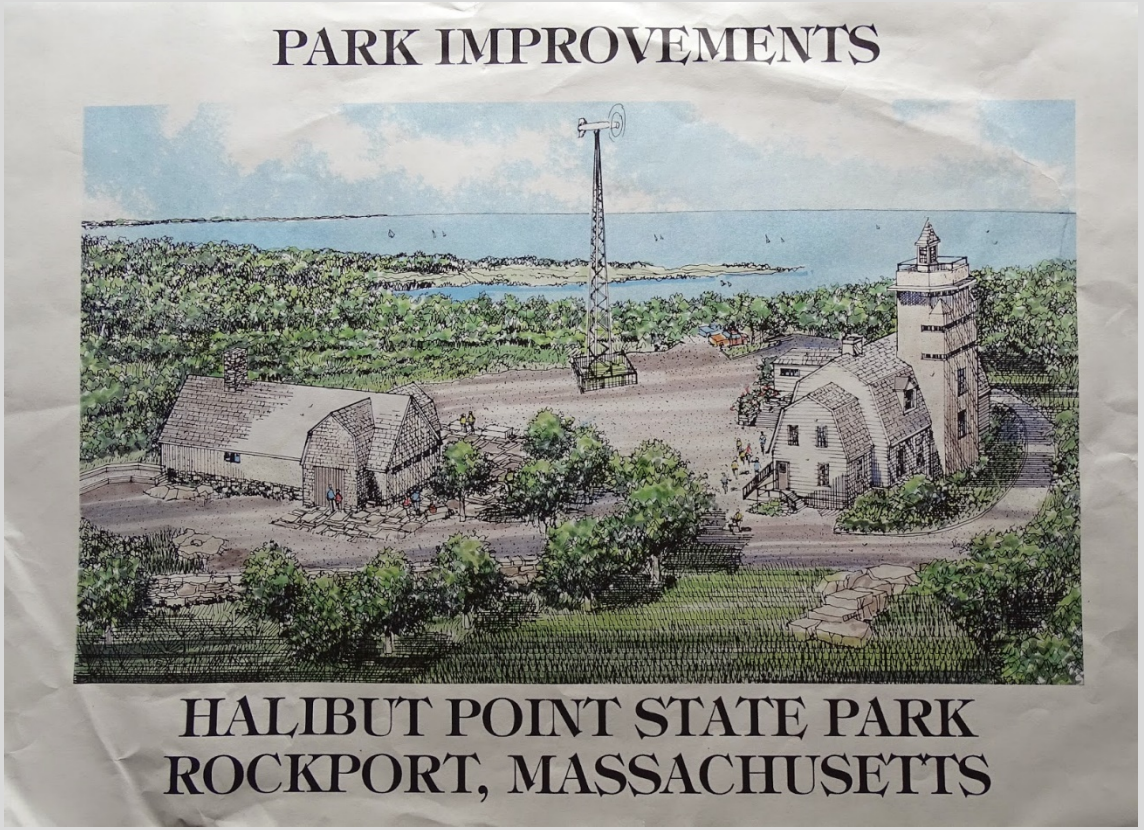
Energy Improvements – Phase 1

1987 Master Plan

92-93- Analysis of site for wind

1997 Improvements:

- Geothermal system – split system to service both floors
- 10k wind turbine installed – removed by 1998
- PV array, Solar hot water
- Clivus, greywater system



Energy Improvements – Phase 2

Spring 2015 – massive mold bloom

VC closed, mold remediated

2016 – new roof

FY2017 – renewable thermal grant received to replace geothermal

2018/19 Building renovation:

- Geothermal removed; new air source heat pump installed
- Building fully insulated
- New PV
- New solar thermal

Lessons

- One size does not fit all – make sure site analysis is comprehensive
- Maintenance, maintenance, maintenance
- Make sure you've got the right experts

Understanding the Present

Keep up at: www.fasterthanexpected.com

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

DOER
Massachusetts Department of Energy Resources

A Record Warm Winter

- Warmest Jan. in 141 years of record keeping
  - 44th consecutive January (421st consecutive month) with temps above 20th-century average
- Second warmest February on record
- Dec 2019-Feb 2020 was warmest in Europe
  - 2.5°F above previous warmest winter (2015-16)
  - 6°F above 1981-2010 average

Source: NOAA, The Guardian

Thawing Permafrost Transforming the Arctic

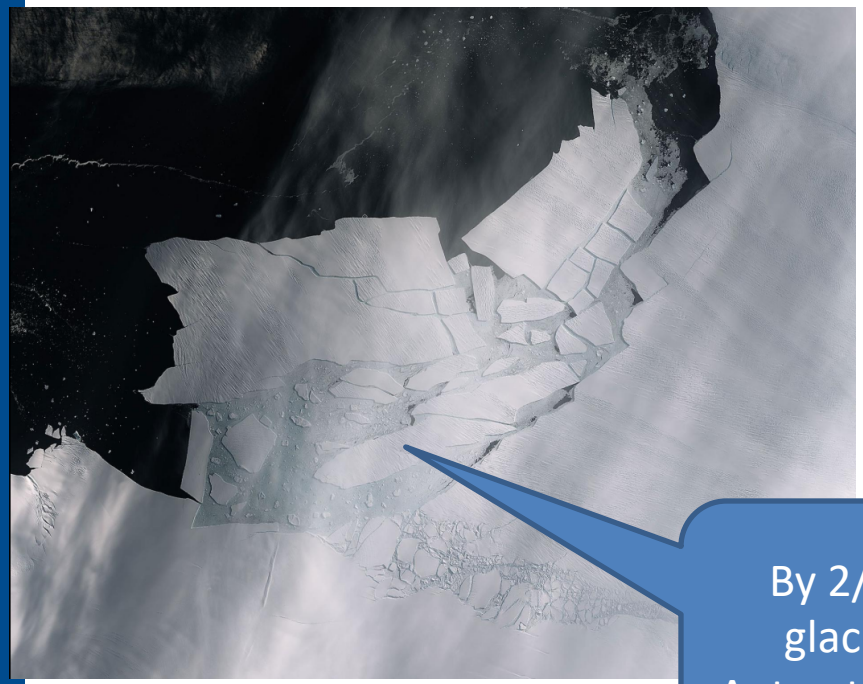
- Arctic warming faster than any other region on earth
  - If warming continues as predicted, ~2.5 million sq.mi. of permafrost (40% of world total) could disappear by 2100
  - ~1,400 gigatons of carbon frozen in Arctic permafrost at risk of being released

Thawing permafrost creates slumps in the tundra, draining potentially contaminated water into lakes rivers. This one is about the size of a football stadium.

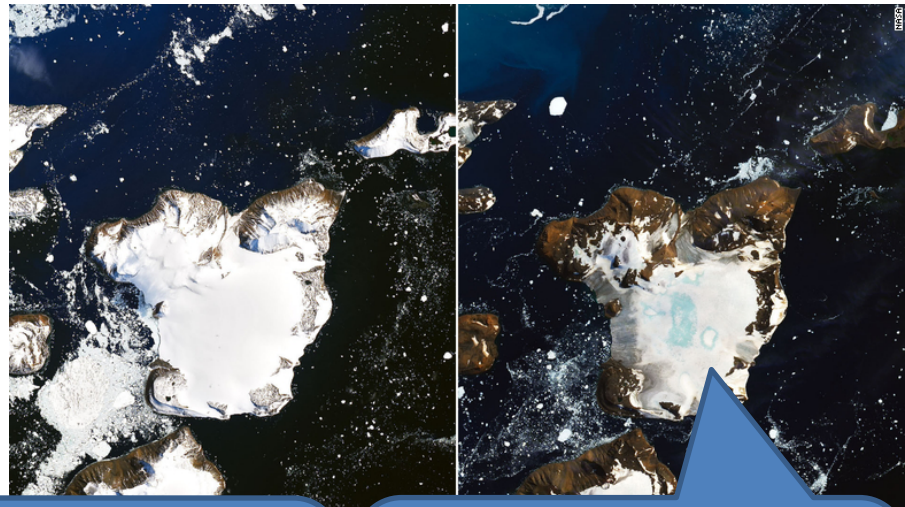
Source: Yale Photo: ED STRUZIK FOR YALE ENVIRONMENT 360

Antarctica Breaks Temperature Record

- Research base on northern tip of continent reached 18.3°C (64.9°F) on 2/7/20, breaking previous record of 17.5°C (63.5°F) set in 2015.
  - Two days later, nearby Seymore Island recorded at 20.75°C (68°F)
- Antarctic peninsula has warmed almost 3°C (5.4°F) over last 50 years



By 2/11, a 116^{2}mi glacier broke off Antarctica's Pine Island



Eagle Island, on the northeast peninsula of Antarctica, lost 20% of its snow in 9 days

Source: UN, National Geographic, The Guardian. CNN

Sea Level Rise Accelerating Along US Coastline

- 25 of 32 tide-gauge stations along the US coastline showed acceleration in SLR last year, according to researchers at the Virginia Institute of Marine Science
  - Acceleration means global sea levels may reach worst-case scenario of 8.2ft increase by 2100

▲ About 61,000 tons of sand is being dumped on Miami Beach to counter rising sea levels as highest rate of rise was recorded along the Gulf of Mexico shoreline. Photograph: Joe Raedle/Getty Images

Source: The Guardian

Plastic Invades Every Part of Ocean

- Over 8 million tons of plastic enters the ocean every year
- Recent studies find 99% ends up on sea floor or "caught like clouds of dust deep in the water column"
- Plastic has been found in every part of the ocean
  - Plastic bags found in the deep of the Mariana Trench on several dives
  - Researchers from St Andrews University discovered ¾ of King Penguins in South Georgia had ingested plastic microfibers

Plastic washes up on shorelines across the world, including Australia (top) and India (bottom)

Global and Regional Response to the New Climate Reality

International Climate Strikes

Millions have participated in climate strikes over the last year, with over 2,000 strikes planned for the year ahead


Greta Thunberg, nominated for Nobel Peace Prize for second consecutive year (The Hill)


Lisbon, Portugal


Sydney, Australia


Hamburg, Germany

Foley Square, Manhattan

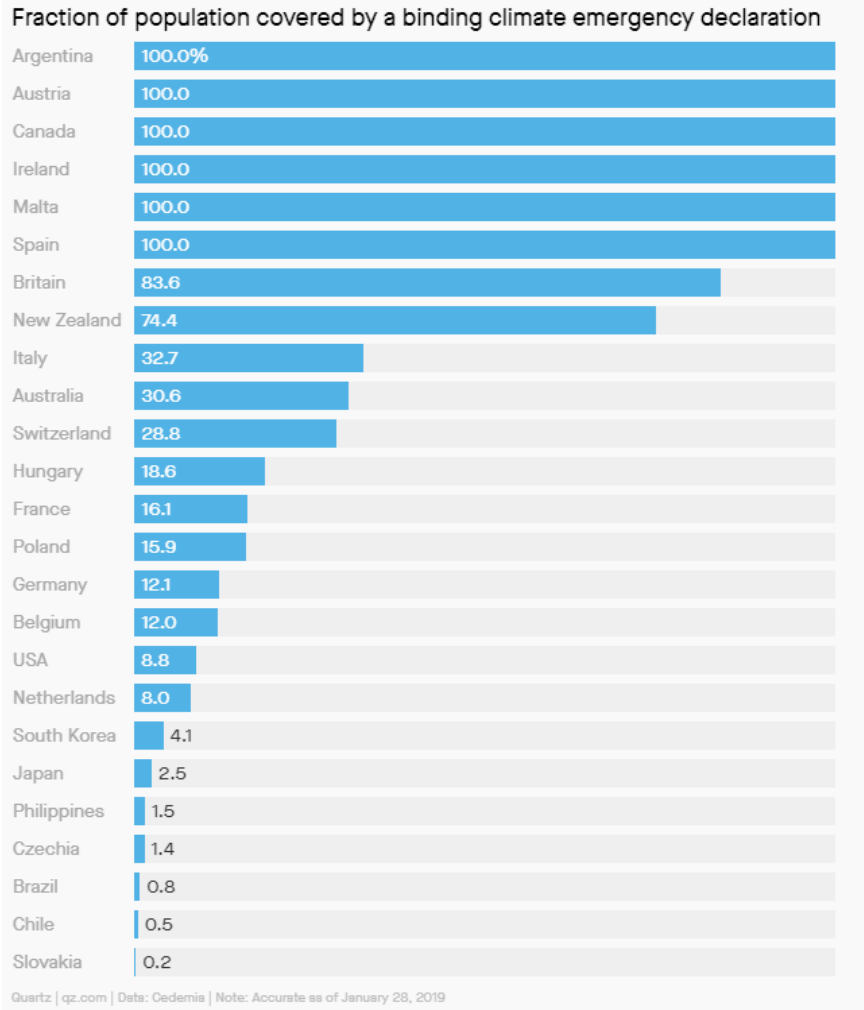
Creating A Clean, Affordable and Resilient Energy Future For the Commonwealth

Source: The Guardian, NY Times

DOER
Massachusetts Department of Energy Resources

Governments Declare Climate Emergencies

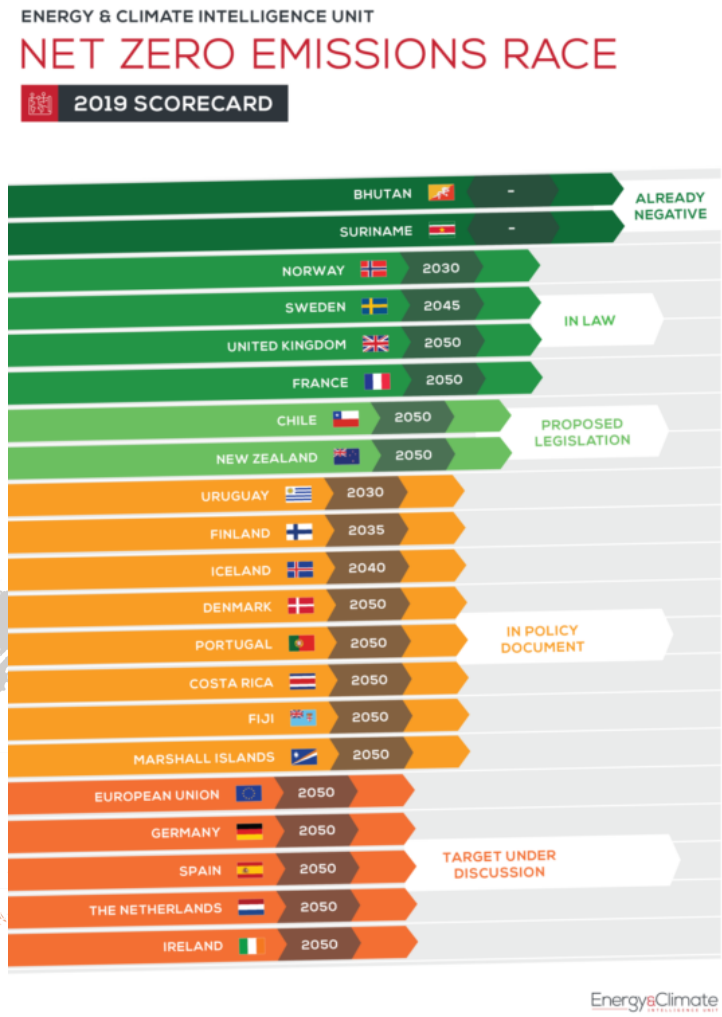
- 1,330 governments have declared climate emergencies, representing 814 million+ people
- Depending on government, declarations:
  - Signify commitment to reduce impacts
  - Provide money for adaptation
  - Act as first step to allow officials or agencies to take immediate action

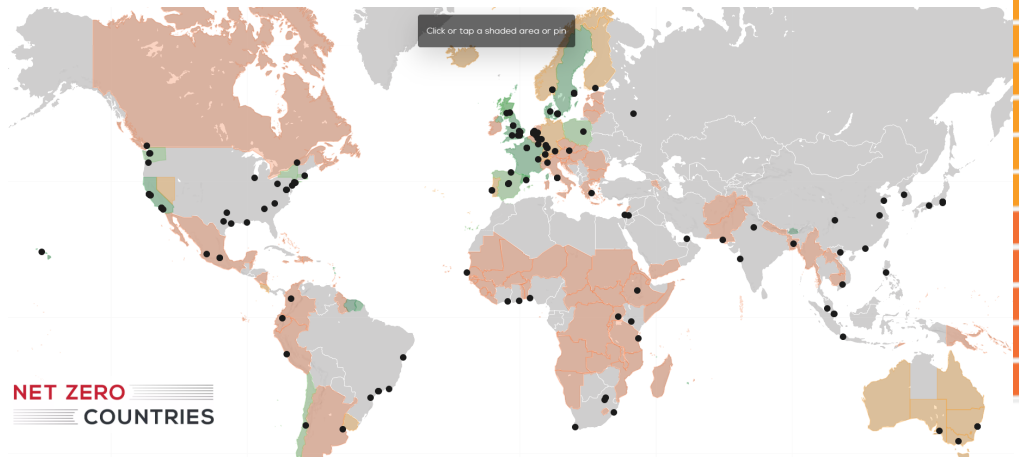


Source: Quartz

Nations Setting Net-Zero Targets

Just 18 months after IPCC report declared need to reach net-zero emissions by 2050, **half the world's economy** has adopted or begun process to adopt commitment





Countries, cities, and companies discussing or implementing net-zero emissions goals

Source: BusinessGreen

Countries Banning Fossil Fuel-Powered Cars

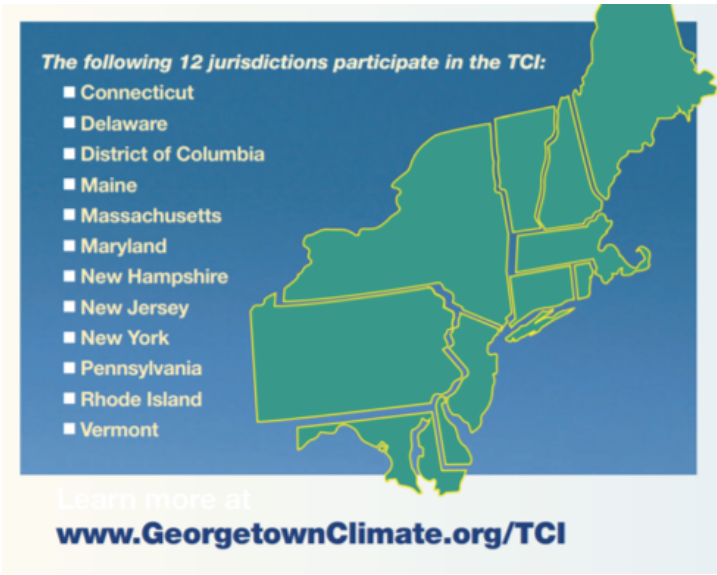
- **In UK**, sales of new gas and diesel-powered cars will be banned starting 2035
- **Norway's** goals include all cars, vans, and city buses sold to be zero-emission by 2025
- **India** has called for all new cars to be powered by electricity by 2030

Sources: CNN, Government.no, BBC

Northeast Transportation and Climate Initiative: Draft Agreement Announced

- Regional "cap-and-invest" program would set emissions caps for vehicle fuels and charge fees for higher emitters
  - Details to be finalized Spring 2020
- Starting 2022, up to $500M could be generated annually in MA and invested in transportation projects
- Program could reduce transportation sector emissions by up to 25% by 2032

TRANSPORTATION & CLIMATE INITIATIVE
Of the Northeast and Mid-Atlantic States



Massachusetts All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon)

Decade	Year-0	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9
2000's				NA	1.906	2.308	2.622	2.773	3.230	2.362
2010's	2.802	3.592	3.717	3.617	3.480	2.462	2.221	2.511	2.823	

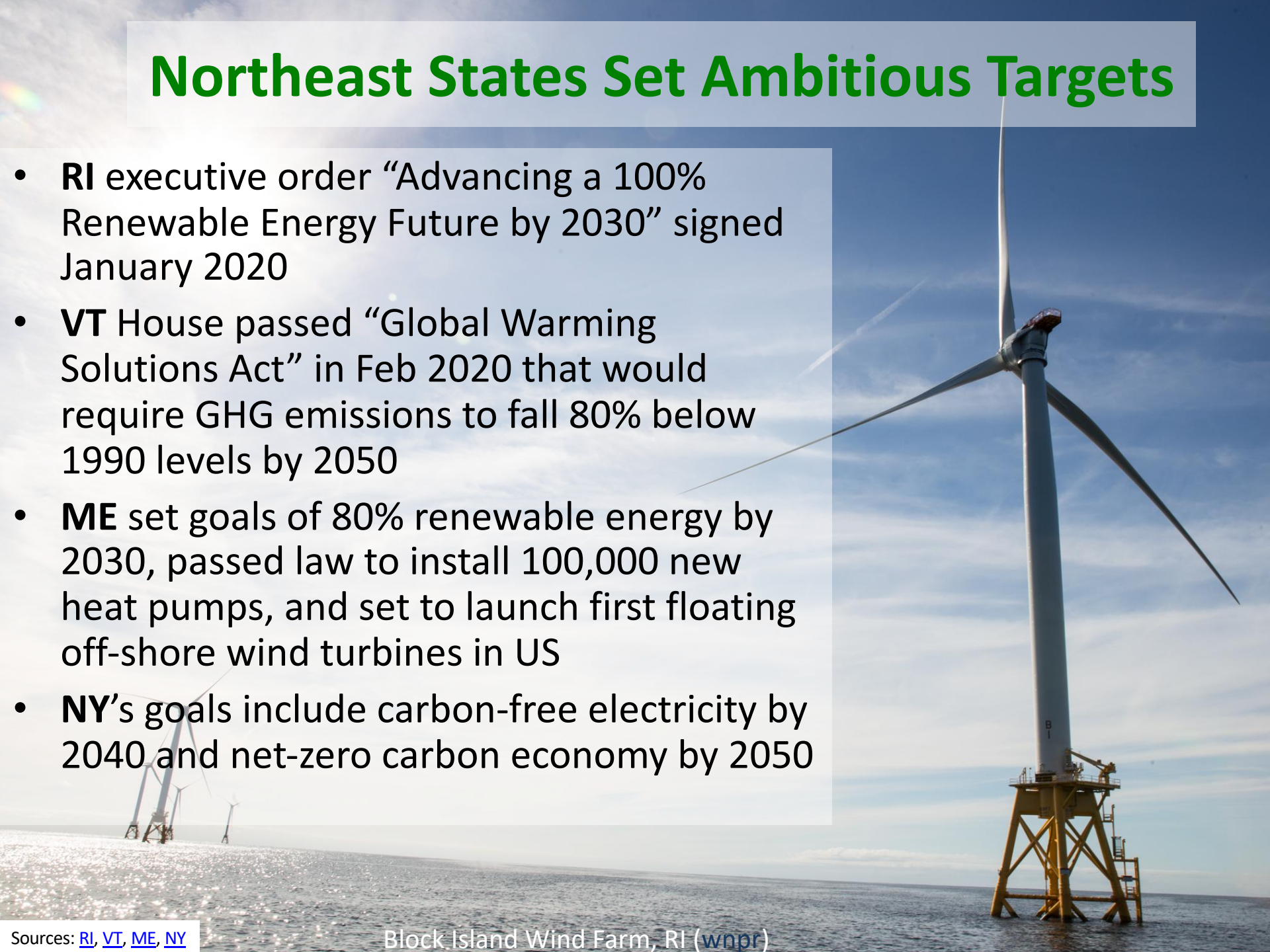
- Current average price of gas in MA is $2.47, ~$0.05 higher than early March 2019
- Gas prices have ranged from $1.90-$3.71 between 2003-2019

Sources: MassDOT, WBUR, Transportation and Climate

DOER
Massachusetts Department of Energy Resources

Northeast States Set Ambitious Targets

- **RI** executive order "Advancing a 100% Renewable Energy Future by 2030" signed January 2020
- **VT** House passed "Global Warming Solutions Act" in Feb 2020 that would require GHG emissions to fall 80% below 1990 levels by 2050
- **ME** set goals of 80% renewable energy by 2030, passed law to install 100,000 new heat pumps, and set to launch first floating off-shore wind turbines in US
- **NY**'s goals include carbon-free electricity by 2040 and net-zero carbon economy by 2050



Sources: RI, VT, ME, NY

Block Island Wind Farm, RI (wnpr)

MA Setting Ambitious Targets

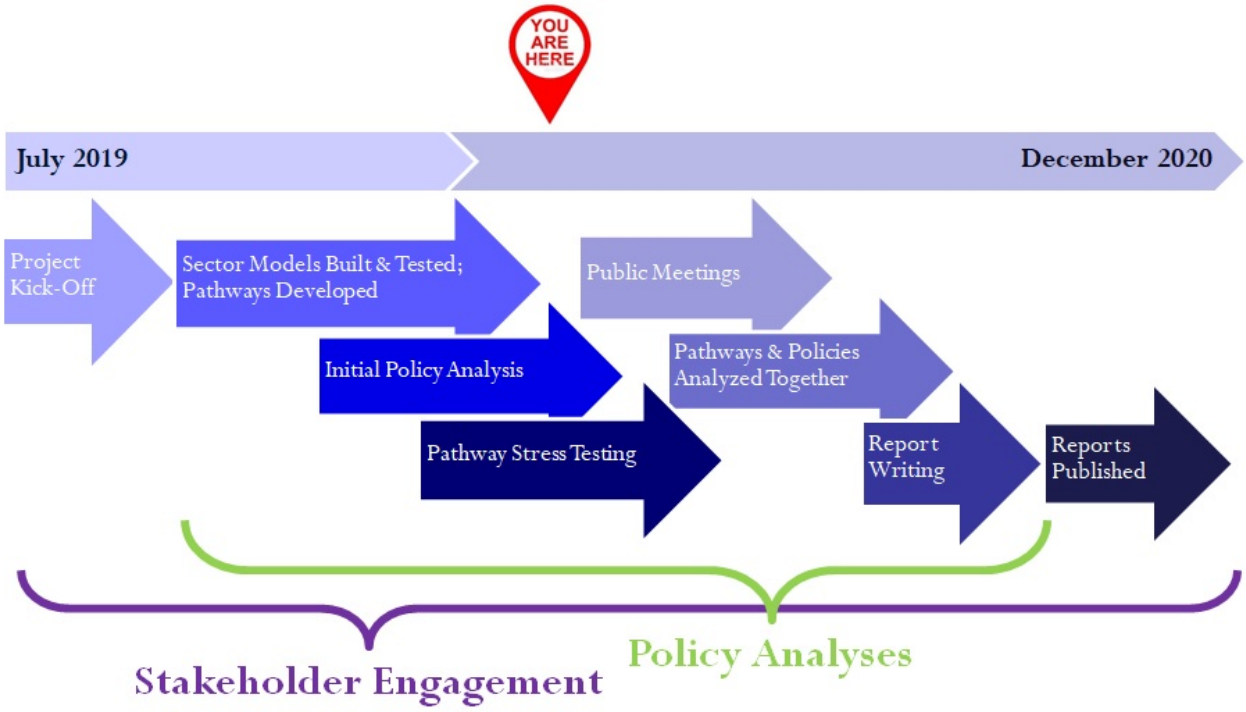
- Governor announced goal of net zero greenhouse gas emissions by 2050
  - Draft determination letter released February, public comments accepted through April 10
- Senate passed a trio of climate-related bills to:
  - Set state goal of net-zero emissions by 2050
  - Set deadline for state to impose carbon-pricing mechanisms for transportation and buildings
  - Limit MBTA bus purchases to zero-emissions vehicles starting in 2030
  - Make permanent the existing rebate program for EVs
  - Set new efficiency standards for a range of products, including common appliances and water fixtures

Source: WBUR

MA Decarbonization Roadmap

- Planning process underway to identify cost-effective, equitable strategies to ensure MA reduces GHG emissions by at least 80% by 2050 and achieve net-zero emissions
- Public Meetings hosted by EEA throughout March
  - March 11th, 12th, 16th, 23rd, 25th

More information available on the Decarbonization Roadmap website



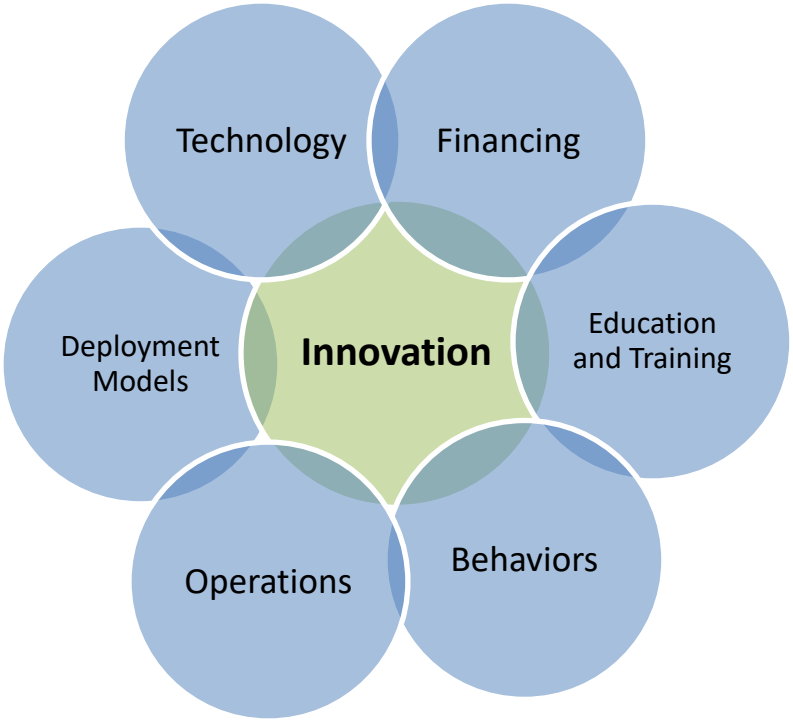
Innovating Toward a Sustainable Future

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

DOER
Massachusetts Department of Energy Resources

The Need to Innovate for the Future

- Progress has been made, particularly in clean electricity
- Science says we must accelerate action to avoid catastrophe
- Setting goals is easy. Implementation is hard.
- Primary challenges will be reducing GHGs from heating, transportation
- Conversations will need to happen across all sectors, initiatives, etc



Draft 2030 Solid Waste Master Plan

Leading by Example Meeting

March 2020

John Fischer

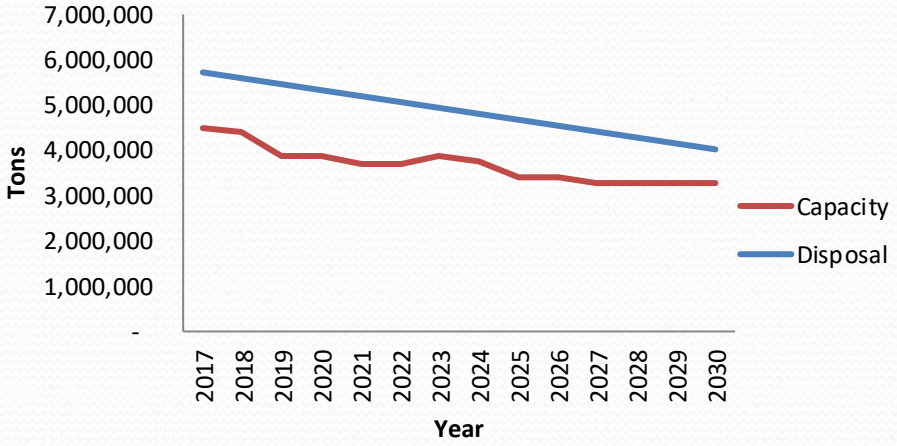
Deputy Division Director, Solid Waste Materials Management

MassDEP

2030 SWMP Proposed Goals

- 30% reduction by 2030
  - 5.7 million → 4 million tons
- 90% reduction by 2050
  - 5.7 million → 570,000 tons
- Reduce the toxicity of the waste stream

Figure 10.1 Projected Disposal vs. Disposal Capacity in Massachusetts (2017-2030)



Major Initiatives

- Develop action plan on source reduction and reuse
  - Single-use packaging/products
  - Office furniture/building material reuse
  - Promote donation of textiles and working durables

- Additional waste bans
  - Commercial Organics (food waste) lowered to ½ ton/week;
  - Propose a ban on textiles and mattresses
  - Increased Compliance & Enforcement

Major Initiatives

- Organics Waste Reduction
  - Increased donation and source reduction
  - Reduce threshold for commercial organics ban to ½ ton per week
  - Targeted grants and loans to support infrastructure development

- Municipal/Commercial Recycling
  - Grants
  - Technical Assistance
  - Education & outreach
  - Hauler recycling requirement – level playing field

Major Initiatives

- Advance Extended Producer Responsibility systems
  - Paint, mattresses, electronics

- Construction & Demolition min performance standards
  - Minimum performance standards
  - C&D facility targeted grants & loans
  - Technical assistance and model local ordinances - source separation, deconstruction & reuse

Major Initiatives

- Market Development
  - Develop comprehensive market development plan
  - Grants & leverage other market development resources
  - Leverage state purchasing power

- Solid Waste Facility Oversight
  - Ongoing permitting, inspections, oversight & enforcement of active & inactive facilities
  - Maintain MWC moratorium, but allow for replacement capacity within current limits, if efficiency & emissions improved
  - Maintain allowance for up to 350K TPY for alternative waste to energy technologies

Master Plan Schedule and Process

- Expect to publish Final 2030 Plan shortly
- Will also publish Response to Comments document
- Year 1 Priorities
  - Source Reduction & Reuse Workgroup & Action Plan
  - Expanded Waste Bans
  - C&D Minimum Performance Standard
  - Increased Waste Ban Inspections
  - Municipal Recycling Contracting Guidance
  - State Agency Recycling Market Development Council
  - Market Development Work Group and Action Plan

Food Material Waste Reduction

- Increased from 100K to 280K tons in 2018
- >55 NONs and 5 penalties
- # businesses diverting increased from 1,350 to 2,300 in 2018
- > 50% growth in food rescue since 2014
- > 1 million tons disposed in trash annually

Food Materials Capacity

- > 600K tons AD in place/under development
- 150K tons compost capacity
- Additional capacity for animal feed
- Further increases in food rescue/donation
- Potential to reduce food waste at source by 50 percent or more

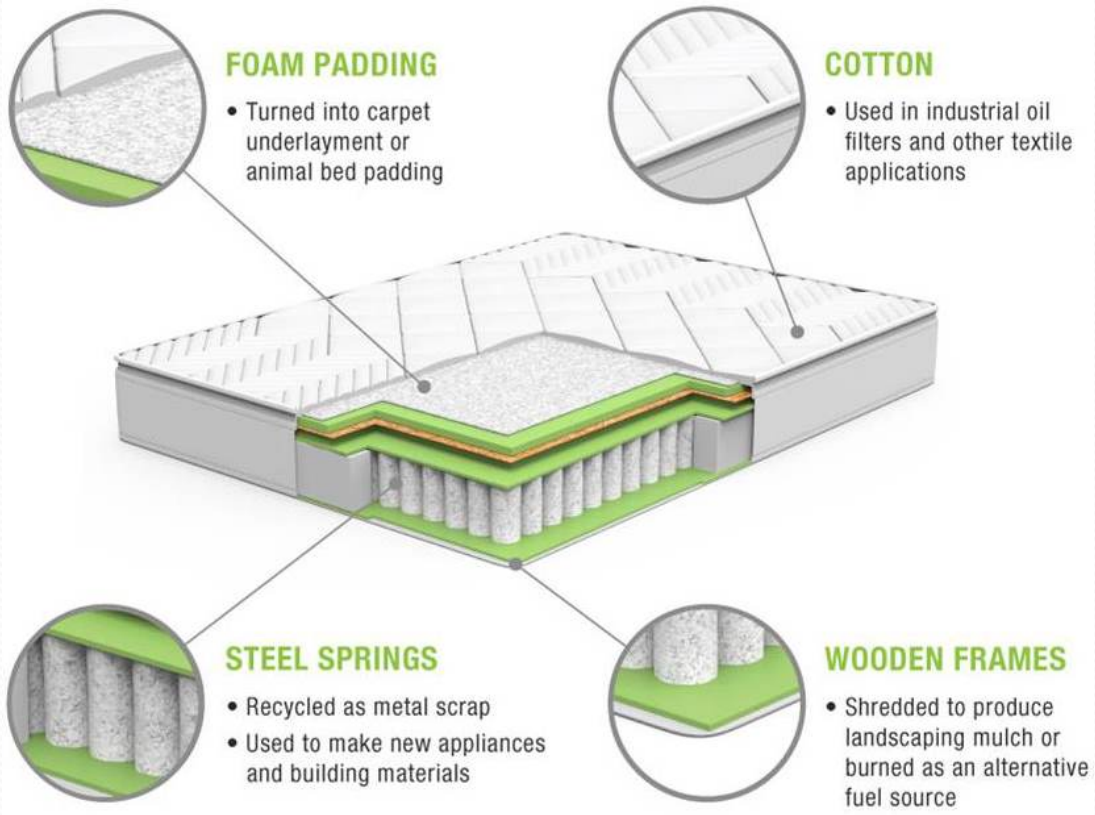
Projected Ban Effects

- Double # businesses subject –about 2,000 additional
- About 100K additional tons subject plus improved compliance from businesses subject now
- Restaurants are sector most affected – about 1,300
- About 30 public schools potentially subject
- RecyclingWorks in MA technical assistance

Mattress Recycling Progress

- 600K mattresses/year total (about 200K residential)
- About 16K tons
- Current recycling > 50K units/year (not including commercial)
- About 90 munis. currently recycling via state contract

Mattress Components



Mattress Recycling Infrastructure

- MassDEP municipal recycling grants, state contract and recycling business grants
- 4 vendors on state contract
- Current capacity about 300K pieces/year – likely growing
- Processing costs - $10-16/piece
  - Typical disposal surcharges at this amount or higher
- Haul costs - $150-500/container
- Difficult to manage at disposal facilities

Textile Reuse and Recycling Infrastructure

- About 230K tons disposed/year
- About 95% can be reused or recycled
- >25 reuse or recycling operations in Mass.
- Many more involved in resale
- >1/2 of munis. have collection programs – many through schools

Value of Textiles

- Reduced disposal costs
- But also have value
- 45% sold as second hand apparel;
- 30% turned into industrial wiping cloths;
- 20% to fiber products (insulation, carpet padding, sound-proofing);
- Local businesses “upcycle” textiles into new products, (e.g., quilts, blankets, and bags)

Waste Ban Regulations Proposed Schedule

- Stakeholder input opportunities
- Draft Regulations with Public Hearings – Late Spring
- Final Regulations – Fall 2020
- Regulatory Effective Date of new bans – Fall 2021

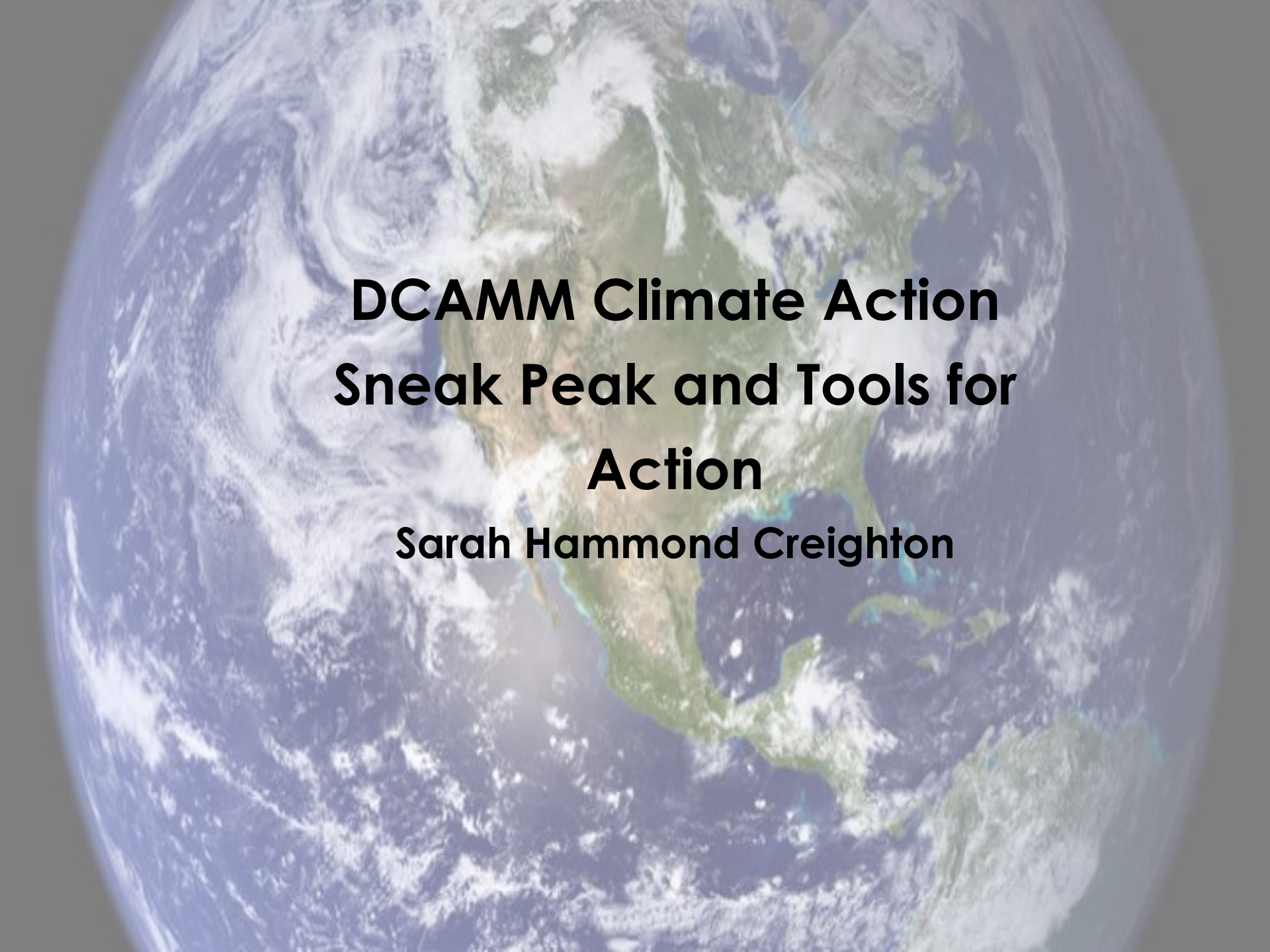
Key questions

- What questions or concerns do these potential additional bans raise?
- Do you feel the needed infrastructure is in place (or will be)?
- What steps should MassDEP take to support additional waste bans?

Questions/Comments

- Contact Information

  John Fischer, Deputy Division Director, Solid Waste
  John.fischer@mass.gov
  617-292-5632
- Waste Ban Comments & Questions
  - Dep.swmp@mass.gov



DCAMM Climate Action Sneak Peak and Tools for Action

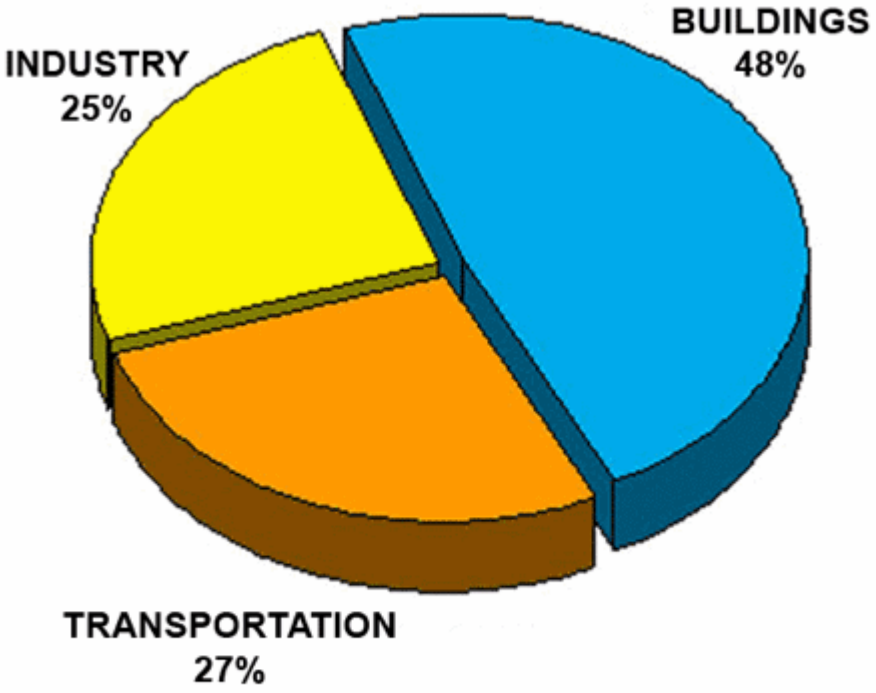
Sarah Hammond Creighton

STATE OF THE STATE: JANUARY 21

"… there's no dispute that the consequences of climate change are real and potentially devastating."

"Tonight, I'm committing the Commonwealth to achieving an ambitious climate goal: net-zero greenhouse gas emissions by 2050."

BUILDINGS: ALMOST HALF OF THE PROBLEM



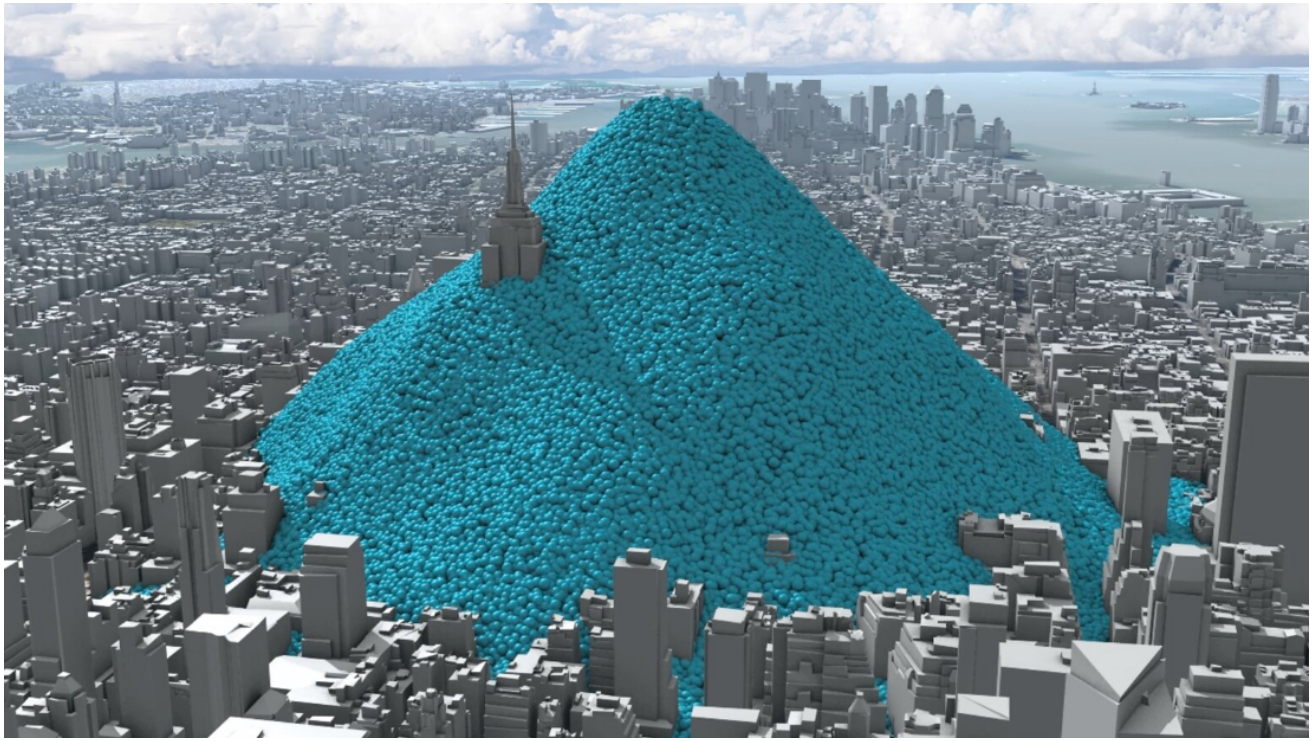
US ENERGY CONSUMPTION

WHAT IS A TONNE OF CO_2?

10 meter diameter sphere

Carbon dioxide gas at 15 °C and standard pressure has a density of 1.87 kg/m3.

CO_2 FROM STATE BUILDINGS IN 2 MONTHS!



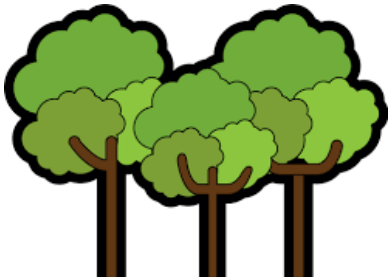
www.carbonvisuals.com

TO GET TO ZERO EMISSIONS

Increase Efficiency

Clean Energy

Strategic Electrification



Carbon Sequestration

Innovation

TO GET TO ZERO EMISSIONS

Increase Efficiency

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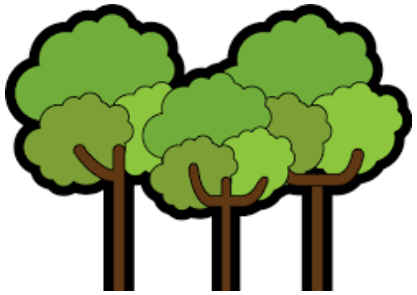
Strategic Electrification

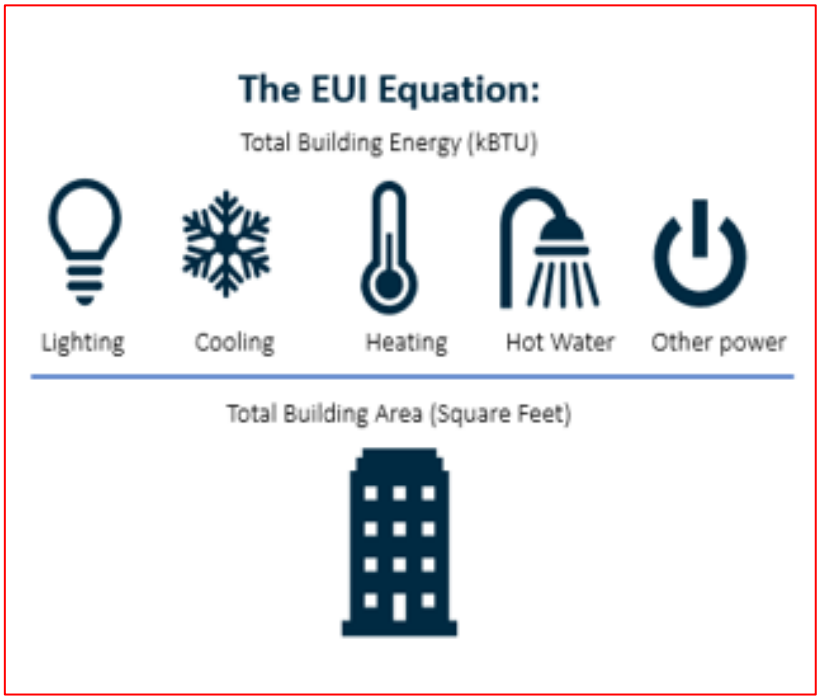


ENERGY USE INTENSITY (EUI - site)

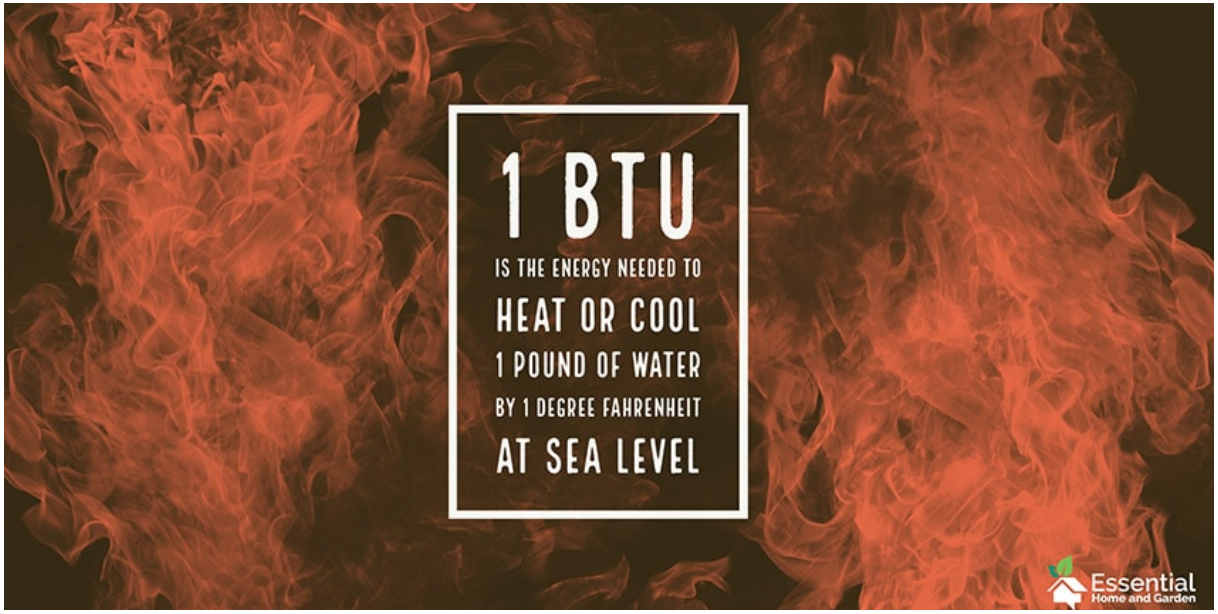
Annual Energy per Gross Square Foot

- kBTU/SF (site)
- Includes electricity and heating fuels

  (including solar used behind meter)
- Measures efficiency



British Thermal Units: DEFINITION



1 kBtu = 1000 BTU

EUI (site)

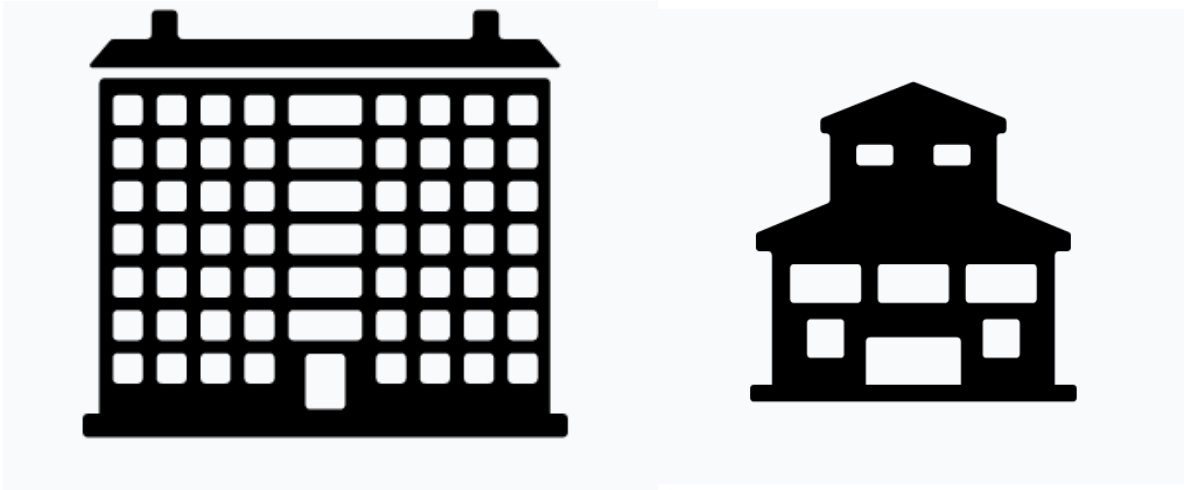
Convert fuels to kBtu

Electricity: 1 kWh = 3.412 kBtu

Nat Gas: 1 therm = 100 kBtu

Oil: 1 gal diesel = 130 kBtu

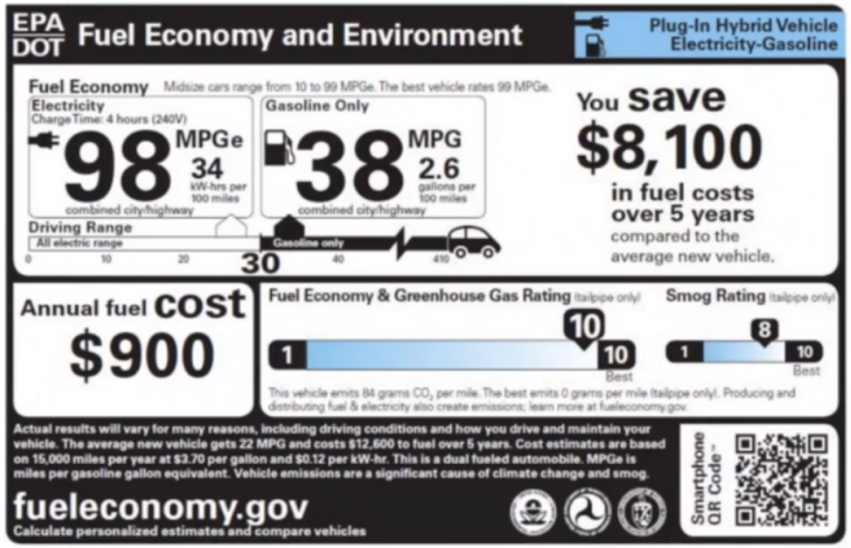
EUI = Site Energy ÷ Gross Square Feet



Energy	150,000,000 kBTU	2,000,000 kBTU
Size	100,000	20,000
EUI	150	100

EUI RATES BUILDINGS

- ✓ Simple number that measures efficiency
- ✓ Allows comparisons of similar building types
- ✓ Independent of size

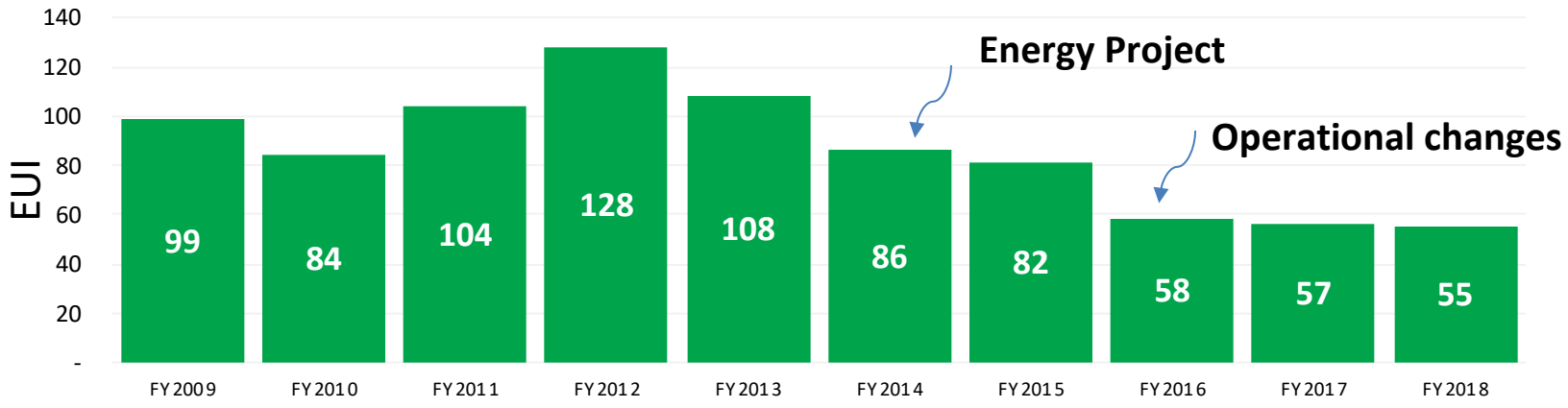


ENERGY PROJECTS and OPERATIONS IMPROVE EUI

Brooke Courthouse

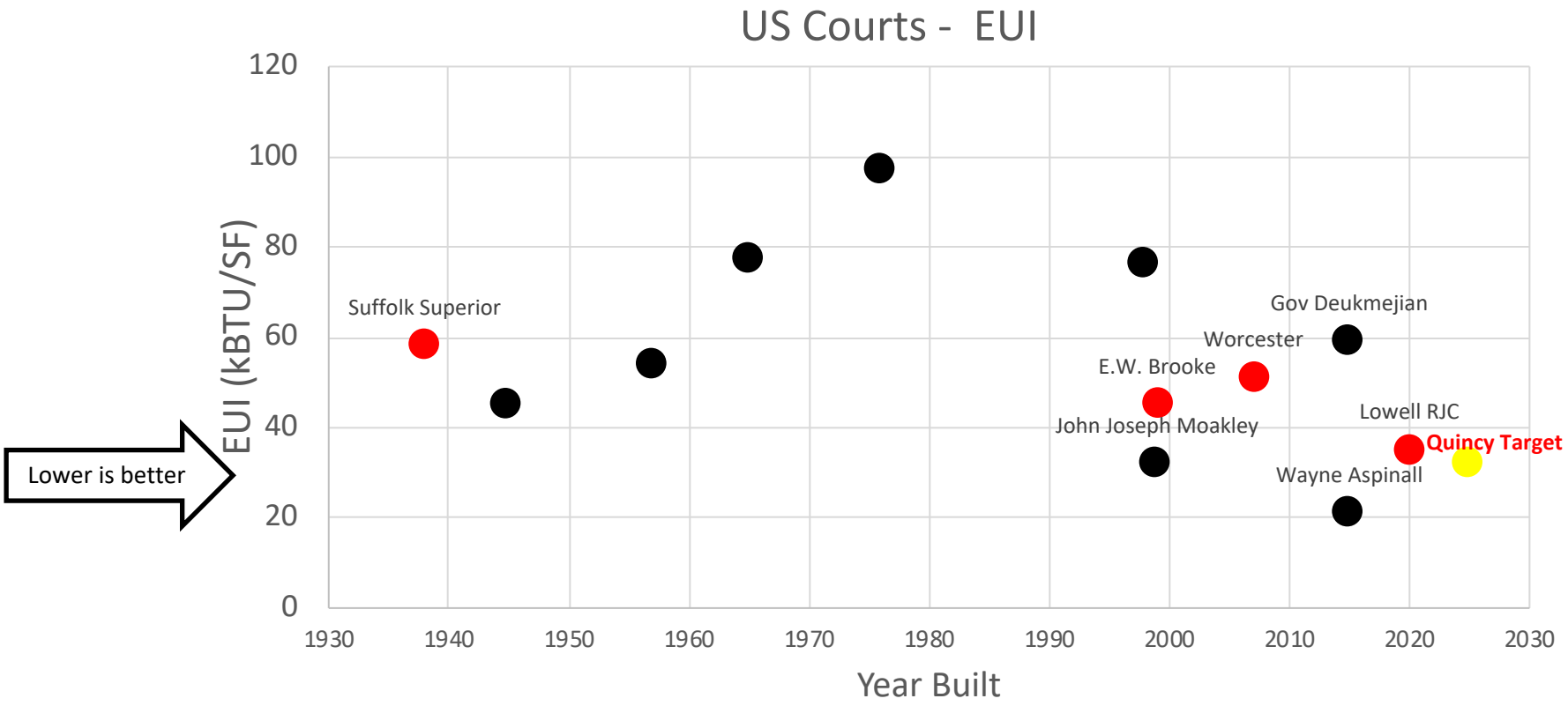
✓ Energy Project

✓ Operations improvements



CLIMATE ACTION

EUI: BEST IN CLASS…



CLIMATE ACTION

SOURCES of EUI DATA

- CBEI and existing building data
- Energy Star (general)
- Commercial Buildings Energy Consumptions Survey (CBECS)

EUI OF STATE BUILDING TYPES

Building type in MA	Avg. EUI
Library	91
Repair Shop	104
Dormitory	119
Gymnasium	157
Laboratory	474

EUI OF CURRENT PROJECTS

Predicted

- Chelsea Soldiers' Home 55
- Cape Cod CC Science 56

Actual

- Bristol CC Allied Health 54
- Fish and Wildlife 45

EUI – COMPARE LIKE BUILDINGS, FOCUS EFFORTS

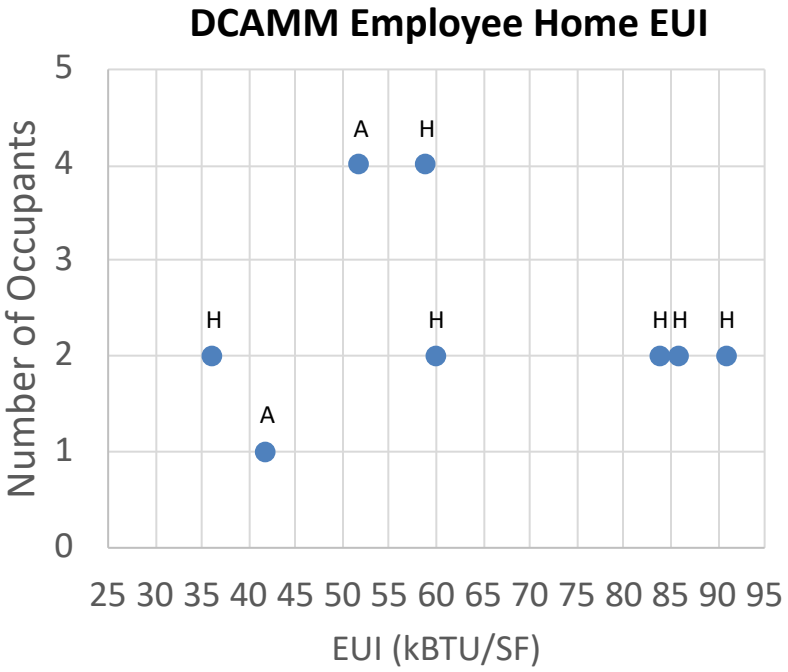
UMass Lowell Academic Buildings			
Building	**Square Feet**	**KBTU**	**EUI**
ETIC	84,000	35,000,000	415
Olney Hall	230,000	34,000,000	148
Ball Hall	100,000	10,000,000	101
Kitson Hall	51,000	4,700,000	92
Olsen Hall	137,000	5,700,000	42
Falmouth Hall	54,000	950,000	17

ENGAGE! EUI WORKS FOR HOMES TOO!

Total Electricity
(from bill)
+
Total Heating fuel
(from bill)

Size
(Square Ft)

http://energysmartohio.com/all-electric/eui-calculator-home-fit-fat/



H = House A = Apartment

TO GET TO ZERO EMISSIONS

Increase Efficiency

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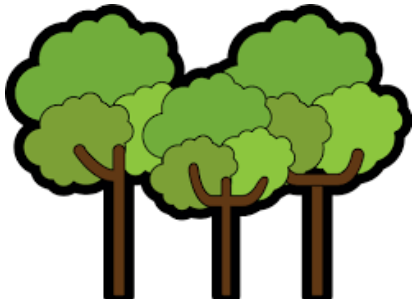
Strategic Electrification



LOWER CARBON FUELS

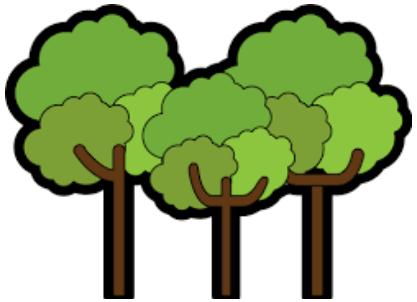
- Renewables
  - Installed at over 65 sites
- Biomass
  - Planned for DYS Connelly
  - Installed at Mt. Wachusett CC
- Technologies of the future!
  - Hydrogen from renewables
  - TBD!

TO GET TO ZERO EMISSIONS

Increase Efficiency

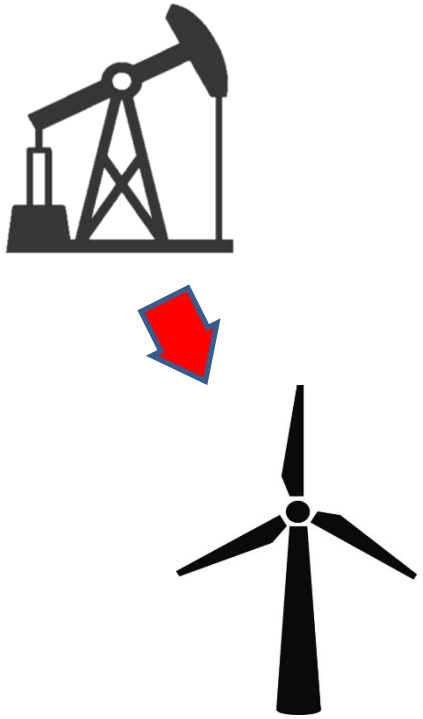
Clean Energy

Strategic Electrification



STRATEGIC ELECTRIFICATION

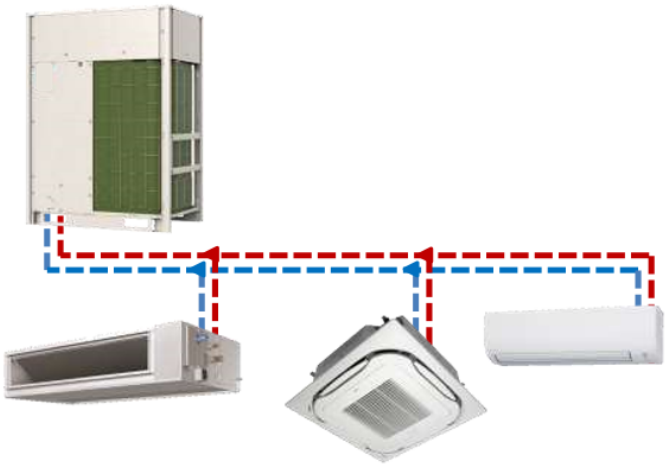
Replacing fossil fuel-based systems (e.g. natural gas space heat) with electric systems powered by renewable energy or low-carbon fuel.



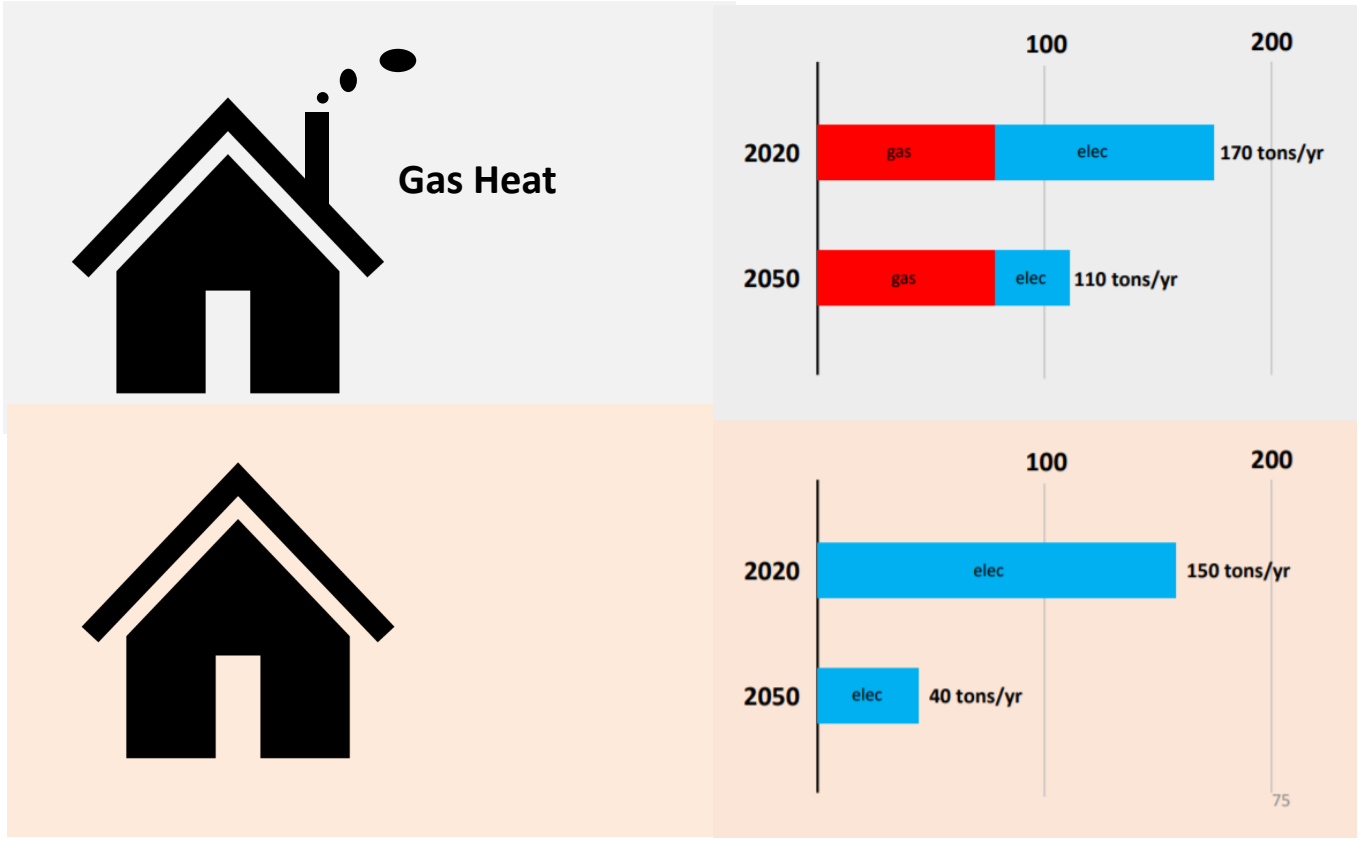
HOW?

Modern Heat Pumps

- More useful heat from one unit of energy
- Can heat and cool
- Run on electricity
- Work in very cold temperatures



DELIVER HEAT WITH LESS CARBON

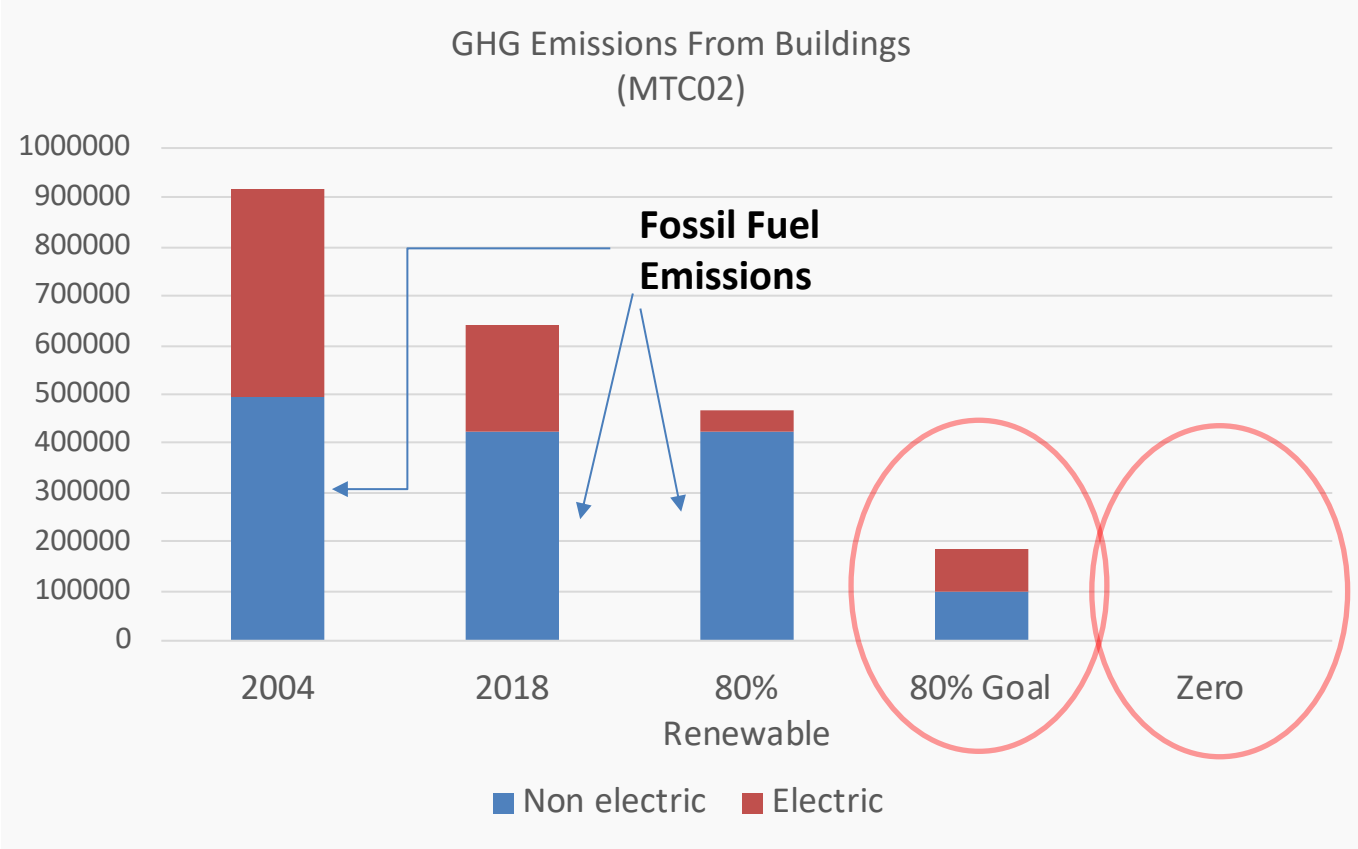


CHELSEA SOLDIERS' HOME

Low EUI + Electrification + Solar

- ✓Predicted EUI = 55
- ✓Ground source heat pumps
- ✓Solar-ready

CLEAN ELECTRICITY IS NOT ENOUGH



CLIMATE ACTION

CONCLUSION

- Buildings generate greenhouse gases
- EUI measures efficiency
  - LOW is better
  - DCAMM projects will track EUI
- To get to zero → low/no carbon fuel
- Electrification reduces carbon

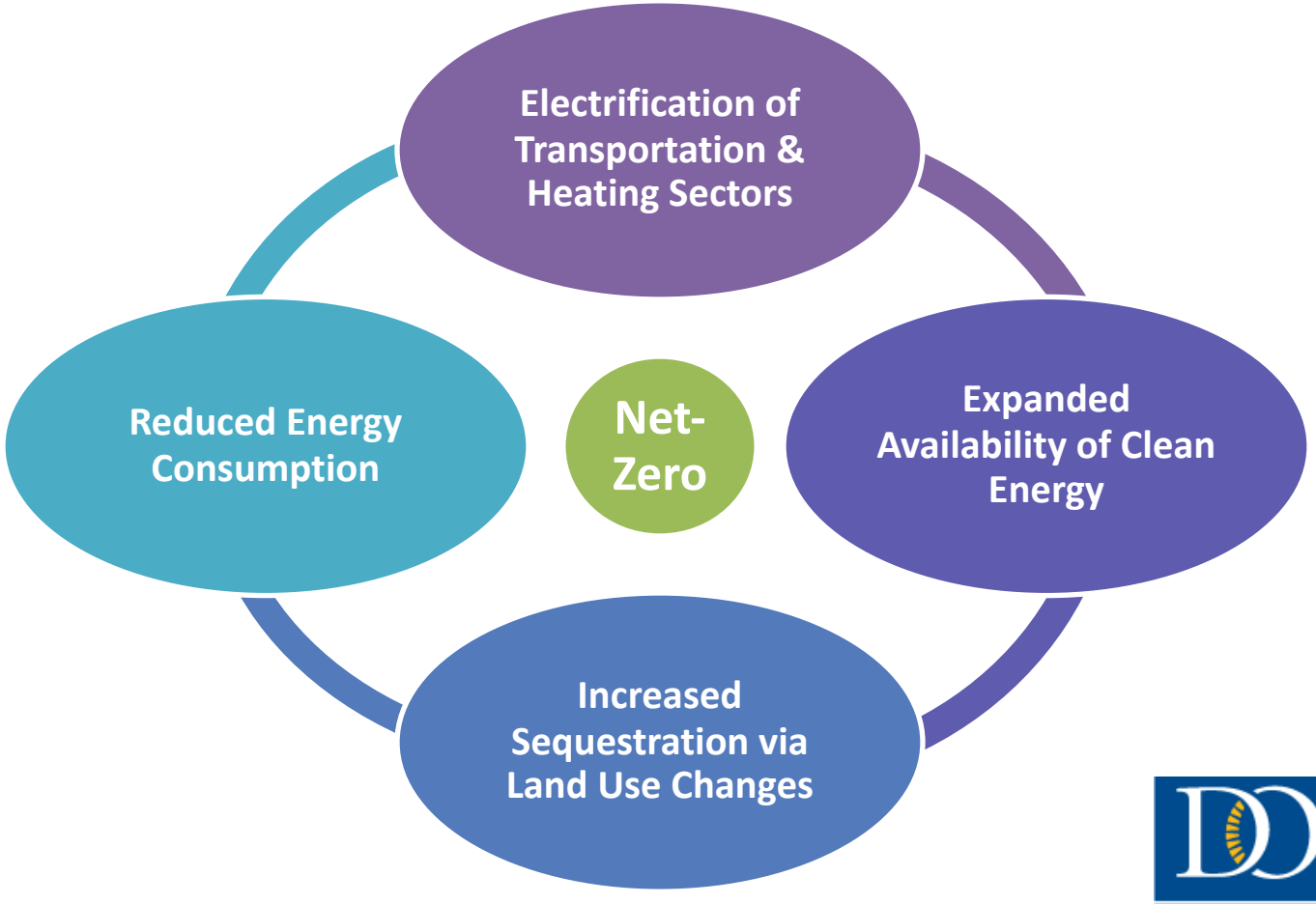
DCAMM employees' responses to "why act now?"

CLIMATE ACTION

Modeling Future Emissions

GWSA 2050 Decarbonization Roadmap

- Core pillars for decarbonization

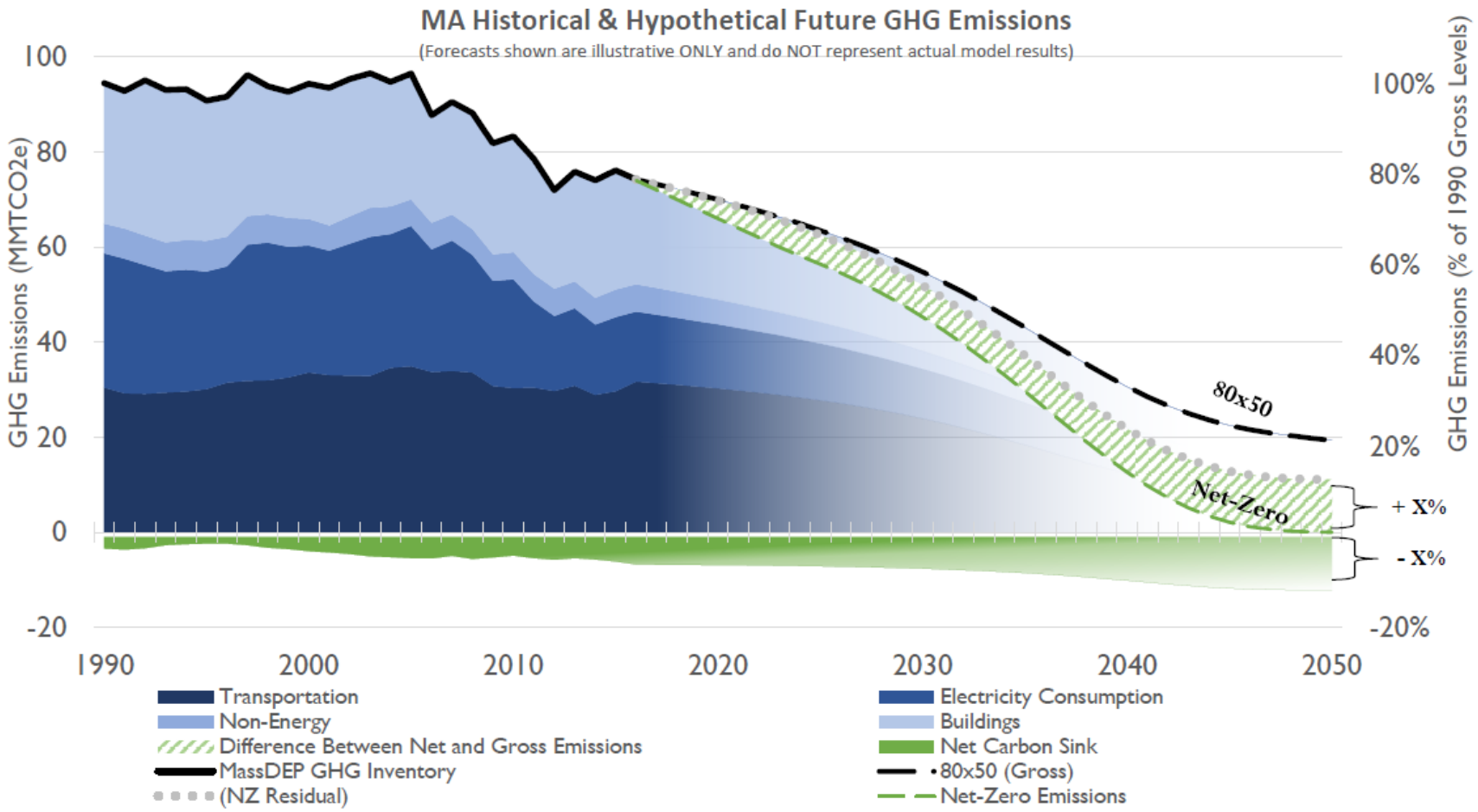


Source: EEA

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

DOER
Massachusetts Department of Energy Resources

GWSA: Setting a 2050 Emissions Limit



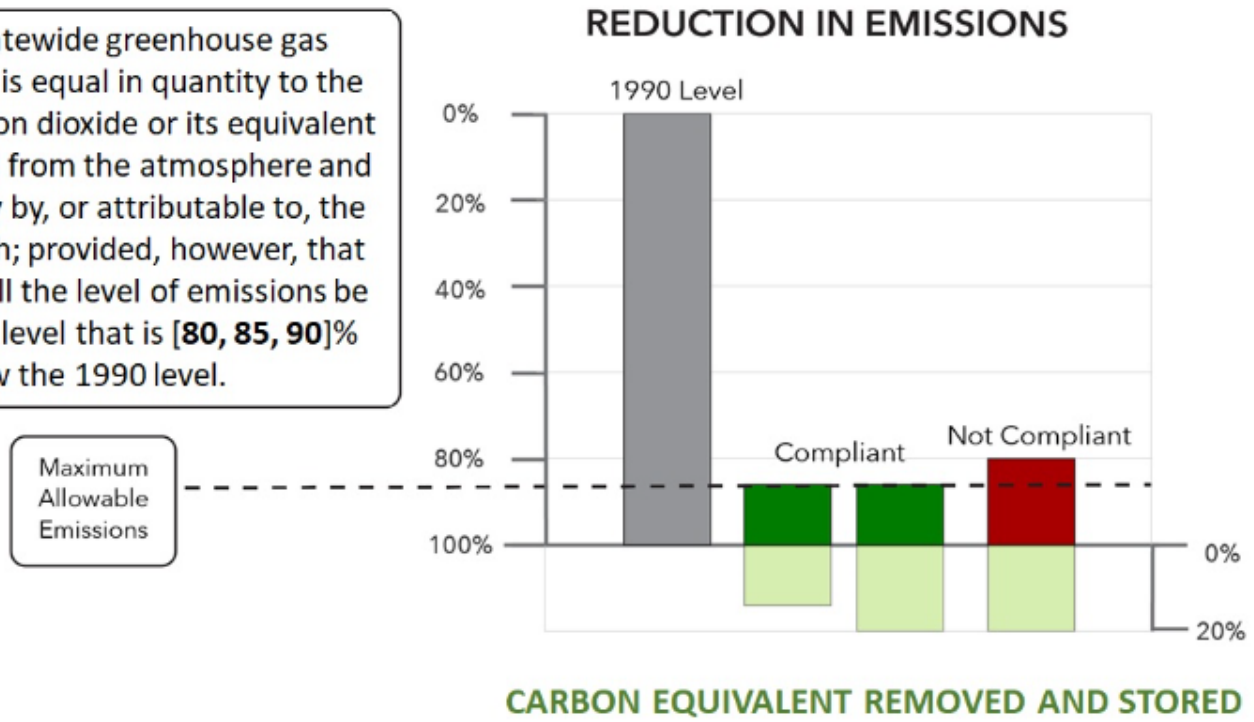
Source: EEA

GWSA: Defining Net Zero

- 2050 Net Zero Letter of Determination
- Comment period open through April 10th @ 5pm

Proposed Language

A level of statewide greenhouse gas emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is [**80, 85, 90**]% below the 1990 level.



Source: EEA

LBE Long-Term Objectives

Objectives

- Support statewide progress toward 2050 goals
- Adjust targets to reflect changing statewide priorities and programs (e.g. strategic electrification)
- Recognize newer technologies (e.g. storage)
- Respond to the latest science
- Add new goals as warranted (e.g. electric vehicles)
- Contribute to local and regional goals while addressing the question of how to deal with environmental attributes

LBE Modeling Exercise

Why:

Identify the breadth and scope of efforts necessary to achieve dramatic reductions in GHG emissions in line with state objectives

How:

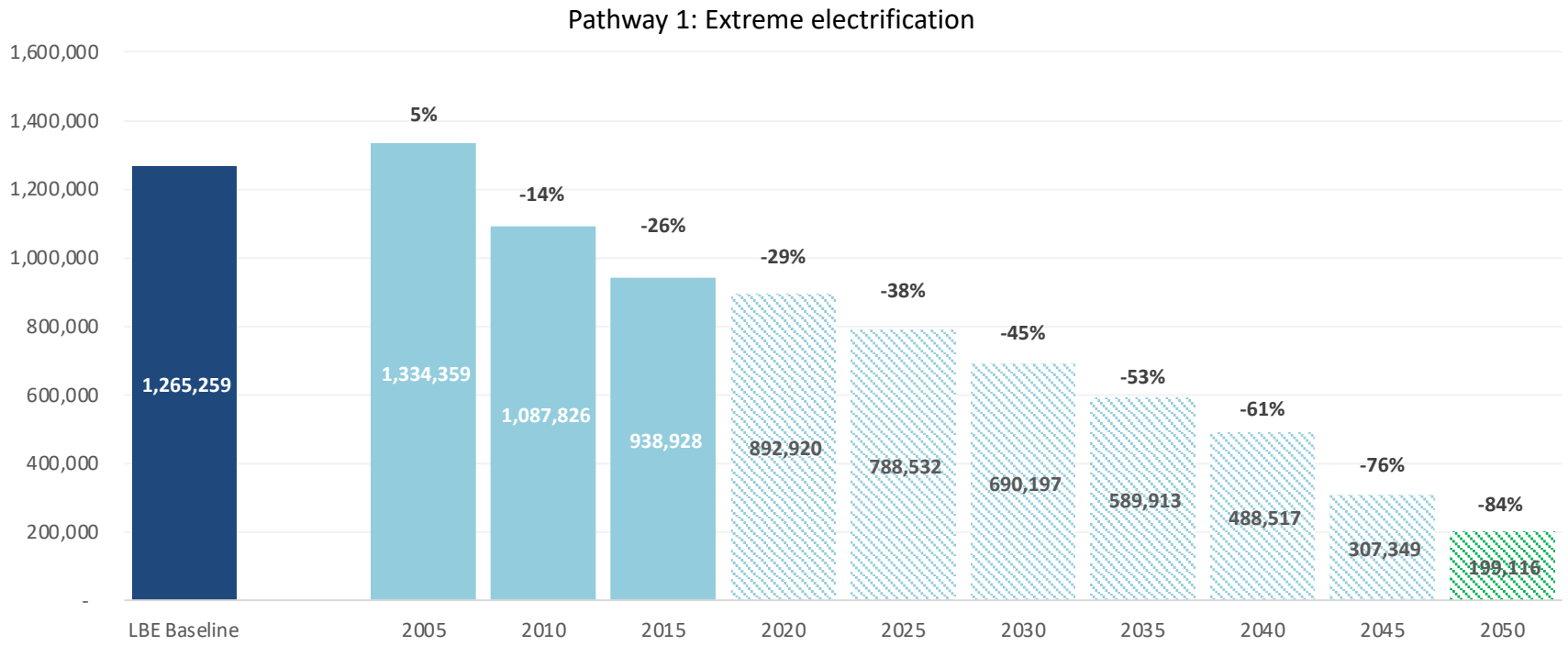
1) Historical data to establish consistent baseline & business as usual scenario
2) Various factors & assumptions that result in varied 2050 scenarios
3) Emissions trends in five year intervals through 2050
4) Various scenario outputs modeled together to see relative impacts

Pathways 1 & 2 Assumptions

Pathway 1: Extreme Electrification	Pathway 2: Electrification & Renewable Gas
95% electrification	**60% electrification; 40% renewable gas**
5% residual fuels	5% residual fuel
80% clean grid by 2050	
15% growth in square footage	
10% efficiency through lighting & controls	
10% efficiency through envelope & HVAC improvements	
320% efficiency for heat pumps; 300% efficiency for EVs	

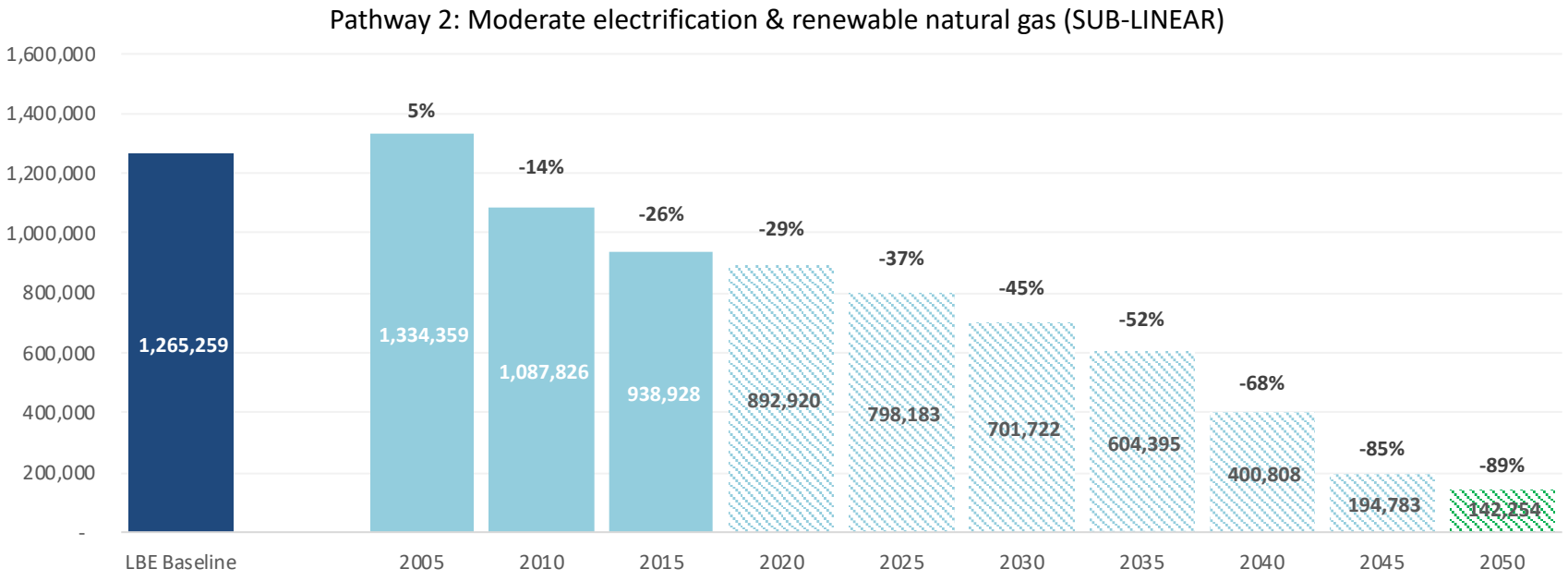
Pathway 1: Extreme Electrification

- Results in 84% emissions reduction by 2050 (1,066,143 MTCO2e)
- In 100% clean grid scenario, results in 98% emissions reduction
- Net-zero emissions achieved through offsets, negative emissions, etc.



Pathway 2: Electrification & Renewable NG

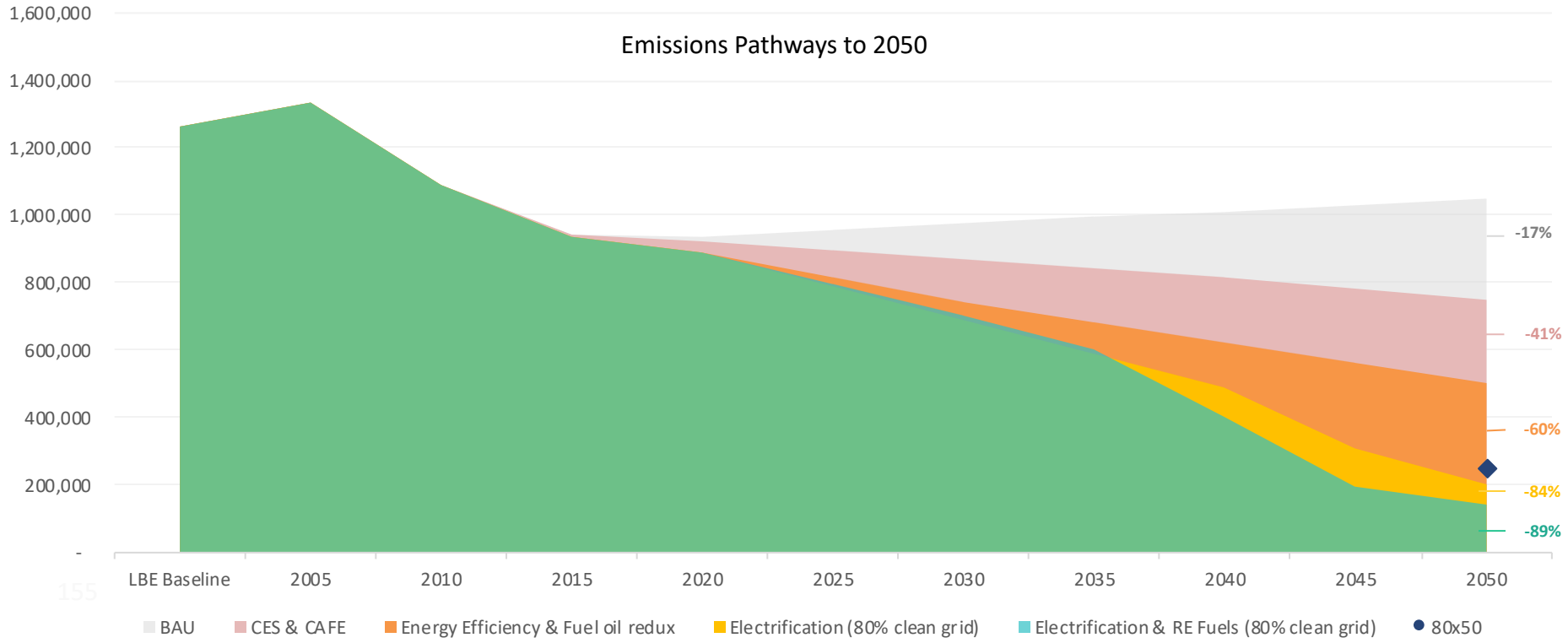
- Results in 89% emissions reduction by 2050 (1,123,005 MTCO2e)
- In 100% clean grid scenario, results in 99% emissions reduction
- Net-zero emissions achieved through offsets, negative emissions, etc.



Emissions Pathways to 2050

3 key wedges to emissions reductions below baseline:

1. Existing policies (CES & CAFE) [-41%]
2. Energy efficiency & elimination of fuel oil [-60%]
3. Deep decarbonization pathways
    a) Extreme electrification of buildings & fleets [-84%]
    b) Electrification and Renewable fuels [-89%]



Modeling Exercise: Key Takeaways

Prioritize electrification	Grid will continue to get cleaner, helping to reduce emissions from electricity
Decarbonizing thermal sector	Natural gas continues to drive emissions
Focus on top emitters	Emissions reductions from largest users at existing facilities essential to achieving 2050 goal
Clean transportation needed to meet goals	Transportation smaller contributor to overall emissions, but necessary for achieving long-term goals across portfolio
Beyond Business-as-usual	Achieving long-term goals will require dramatic and transformational change

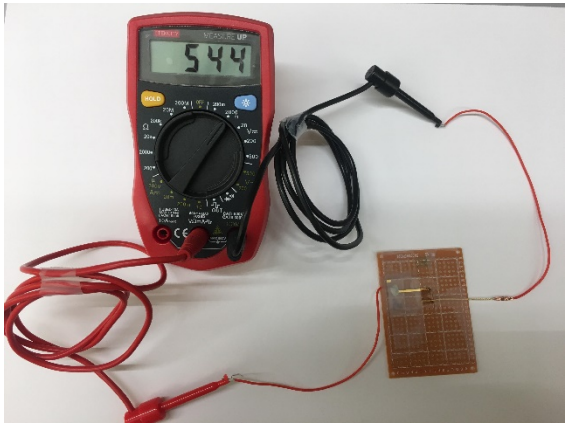
Welcome to the Future: Innovative Discoveries

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

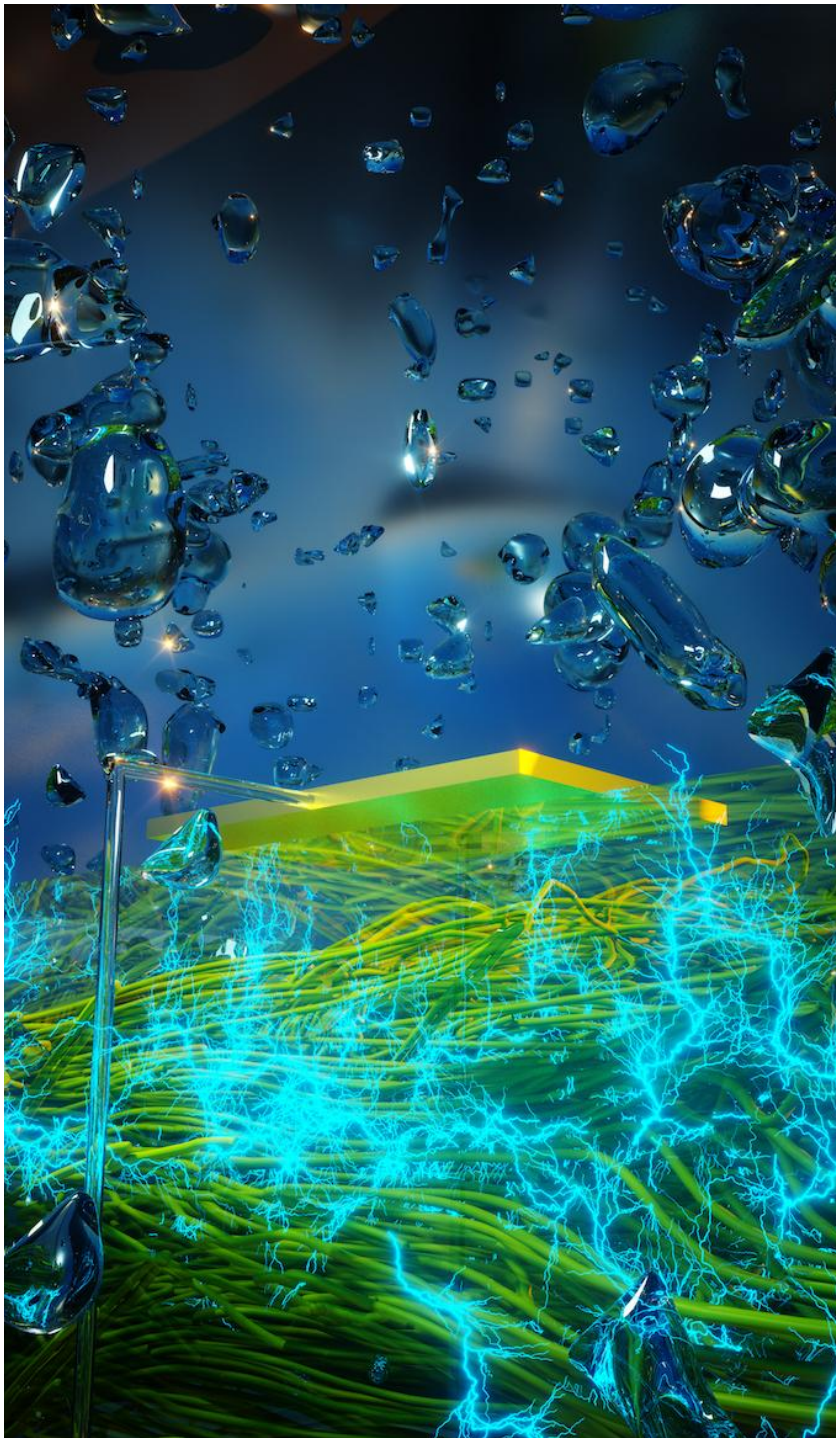
DOER
Massachusetts Department of Energy Resources

New Green Tech from UMA Generates Electricity 'Out of Thin Air'

- Air-gen device uses thin film of protein nanowires, electrodes, and water vapor to generate electricity
- Current device can power small electronic wearables
- Could eventually be scaled-up to grid-level applications



Source: UMass



Cooling Buildings with Solar Radiation

- SkyCool Systems device converts heat from a building into an infrared wavelength of light, allowing it to be sent directly into space
- Rooftop panels can cool fluids as much as 25F below ambient air temperature, without electric input

Source: Power-technology.com

Lithium-Sulphur Batteries Could Give EVs 620 Miles on One Charge

- Researchers from Melbourne's Monash University developed battery that can power a smartphone for five continuous days, and allow EV to drive more than 620 miles
- Compared to Lithium-Ion, Lithium-Sulphur batteries can be produced with lower manufacturing costs, use of abundant materials, and are easier to recycle

urce: Zdnet.com, Gigabit Magazine

Next LBE Council Meeting

Save the Date!

May 12, 2020

10:00 am–12:00 pm

Worcester State

Spotlight on Demand Response