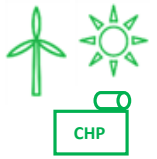
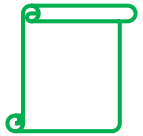
# MA Leading by Example Council Meeting

January 12, 2021

## State Government Progress – as of January 2021

| Greenhouse Gas (GHG) Emissions | Energy Use Intensity per Square Foot | Electricity via Renewable & Onsite Generation | Heating Oil Consumption at State Facilities |
|---|---|---|---|
|  |  |   |  |
| ↓ 35% | ↓ 14% | 20% | ↓ 85% |
| 2004 -2019 | 2004-2019 | In 2019 | 2004-2019 |

| 28.6 MW Installed Solar PV at State Sites | 94 LEED Certified State Buildings | 225 EV Charging Stations at State Sites | Leading by Example Grants Awarded |
|---|---|---|---|
|  |  |  |  |
| 20.5 MW | 57 | 174 | $12.6 M |
| Since 2015 | Since 2015 | Since 2015 | Since 2015 |

# Agenda

- Welcome
- Local and Regional Clean Energy News
- LBE Updates
- The Lay of the Federal Landscape
- Cutting Carbon in the Commonwealth
- State Facility Planning
- Q&A and Closing

*Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth*

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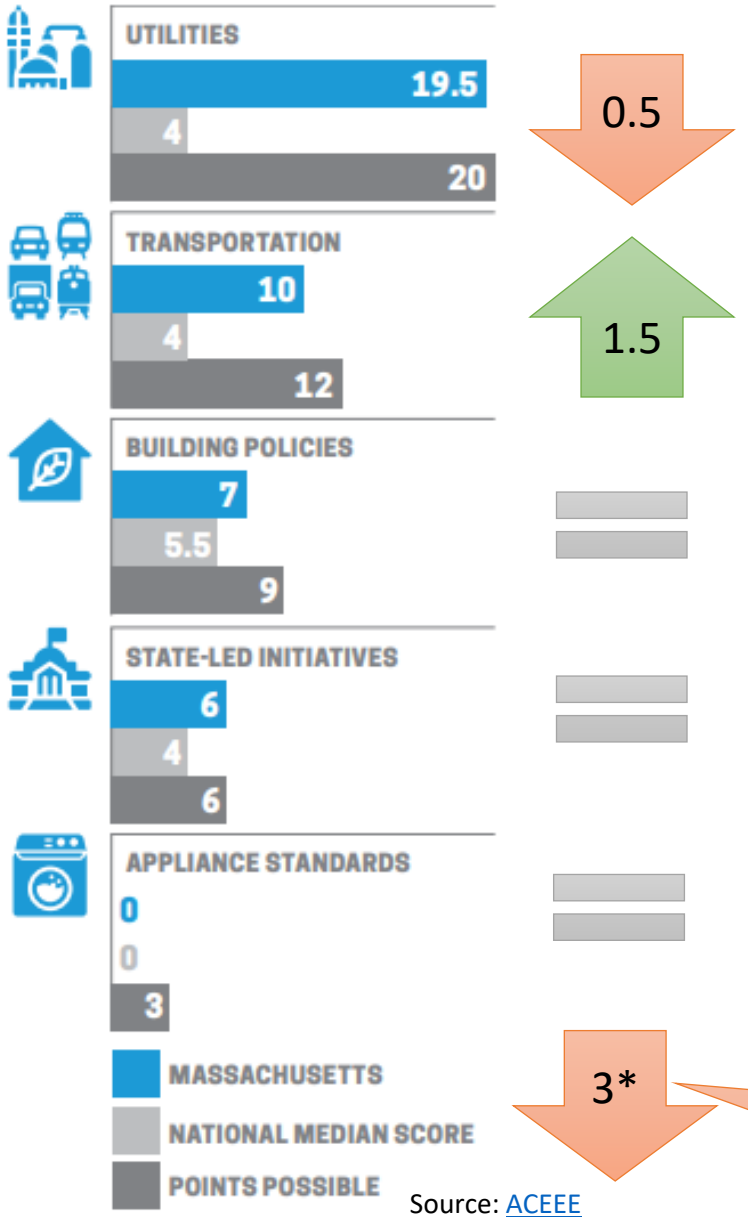
Massachusetts Department of Energy Resources

# Local and Regional Clean Energy News

MA drops to **2nd place** in ACEEE ranking for first time after a 9-year run in 1st

# 2020 ACEEE State Energy Efficiency Scorecard




Source: ACEEE

- 42.5 points earned out of a possible 50, 2 points behind 2019
  - 0.5 points behind California
- LBE still receives maximum possible points (6/6)
- Biggest point gain in Transportation category, thanks in part to setting targets to reduce vehicle miles traveled, EV incentive programs, tailpipe emission standards, and more
  - MA has more EV registrations and public charging stations per capita than most states
- Points still available in Transportation, Building Policies, and Appliance Standards
- 7 out of top 10 are in northeast/mid-Atlantic
  - New England states hold ranks 2, 3, 4, and 7

Combined Heat and Power no longer a category

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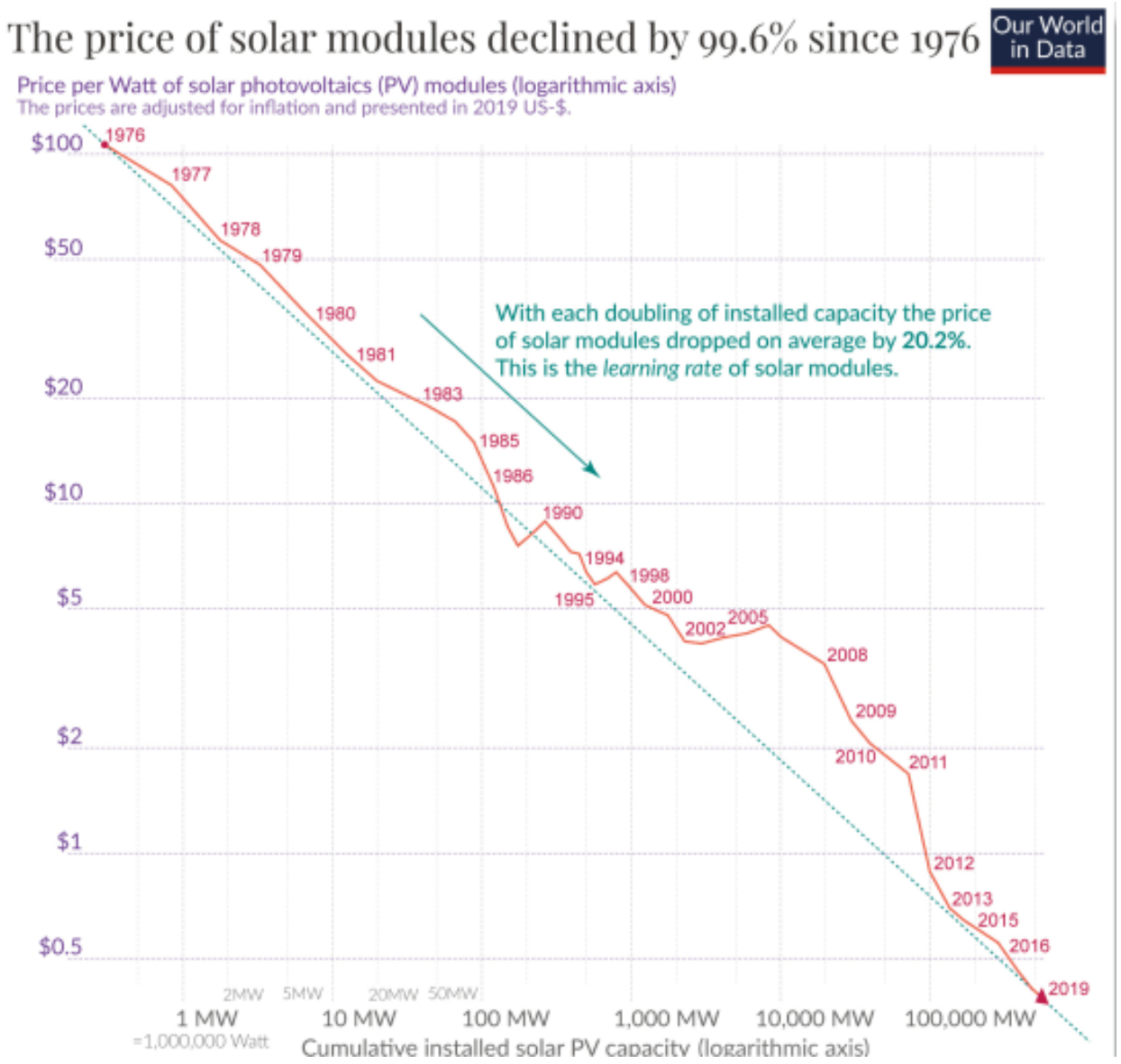
# Declining Price of Solar

- As cumulative installed solar PV capacity has increased, price per watt has decreased
- Price of solar electricity dropped 89% over last 10 years, from $359 to $40/MWh




Source: Fast Company

# Local Solar Saves Billions in New England

- ISO New England published detailed data on electricity produced by every small (<5MW), local solar installation in New England from 2014-2019
- In sum, small scale solar in New England has:

Produced 8,600 GWh of electricity

Enough to power 1.2 million homes for 1 year

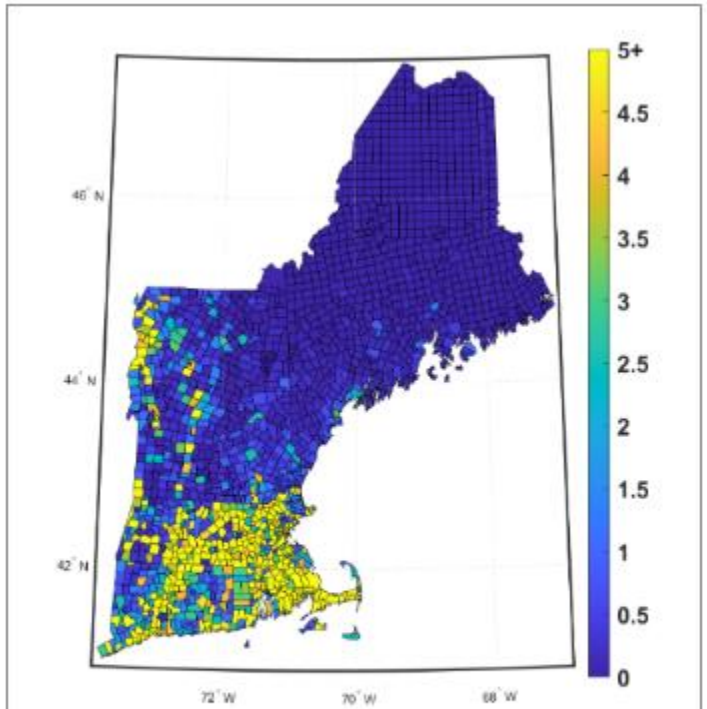
Reduced GHG emissions by 4.6 million tons

equivalent to 1 million cars off the road for 1 year

Reduced NOx, SOx, and particulate matter by 6 million lbs

Saved $87 million in public health costs

Saved customers $1.1 billion in wholesale electricity costs




Heat map illustrates the total small-scale PV installed nameplate capacity in each town, as of 12/31/19

*Source: ISO New England, 2020*

Source: Vote Solar

# Vermont State House Backed by Battery

- VT State House is first in nation to have backup power stored in batteries
- Installed fall 2020, the 250 kWh system replaced a 50+ year-old diesel generator
- The project is expected to:
  - Save taxpayers $44,000
  - Reduce CO2 emissions by 6,388lbs per year
  - Improving the building's resiliency
  - Reduce demand charges


Source: VermontBiz

# UML and Stony Brook Receive Energy Resilience Grant

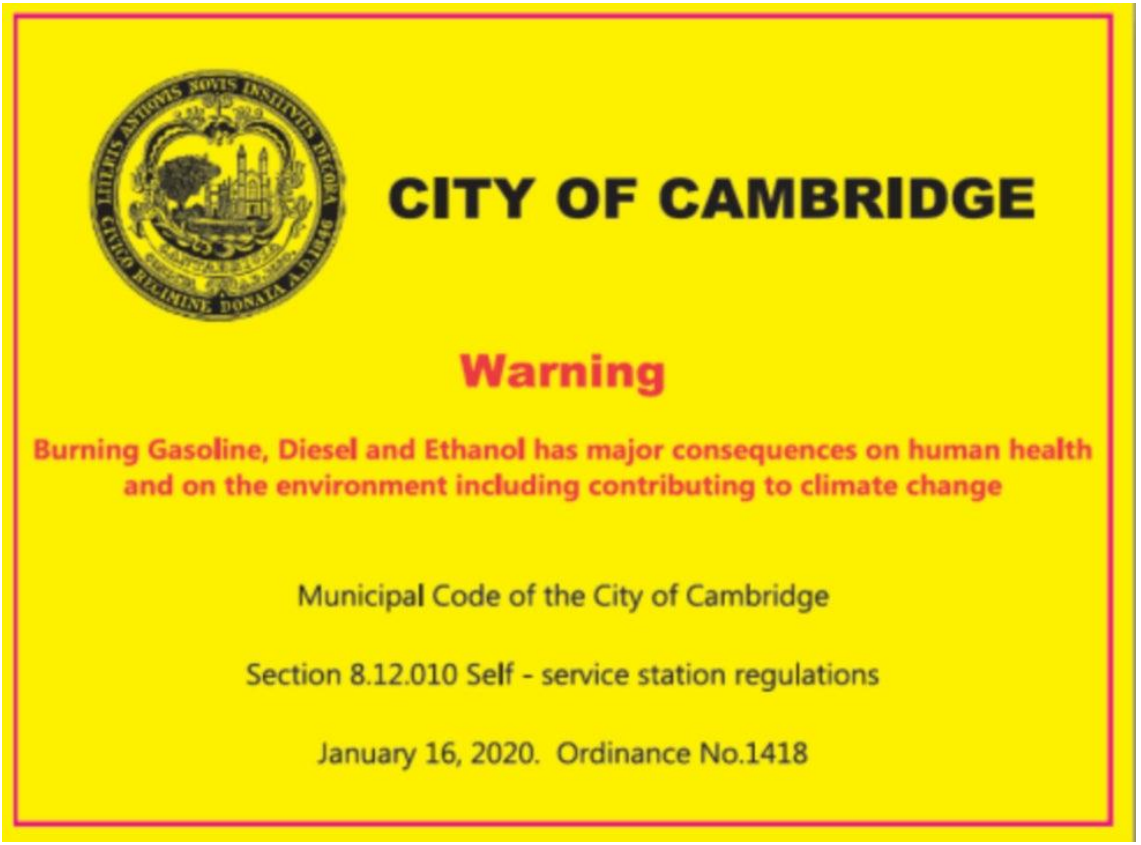
- $7.36 million grant from US Navy will fund nine distinct research projects focused on grid resilience, including:
  - Improving grid control
  - Security and infrastructure monitoring
  - Energy storage
  - Materials and grid management
  - Zero-carbon fuels
  - New training methods
- Project will run through fall 2022



Source: Microgrid Knowledge

# Climate Warning Gas Pump Labels

- Last year, the British Medical Journal advocated for climate warning labels as "*a low cost, scalable intervention to facilitate change in individuals' and society's views and behaviour*"
- Cambridge, MA became first U.S. city to require these labels on gas pumps
- Sweden made warnings mandatory on gas pumps in May; a similar attempt recently failed in Berkley, CA




Source: Independent

# First batch of “never-charge” EVs sold out

330 of Aptera’s futuristic three-wheelers sold out in first 24 hours

Only $26,000!

Built-in solar offers ~40 free miles of electricity per day, 11,000 miles/year

Aerodynamic, lightweight materials

1,000 mile range on a charge

Source: Independent

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# LBE Updates

# 2020 LBE Recognition Award Winners

## Municipal

City of Woburn

Town of Egremont

## Agency

MassDOT Aeronautics

Executive Office of Health and Human Services

## Higher Ed

UMass Medical School


Fitchburg State University

## Individual

Paul Antoniewicz, Trial Courts

Larry Sullivan, Town of Norfolk

# 2020 LBE Recognition Award Winners

## Municipal

- City of Woburn
- Town of Egremont

## Agency

- MassDOT Aeronautics
- Executive Office of Health and Human Services


100% recycled Styrofoam award frames, from [BetterFrames]

## Higher Ed

- UMass Medical School
- Fitchburg State University

## Individual

- Paul Antoniewicz, Trial Courts
- Larry Sullivan, Town of Norfolk

# Mass*EVolves* Honorees

- The 3rd annual Mass*EVolves* virtual recognition ceremony celebrated the work of public and private institutions to promote Electric Vehicle adoption across the Commonwealth
- Join us in congratulating our partners for their work:
  - UMass Amherst
  - UMass Boston
  - UMass Dartmouth
  - UMass Medical School
  - Bristol Community College
  - Holyoke Community College
  - Worcester State University

Executive Office of Energy and Environmental Affairs

MassDEP

RECHARGE AMERICA

# 2021 EV Purchase Challenge for State Entities

MassEVolves +

# Mass*EVolves* Participation

- Mass*EVolves* supports and publicly recognizes organizations who take specific steps to encourage greater electric vehicle adoption
- All state entities (i.e., campuses, Executive Branch agencies, and quasi-public authorities) are now eligible to participate
- Participating entities pledge to take actions such as installing EV charging stations and converting fleet assets to zero emission vehicles (ZEVs)

# 2021 EV Purchase Challenge

- In partnership with LBE, Mass*EVolves* and EEA recently announced an annual, voluntary **challenge to advance progress toward the adoption of electric vehicles in state fleets** in support of emissions reduction targets
- The EV Purchase Challenge offers a unique **opportunity to demonstrate leadership and gain additional recognition** for on-the-ground efforts to reduce environmental impacts
  - Criteria for the 2021 Challenge includes **the purchase of at least one fleet ZEV**
- Interested state entities **first submit a Mass*EVolves* pledge** and can then elect to participate in the EV Purchase Challenge

# Benefits of Participation

- Access to **resources**
  - Educational opps. for staff and drivers, support for navigating vehicle selection and procurement, fleet analyses, and technical expertise
- Peer-to-peer **learning** about ZEV and charging experiences
- Public **recognition** for participation in Mass*EVolves*
  - Additional distinction for entities that have purchased or will be purchasing fleet EVs between 2018 and end of CY 2021

CONTACT: CATIE SNYDER
(CATIE.SNYDER@MASS.GOV)

# More Details Coming Soon!

# LBE Solar Grant Updates

- PON extended through June 30, 2021, on COMMBUYS
  - Applications accepted and reviewed on a rolling basis until grant funds are no longer available
- New applications will be placed on hold due to potentially limited grant funding
- Submission of applications still recommended -- if projects under review do not move forward, we will return to the on-hold application queue
- Applicants will be kept apprised of any changes to application status or grant funding availability

*MEMA, Salem State, Cape Cod Regional Transit Authority, and UMass Boston implemented solar grant projects under the current PON*

*5.7 MW of solar canopy and rooftop projects were recently awarded grants; announcements pending agreement finalization*

*Additional applications currently under review*

# FY20 Tracking Form Update


**Many thanks to everyone who has submitted their FY20 tracking form!**

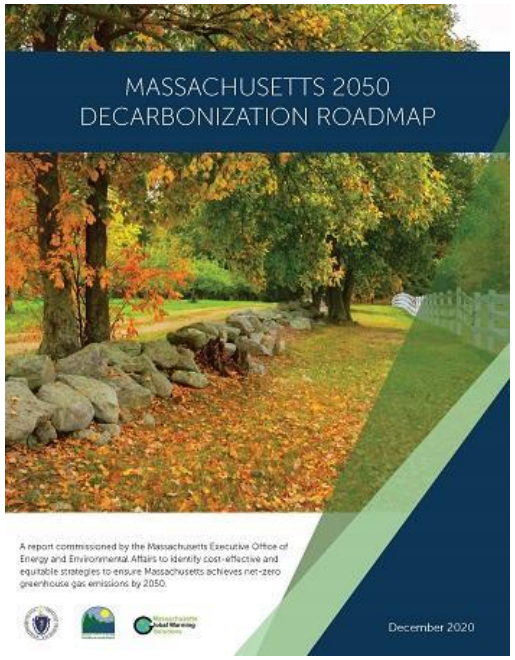
Department of Correction
Fitchburg State University
Framingham State University
Mass. College of Liberal Arts
Mass. Maritime Academy
Mass. Port Authority
North Shore Community College
Quinsigamond Community College
Salem State University
Springfield Tech. Community College
UMass Amherst
UMass Boston
UMass Lowell
UMass Medical School
Worcester State University

**If you have not yet submitted, please reach out to Chelsea on the status of your form.**

Happy to answer questions and/or help with your submission!

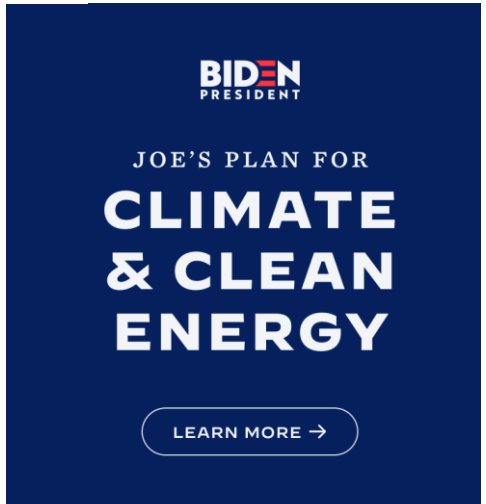
# Planning for the Decarbonized Future

# So Much Happening, So Little Time…


LEARN LIVE LEAD Sustainable UMASS

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





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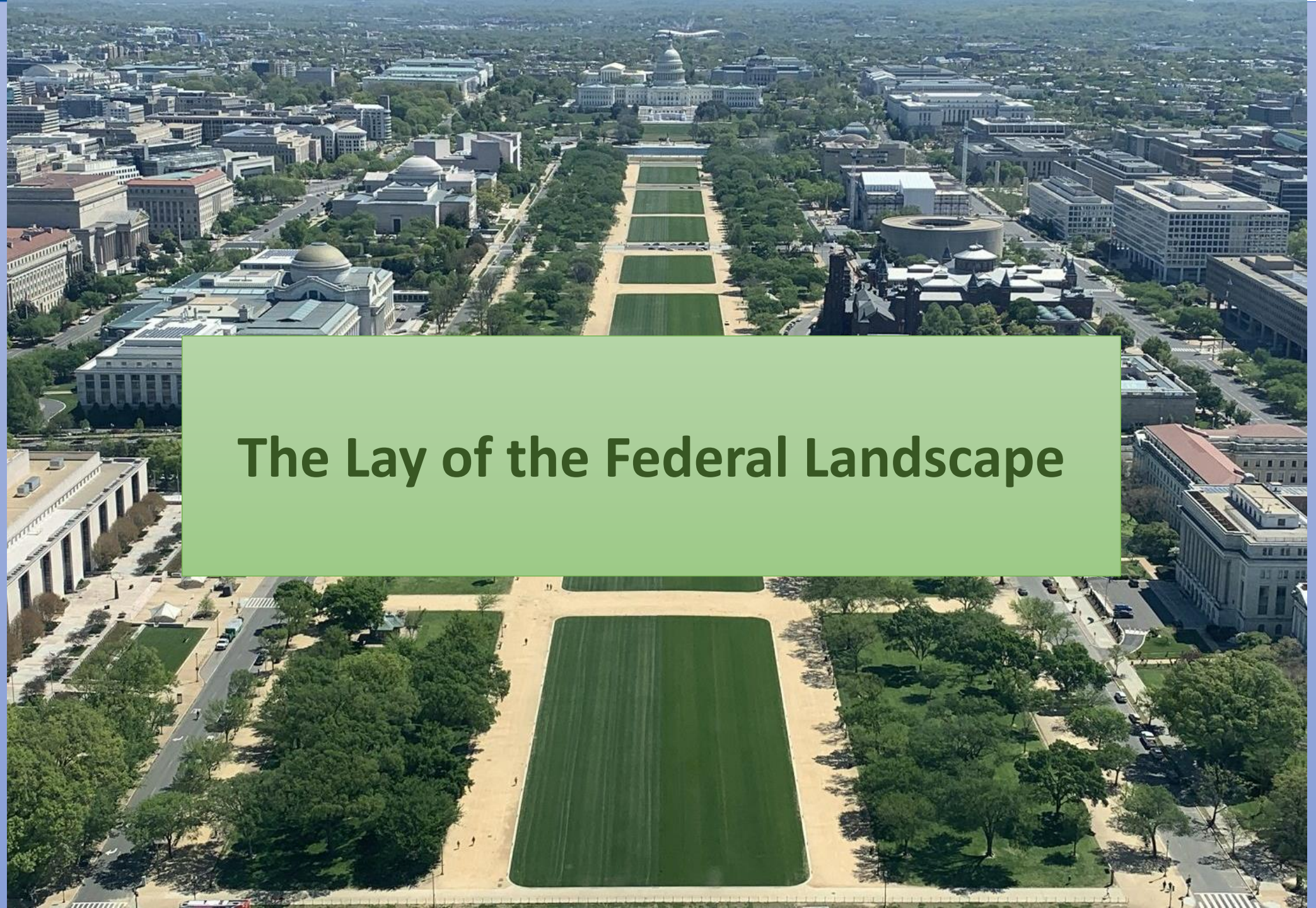
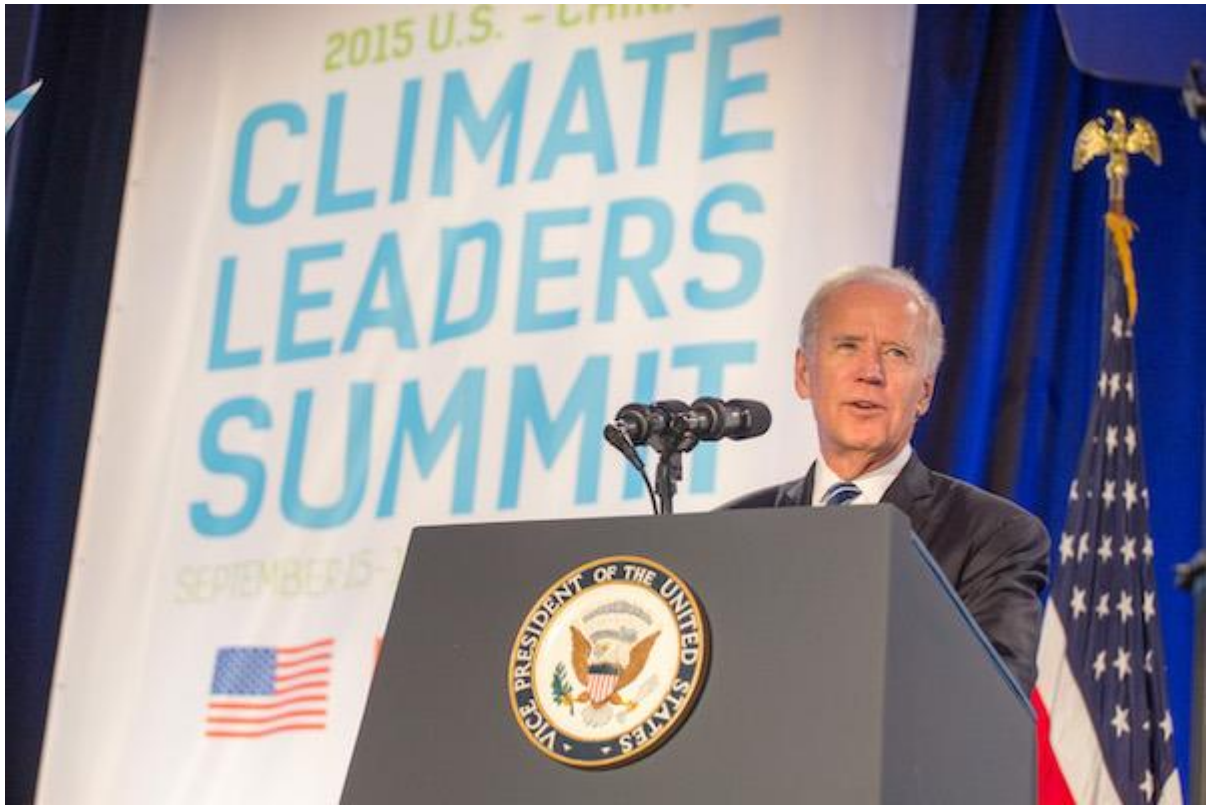
Massachusetts Department of Energy Resources



# The Lay of the Federal Landscape

# Biden Administration Climate and Energy Plan

- Rejoin Paris Climate Accord, with new emissions target
  - Power sector exceeded original goal of 28% reduction (33% reduction in 2019)
- Convene a world summit in November 2021 to "persuade (other countries) to join the U.S. in making more ambitious national pledges"
- 4-year, $2 trillion climate plan
  - 100% emission reduction from the electricity sector in the next 15 years
  - Economywide net-zero emissions by 2050




Source: POWER, JoeBiden.com

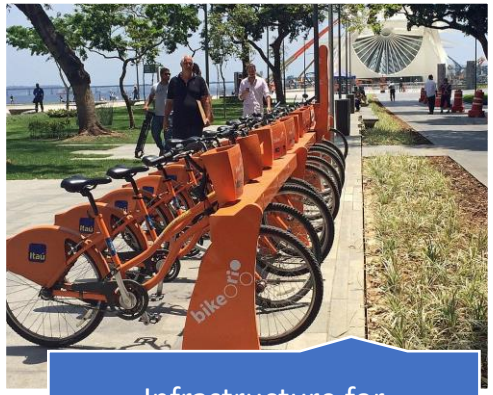
# Biden's Climate and Energy Plan

The key elements of the Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future include:

1. Build a **Modern Infrastructure**

Railroad electrification

Public transportation in cities of 100,000+ people



Infrastructure for pedestrians, cyclists

Redevelop Brownfield and underutilized community sites

Source: JoeBiden.com

# Biden's Climate and Energy Plan

The key elements of the Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future include:

1. Build a **Modern Infrastructure**
2. Position the **U.S. Auto Industry** to Win the 21st Century


Commit to purchase clean vehicles


Establish ambitious fuel economy standards

Install 500,000 EV stations

All American-built buses to be emission-free

Source: JoeBiden.com

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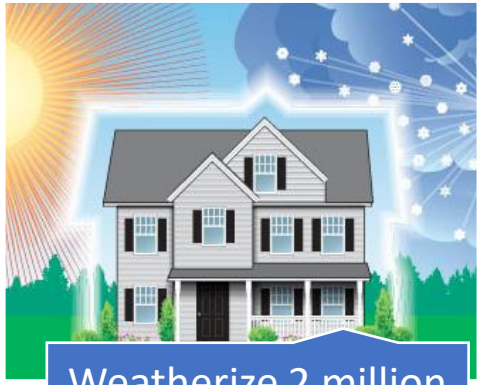
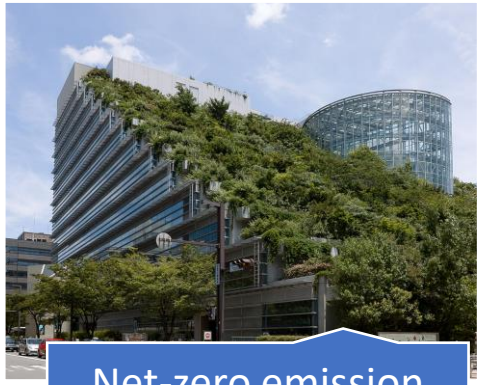
The key elements of the Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future include:

1. Build a **Modern Infrastructure**
2. Position the **U.S. Auto Industry** to Win the 21st Century
3. Make Dramatic **Investments in Energy Efficiency** in Buildings

Upgrade 4 million buildings



Weatherize 2 million homes



Net-zero emission building standard

Construct 1.5 million efficient homes

Source: JoeBiden.com

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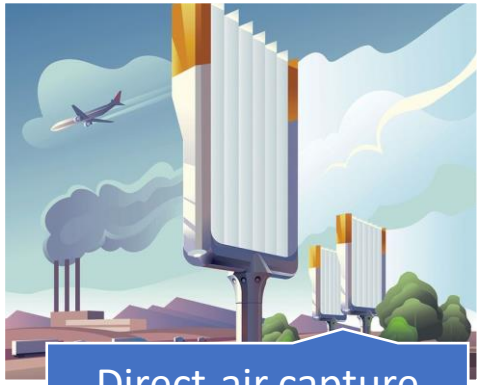
3. Make Dramatic **Investments in Energy Efficiency** in Buildings
4. Pursue a Historic Investment in **Clean Energy Innovation** through creation of Advanced Research Projects Agency on Climate (ARPA-C)

Grid-scale energy storage

Affordable green hydrogen

Emission-free refrigerants



Direct-air capture sequestration

Source: JoeBiden.com

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3. Make Dramatic **Investments in Energy Efficiency** in Buildings
4. Pursue a Historic Investment in **Clean Energy Innovation**
5. Advance Sustainable **Agriculture and Conservation**


Civilian Conservation Corps

Restore areas impacted by resource extraction

Voluntary carbon farming market

Source: JoeBiden.com

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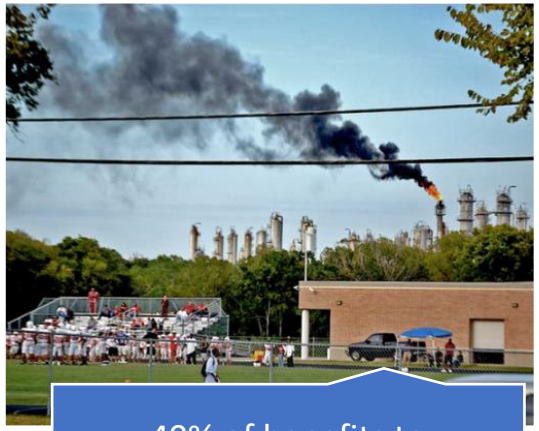
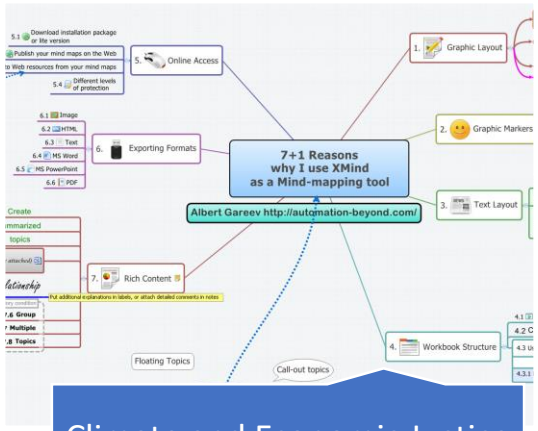
5. Advance Sustainable **Agriculture and Conservation**
6. Secure **Environmental Justice and Equitable Opportunity Economy**



40% of benefits to disadvantaged communities




Climate and Economic Justice Screening Tool

Implement government-wide EJ plan

Source: JoeBiden.com

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4. Pursue a Historic Investment in **Clean Energy Innovation**
5. Advance Sustainable **Agriculture and Conservation**
6. Secure **Environmental Justice and Equitable Opportunity Economy**
7. Achieve a **Carbon Pollution-Free Power Sector** by 2035

Reform and extend tax incentives

Develop innovative financing mechanisms

Establish an *Energy Efficiency and Clean Electricity Standard* (*EECES*)

Source: JoeBiden.com

# Biden's Climate and Energy Picks

## Department of Interior

Deb Haaland

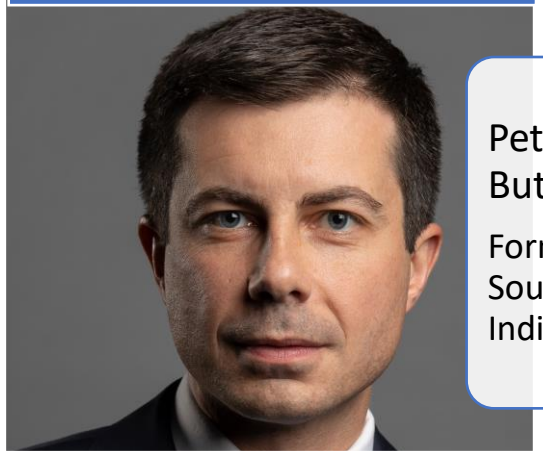
House Representative since 2018

## Environmental Protection Agency

Michael Regan

Head of NC Dept of Environmental Quality

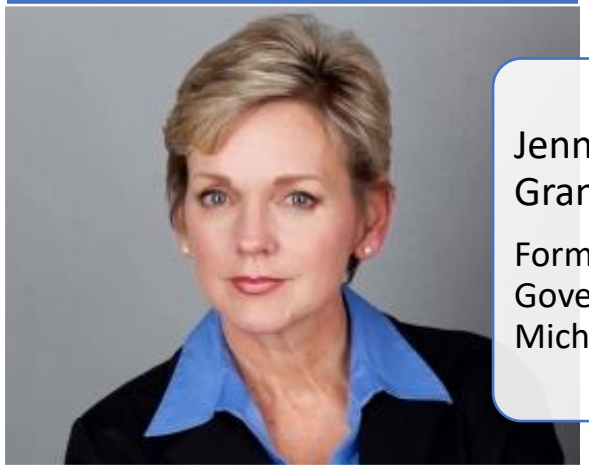
## Department of Transportation



Pete Buttigieg

Former Mayor, South Bend, Indiana

## Department of Energy



Jennifer Granholm

Former Governor of Michigan

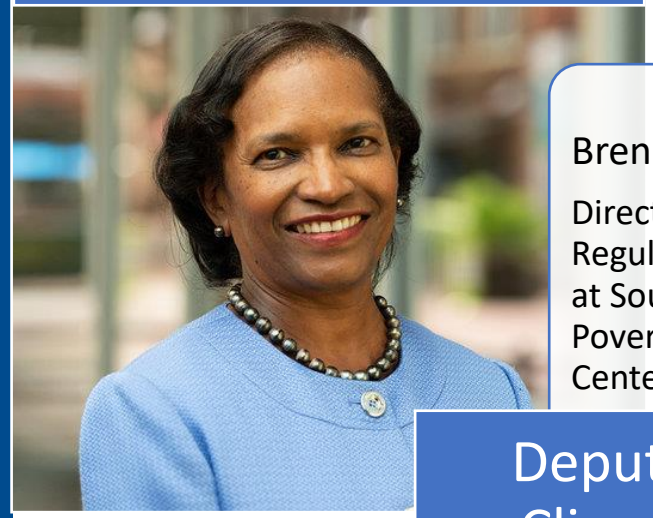
## Treasury Department

Janet Yellen

Former Chair of Federal Reserve

# Biden's White House Climate Picks

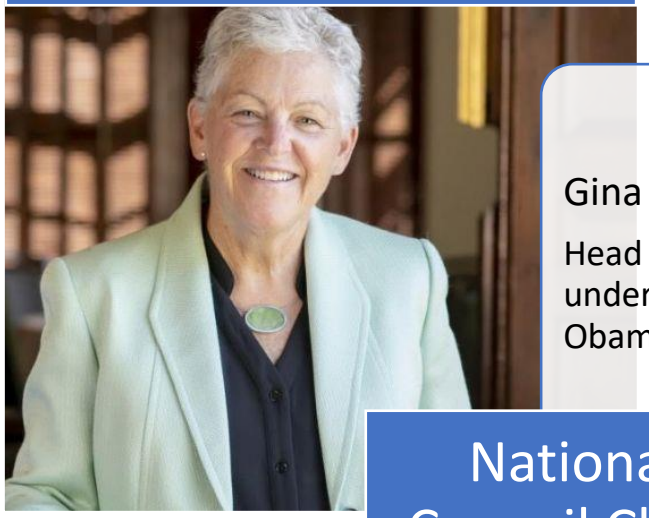
## White House Council on Environmental Quality



Brenda Mallory

Director of Regulatory Policy at Southern Poverty Law Center

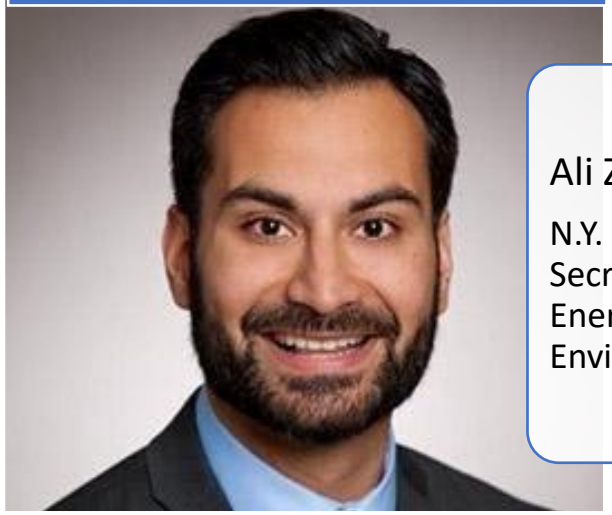
## National Climate Advisor



Gina McCarthy

Head of EPA under President Obama

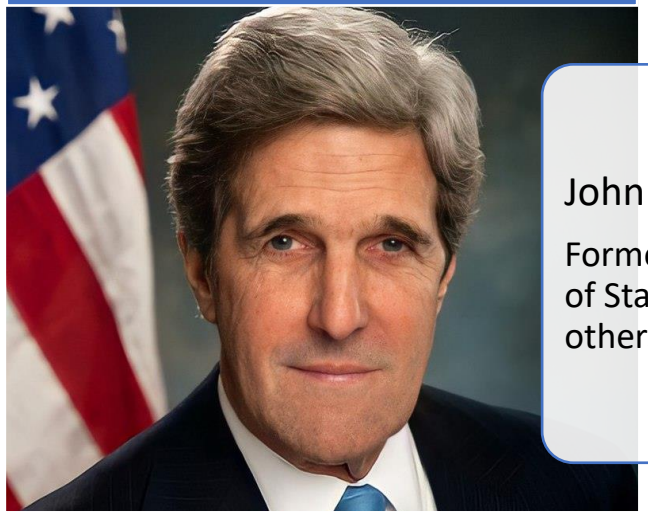
## Deputy National Climate Advisor



Ali Zaidi

N.Y. Deputy Secretary of Energy and Environment

## National Security Council Climate Envoy



John Kerry

Former Secretary of State (among others!)

# CARES Act and the Energy Act of 2020

Consolidated Appropriations Act of 2021 included funding for clean energy and energy efficiency programs under the $35.2 billion “Energy Act of 2020” provision

## Energy Efficiency

- Reauthorizes Weatherization Assistance Program
- Water and energy considerations added to RD&D programs
- Establishes Smart Building Accelerator

## Carbon Management and Removal

- Carbon capture and utilization RD&D and pilot programs
- RD&D program to improve efficiency of gas turbines
- Research on blue hydrogen and utility for carbon capture

## Renewable Energy and Storage

- RDD&D for renewable energy, including improving efficiency and lowering costs
- Renewable production on Federal land, with target of 25GW by 2025
- RD&D to advance energy storage tech and commercialization

## Additional Program areas

- Grid modernization, RD&D on smart grids, micro-grids, etc
- Office of Technology Transitions to improve commercial impact of research investments
- RD&D on Hydrogen and Fuel Cell, Vehicle, and Bioenergy technologies

Source: Senate.gov, Journal of Accountancy, GreenTechMedia

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# CARES Act Tax Benefits

- Section 48 Energy Investment Tax Credit program expansion
  - 26% credit retained for solar built though 2022; drops to 22% in 2023, 10% in 2024 (0% in 2024 for small-scale solar)
  - 26% credit for waste energy recovery that begins construction through 2022, 22% in 2023
  - Offshore wind projects that begin construction from 2017-2025 eligible for 30% investment tax credit (up from 12% in 2019, 18% in 2020)

Electricity from Mayflower Wind expected to now cost 10% less

- Tax incentive extensions for clean fuels and technologies, including:
  - Energy-efficient commercial buildings
  - CO2 sequestration
  - Fuel cell motor vehicles
  - Alternative fuel vehicle refueling stations
  - Second-generation biofuels

Source: Journal of Accountancy, State House News, GreenTechMedia, Latham&Watkins

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Massachusetts Department of Energy Resources

# Cutting Carbon in the Commonwealth: State Policies

# Massachusetts' 2050 Roadmap & 2030 Clean Energy and Climate Plan

Hong-Hanh Chu
GWSA Program Manager
Executive Office of Energy and Environmental Affairs
Hong-Hanh.Chu@mass.gov

# Overview

- Integrated Analytical & Policy Development Process
- Statewide Emissions: Past & Future
- 2050 Roadmap: Key Findings
- Next Steps for 2050 Roadmap
- Sector-Specific Approaches to Achieve 45% Emissions Reduction
- Next Steps for 2030 Clean Energy and Climate Plan

# Integrated Analytical & Policy Development Process

## 2050 Decarbonization Roadmap Study (www.mass.gov/2050Roadmap)

- Long range, comprehensive analysis of cost effective and equitable pathways to reduce greenhouse gas emissions by at least 85% and achieve Net Zero in 2050.

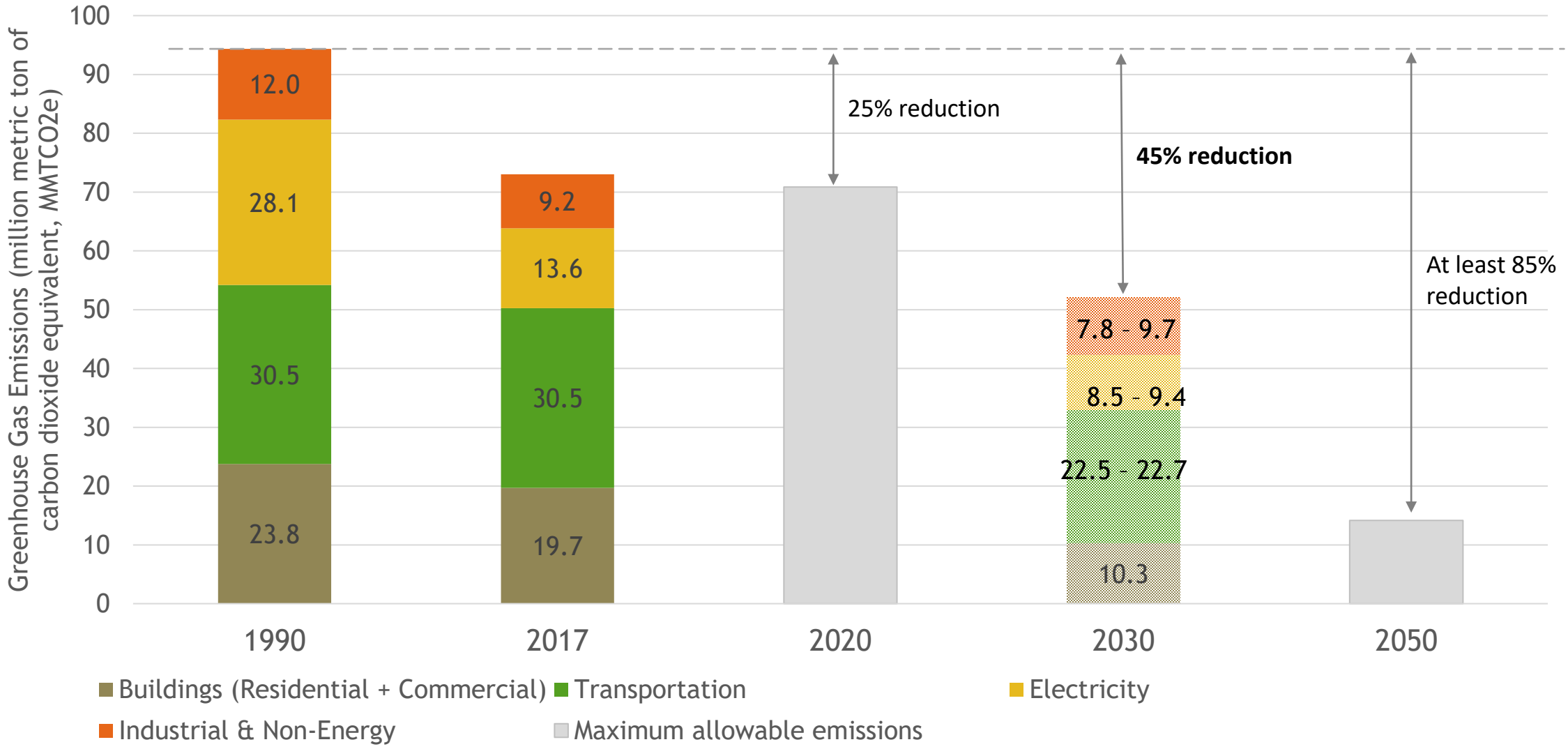
## 2030 emissions limit: 45% emissions reduction from 1990 baseline level

- Iterative process to determine the emissions limit that is technically feasible and cost effective while still maximizing the Commonwealth's potential to achieve Net Zero in 2050.

## Clean Energy and Climate Plan for 2030 (2030 CECP) (www.mass.gov/2030CECP)

- Implementation plan outlining strategies, policies, and actions for how the Commonwealth can achieve the 2030 emissions limit affordably and equitably.

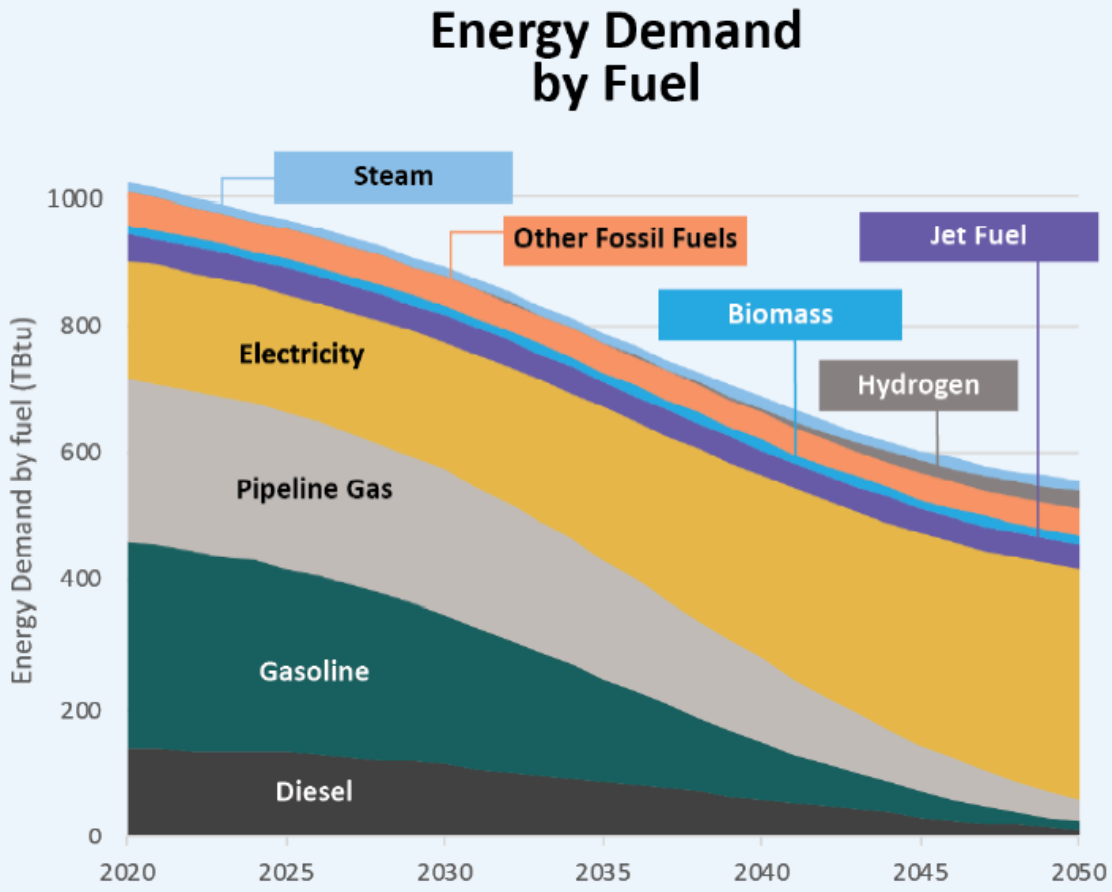
# Statewide Emissions: Past & Future

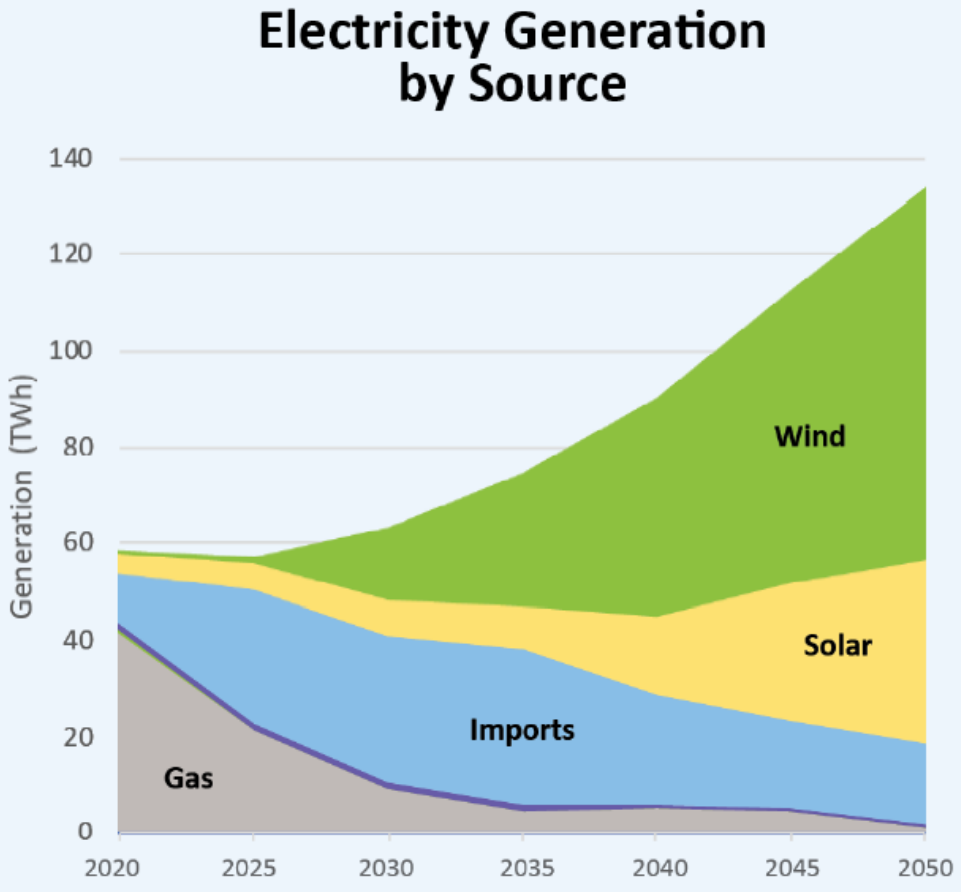


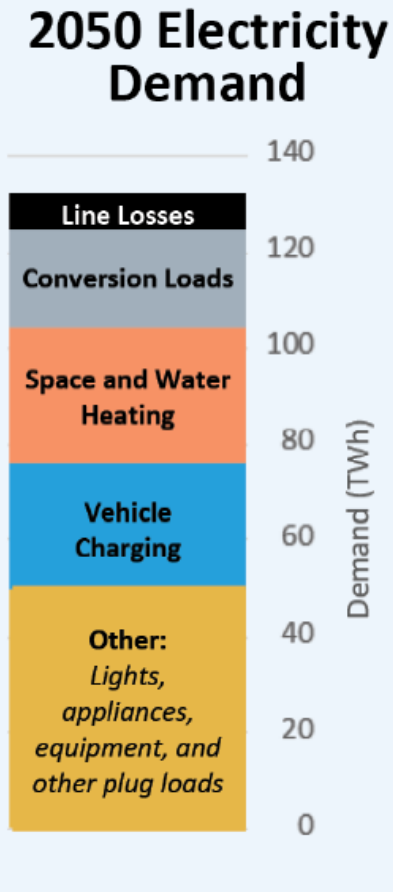

**Net Zero emissions: sources of emissions = removal of emissions**

# 2050 Roadmap: Key Findings

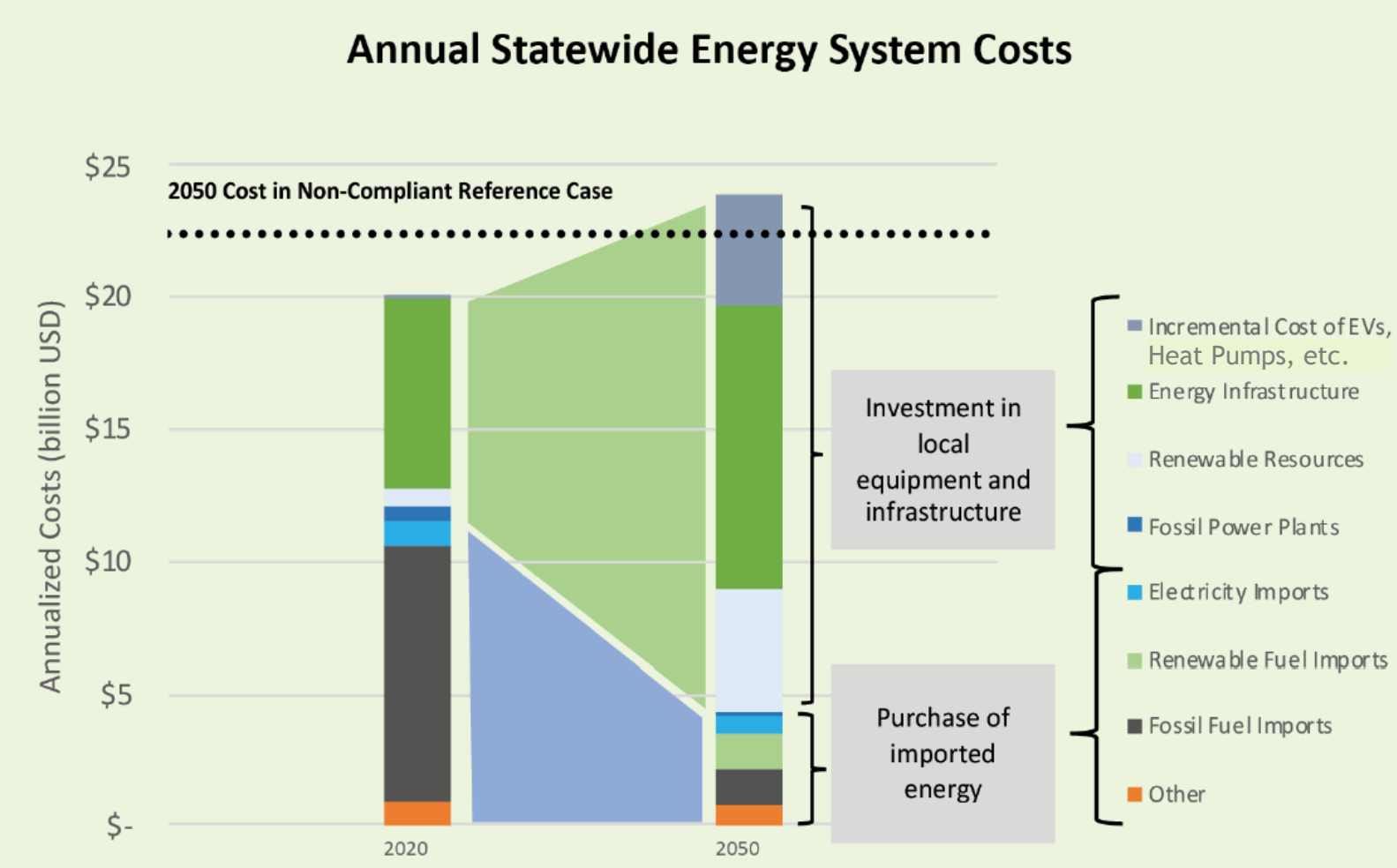
# Energy System Transition to 2050: Energy Demand and Supply



# Energy System Transition to 2050: Energy Costs & Benefits




- Equipment replacement at end of life helps with cost effectiveness
- Achieving Net Zero by 2050 would lead to an estimated annual impact of:
  - 400 avoided deaths from cardiovascular and respiratory illness;
  - 25,000 days of work absences avoided;
  - 15,000 new jobs on average
- The health benefits are valued at $4.5 billion annually, exceeding projected costs for the Net Zero pathways.

# System Transformation to 2050: Buildings Sector

*Figure 7. Percentage of Massachusetts built square footage by typology and vintage for residential.*

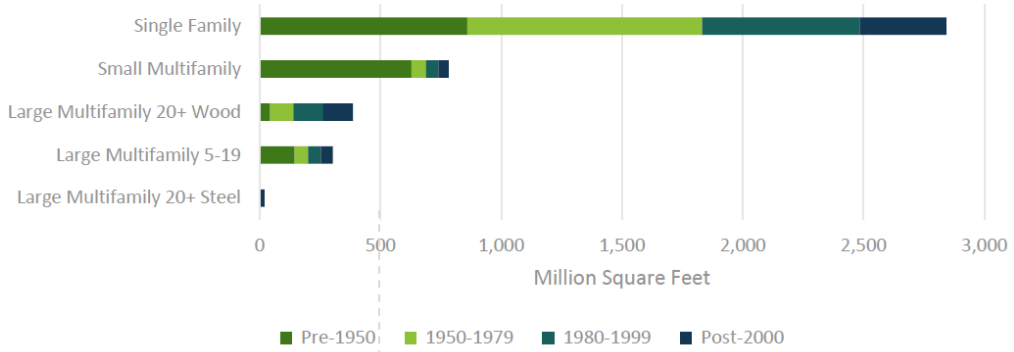
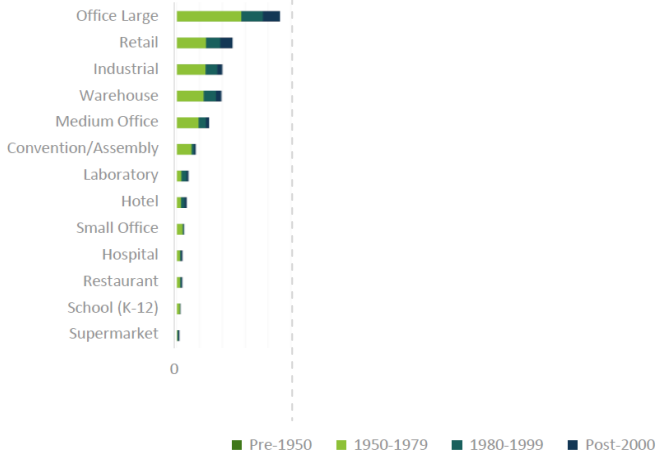



*Figure 8. Percentage of Massachusetts built square footage by typology and vintage for commercial buildings. Note differing scale from Residential.*

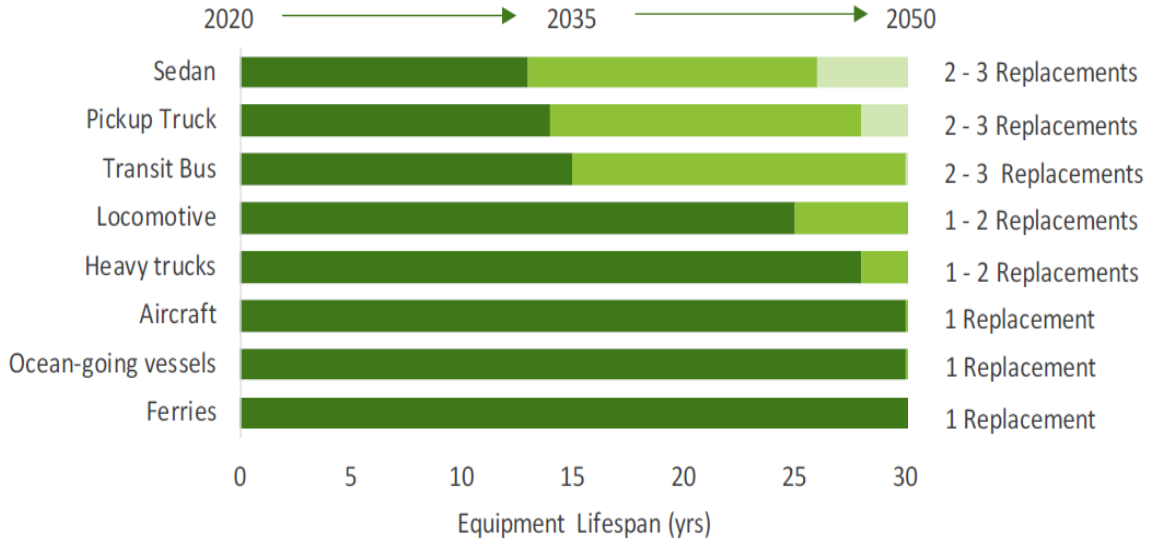



- Small homes are 60% of building emissions and are relatively easy to decarbonize
  - Pace & scale of retrofits: nearly 100,000 homes installing heat pumps or other renewable thermal systems each year for the next 25-30 years.
- Electrification of space and water heating is a low-risk, cost-effective strategy.
- Investing in envelope efficiency drives down costs to consumers and the entire energy system.
- Decarbonized fuels may be available and appropriate strategy for some buildings, but the use of gas for building heat must start to decline in the near term.
- New Construction is easier to build “2050 compliant” from the start.

# System Transformation to 2050: Transportation Sector

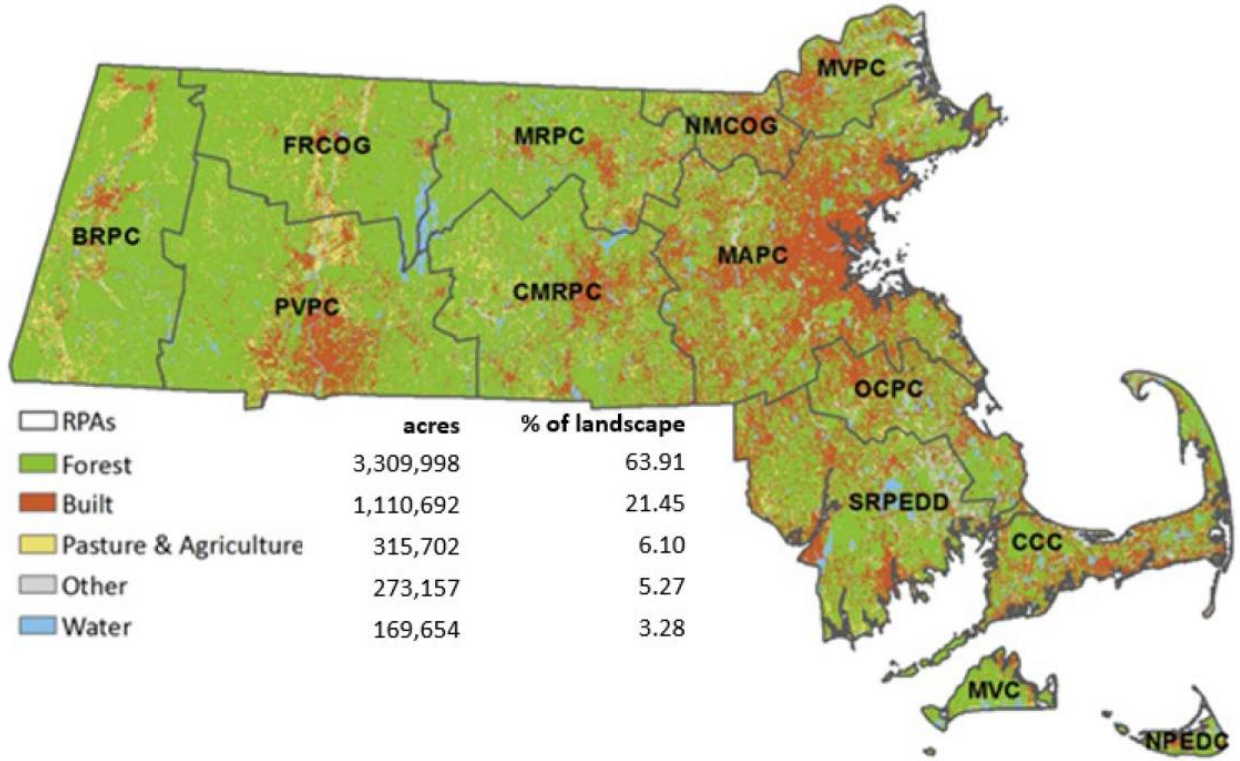
- Cars, trucks, and buses are emissions-free and mostly electric; Zero-carbon fuels like hydrogen help power the rest of the transportation system.
  - ~50% of sales of zero emission light-duty vehicles by 2030
- A healthy public transit system, bike lanes, sidewalks, and transit-oriented development complement vehicle electrification and help to reduce congestion.

*Figure 6. Illustrative replacement cycles of various vehicle types.*




# System Transformation to 2050: Land Use

- Forests and other natural and working lands are managed strategically to enhance carbon sequestration while maintaining and building ecosystem health and resiliency.
  - MA forests are projected to sequester 5-6 $MMTCO_2e$ per year from now through 2050 (more if include soil carbon)
  - By 2050, we will need at least 4-9 MMTCO2e of addition annual sequestration services




| RPAs | acres | % of landscape |
|---|---|---|
| Forest | 3,309,998 | 63.91 |
| Built | 1,110,692 | 21.45 |
| Pasture & Agriculture | 315,702 | 6.10 |
| Other | 273,157 | 5.27 |
| Water | 169,654 | 3.28 |

# Next Steps

- The 2050 Decarbonization Roadmap Report and 6 technical reports are available on www.mass.gov/2050Roadmap
  - Public webinar scheduled for questions and answers on the 2050 Roadmap approach and findings:  Friday, Jan 15 from 12-1:30pm
- Update the 2050 Roadmap analysis in next few years to inform greenhouse gas emissions reduction strategies and policies.

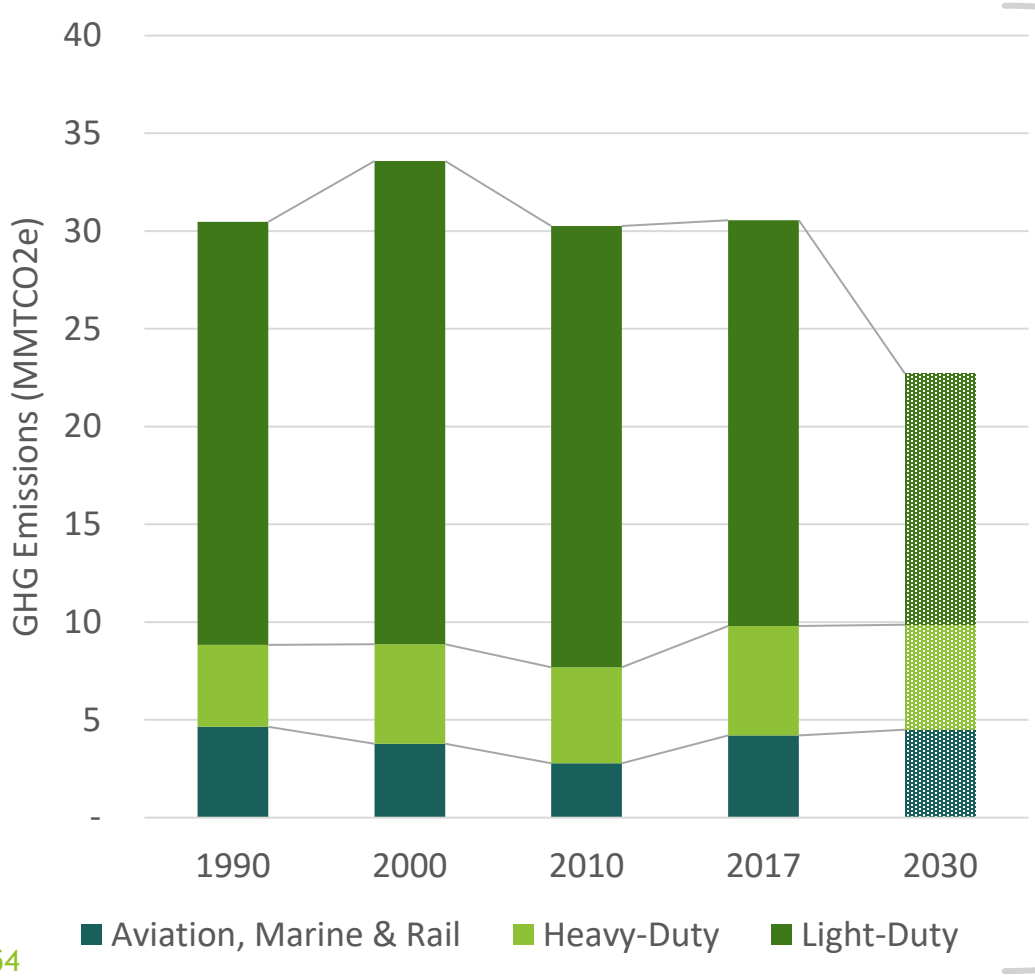
# Interim Clean Energy and Climate Plan for 2030: High-Level Summary

# Estimated Emissions Reduction from Full and Timely Implementation

| Sector | *Gross Greenhouse Gas (GHG) Emissions ($MMTCO_2e$)* | | | *GHG Reductions in 2030 (from 2017)* |
|---|---|---|---|---|
| | **1990** | **2017** | **2030** | |
| **Transportation** | 30.5 | 30.5 | 22.5 - 22.7 | 7.8 – 8.1 |
| **Buildings** | 23.8 | 19.7 | 10.3 | 9.4 |
| **Electricity** | 28.1 | 13.6 | 8.5 - 9.4 | 4.2 – 5.1 |
| **Industrial & Non-Energy** | 12.0 | 9.2 | 7.8 - 9.7 | (0.5)* – 1.4 |
| **Total** | **94.5** | **73.0** | **49.1 – 52.1** | **20.9 – 23.9** |
| **% Reduction From 1990** | - | **23%** | **45% - 48%** | |
| *Negative reduction indicates an increase – this reflects partial mitigation of emissions growth | | | | |

# Transportation Sector: ~ 8 MMTCO$_2$e Reduction

**Where emissions reductions are expected to come from?**
*Historical & Projected MA GHG Emissions*




**What do the emissions savings translate to?**
*Key Metrics*

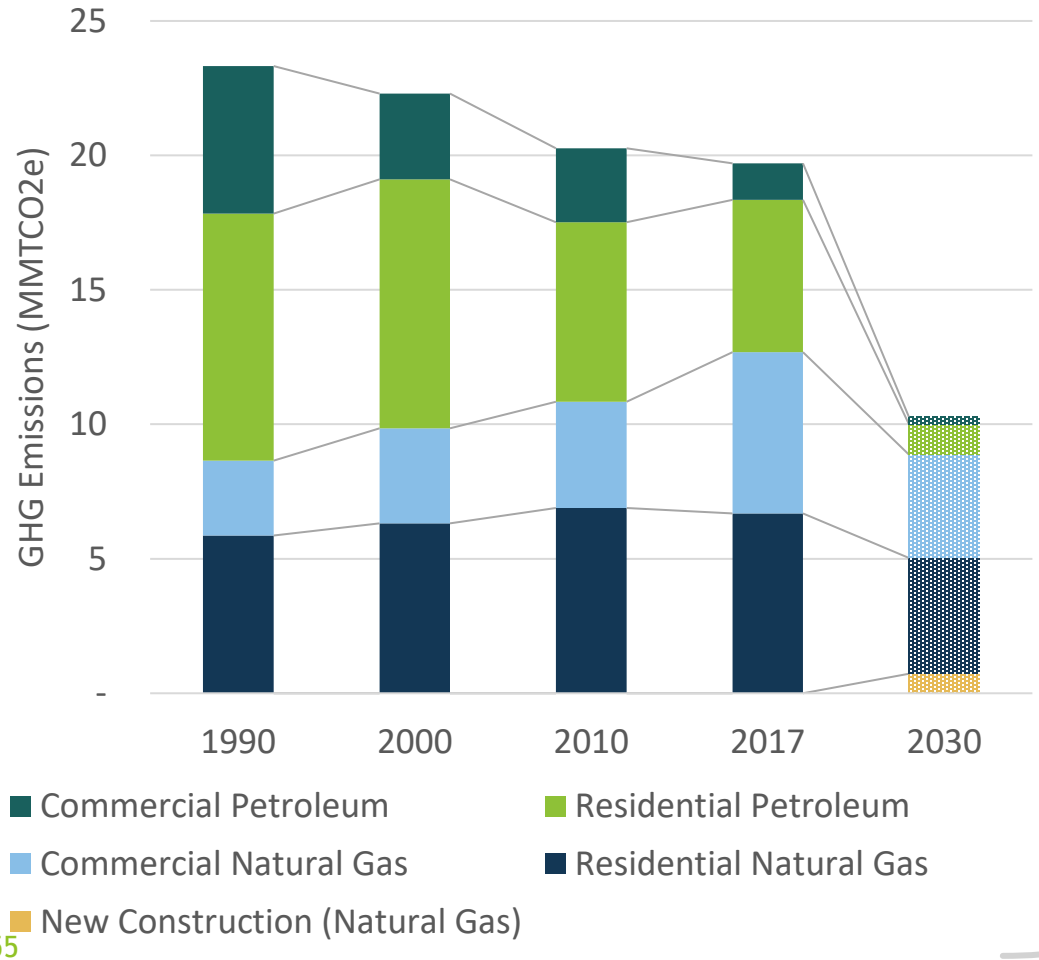
| | |
|---|---|
| At least **750,000** | **Light-duty zero-emission vehicles (ZEV) on the roads** |
| **20%** (approximate) | **Reduction in carbon intensity of diesel fuel** |
| **15%** | **Reduction in commuter miles** |
| **56** billion miles | **Light-duty vehicle miles traveled (VMT) each year stabilized at this level** |

**How are we going to achieve it?**
*Main Strategies*

- *T1. Cap Transportation Sector Emissions and Invest in Clean Transportation Solutions;*
- *T2. Implement Coordinated Advanced Clean Vehicle Emissions and Sales Standards;*
- *T3: Reduce Upfront ZEV Purchase Cost Burden;*
- *T4. Deploy Electric Vehicle Supply Equipment & Enable Smart Charging;*
- *T5. Engage Consumers & Facilitate Markets;*
- *T6. Stabilize Light-Duty VMT & Promote Alternative Transportation Modes.*

# Buildings Sector: ~ 9.4 MMTCO$_2$e Reduction

**Where emissions reductions are expected to come from?**
*Historical & Projected MA GHG Emissions*




**What do the emissions savings translate to?**
*Key Metrics*

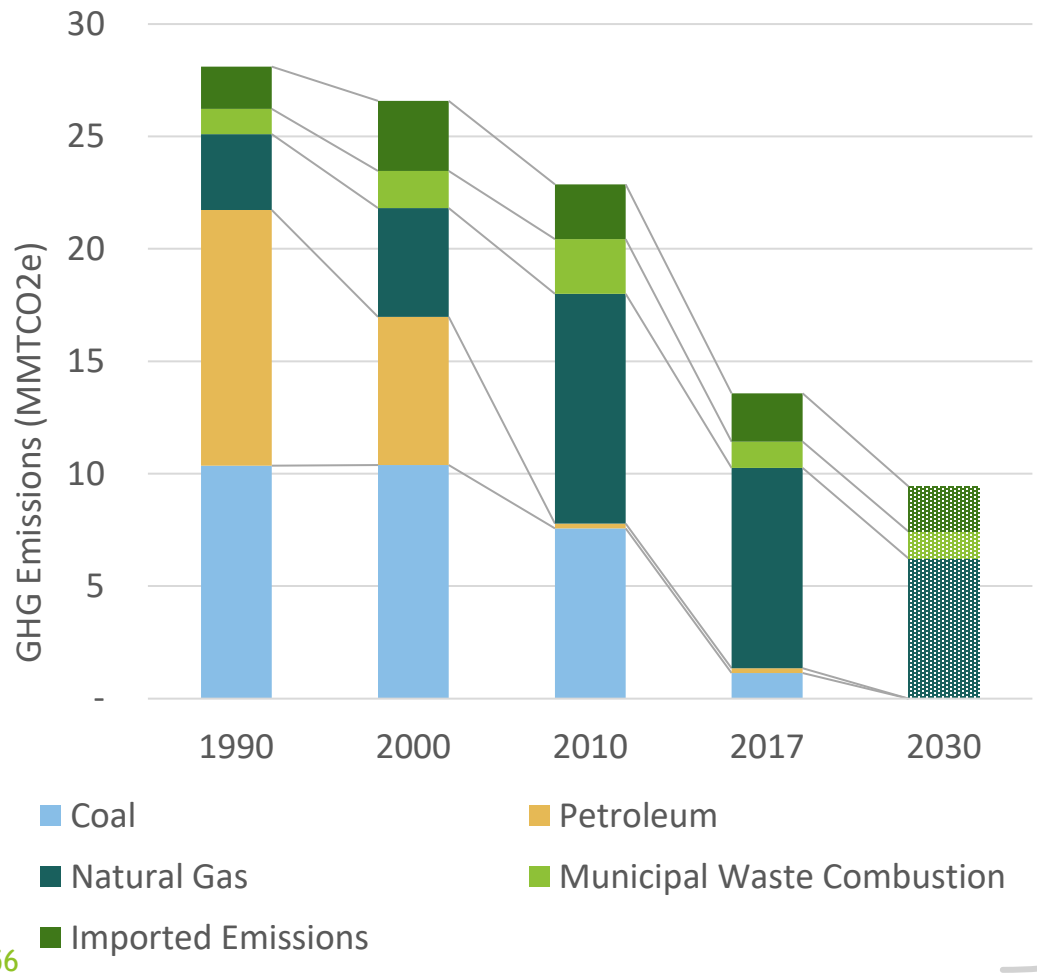
| | |
|---|---|
| **1 million** (approximate) | **Home heating systems electrified** |
| **350 million** (approximate) | **Square feet of commercial space with electric space heating** |
| **20%** | **Buildings with deep energy retrofit** |
| **20%** (approximate) | **Reduction in carbon intensity of blended fuel oil** |
| **2028** | **Year when all new construction are built with a high-performance envelope** |

**How are we going to achieve it?**
*Main Strategies*

- *B1. Avoid Lock-In of Building Systems That Are Not 2050-Compliant;*
- *B2. Pivot the Market for Building Envelope Retrofits and Clean Heating Systems;*
- *B3: Convene the Commission and Task Force on Clean Heat & Cap Heating Fuel Emissions.*

# Electric Sector: > 4.2 $MMTCO_2e$ Reduction

**Where emissions reductions are expected to come from?**
*Historical & Projected MA GHG Emissions*




**What do the emissions savings translate to?**
*Key Metrics*

- **5.2 GW** — **Solar energy generation**
- **3.2 GW** — **Offshore wind energy generation**
- **1 GW** — **New transmission to Quebec hydroelectricity**

**How are we going to achieve it?**
*Main Strategies*

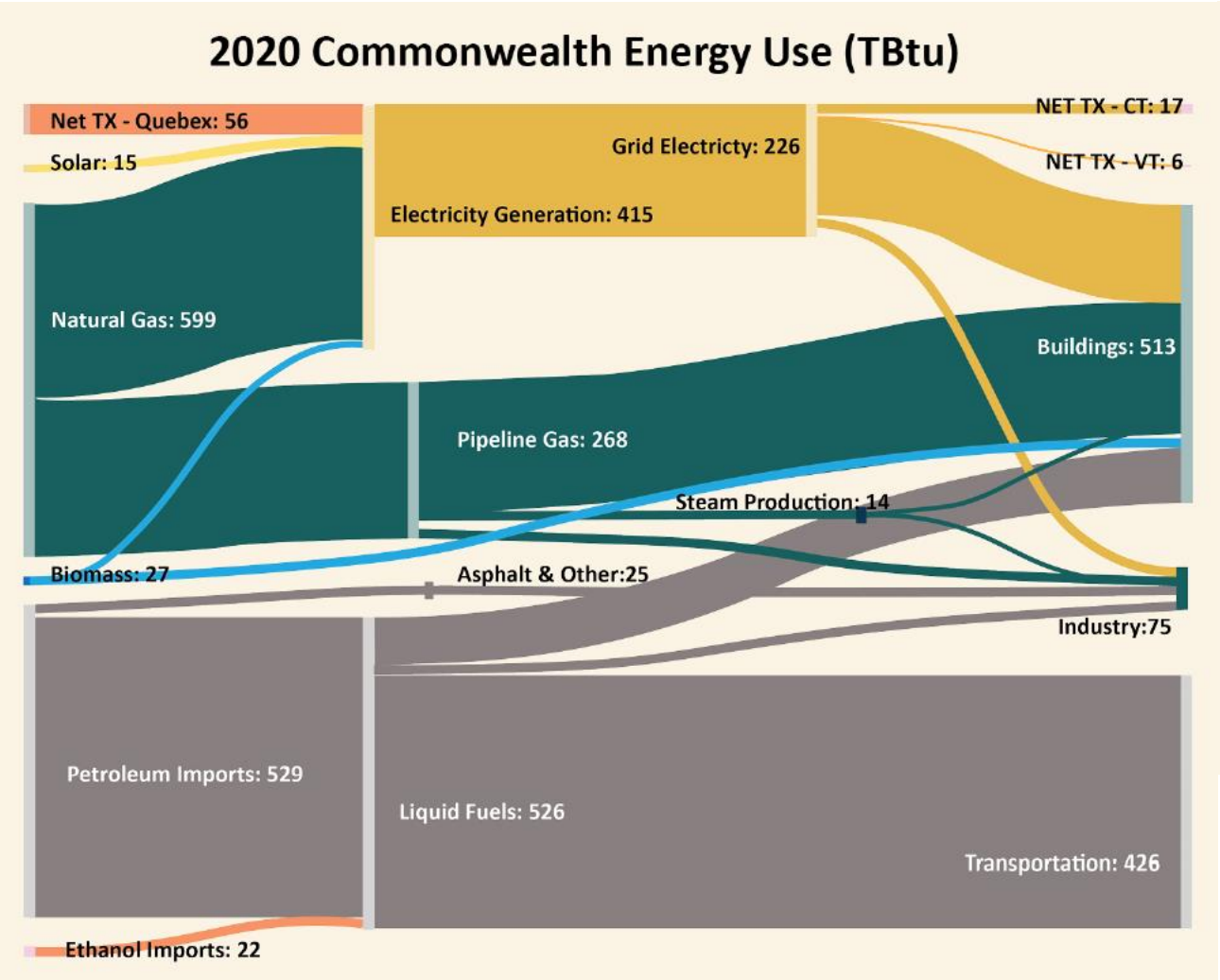
- *E1. Fill Current Standards & Execute Procurements;*
- *E2. Develop and Coordinate Regional Planning and Markets;*
- *E3. Align Attribute Markets with GWSA Compliance;*
- *E4. Continue to Deploy Solar in Massachusetts;*
- *E5. Develop a Mature Offshore Wind Industry in Massachusetts;*
- *E6. Incorporate GWSA into Distribution-Level Policy Considerations.*

# Next Steps

- Public comment on the interim Clean Energy and Climate Plan for 2030 now until February 22, 2021.
  - Public webinars scheduled for discussion on the strategies, policies, and actions proposed in the interim plan:
    - Session 1: Thursday, January 28, 2021, 9:30am to 11am
    - Session 2: Saturday, February 6, 2021, 10:30am to 12pm
  - Visit www.mass.gov/2030CECP for more information.
- Finalize the Clean Energy and Climate Plan for 2030 in Spring of 2021.
- Work with state agencies on implementation and progress tracking & reporting.
- GWSA 15-Year Progress Report due by December 31, 2023.
- Next mandated update of the Clean Energy and Climate Plan is due by December 31, 2025.

# Extra slides

# Energy System Transition to 2050: Energy Flows



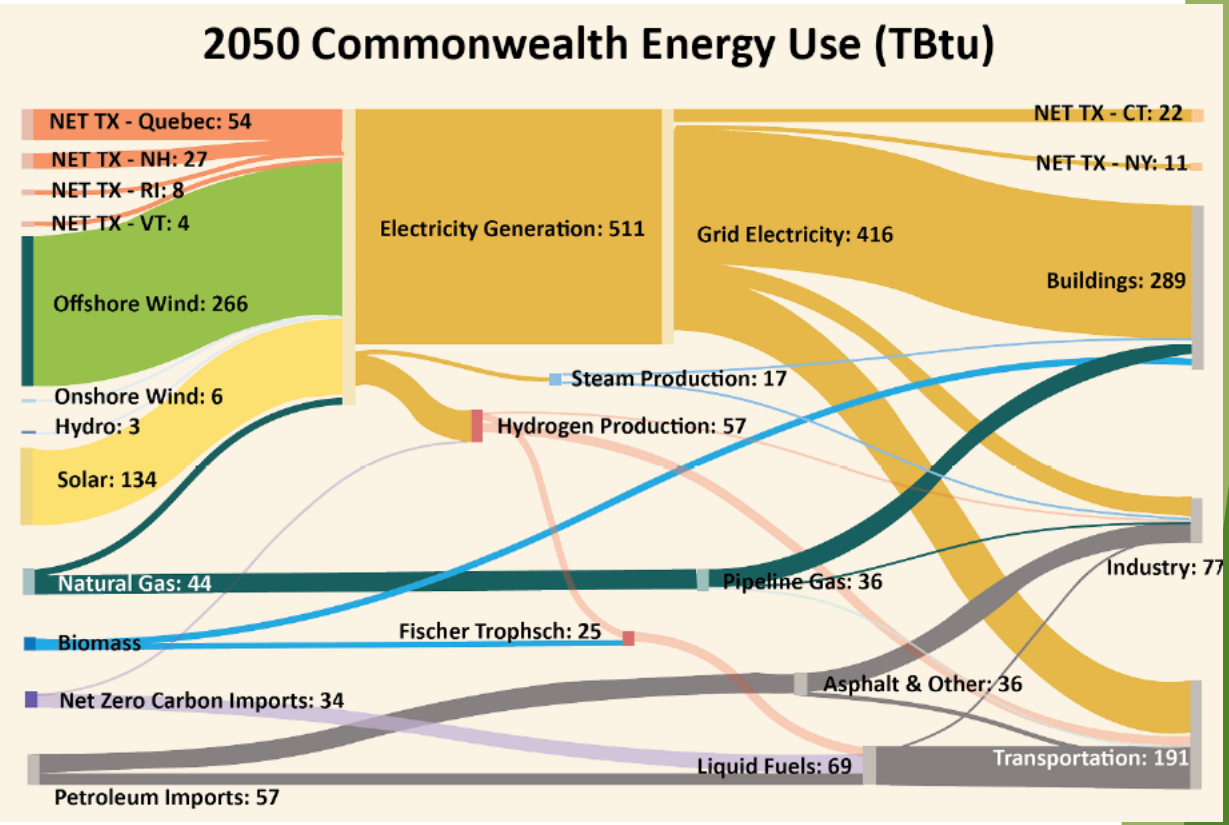



*Figure 19. Building electricity load duration profile for selected Single-Family Home vintages. Hours for each modeled level of intervention are sorted from highest to lowest. Each building ECM is ordered independently in this figure meaning that calendar (equivalent weather) days are not aligned. For example, the baseline peak hours are in the summer while the peak hours for the retrofitted buildings are predominantly in the winter.*

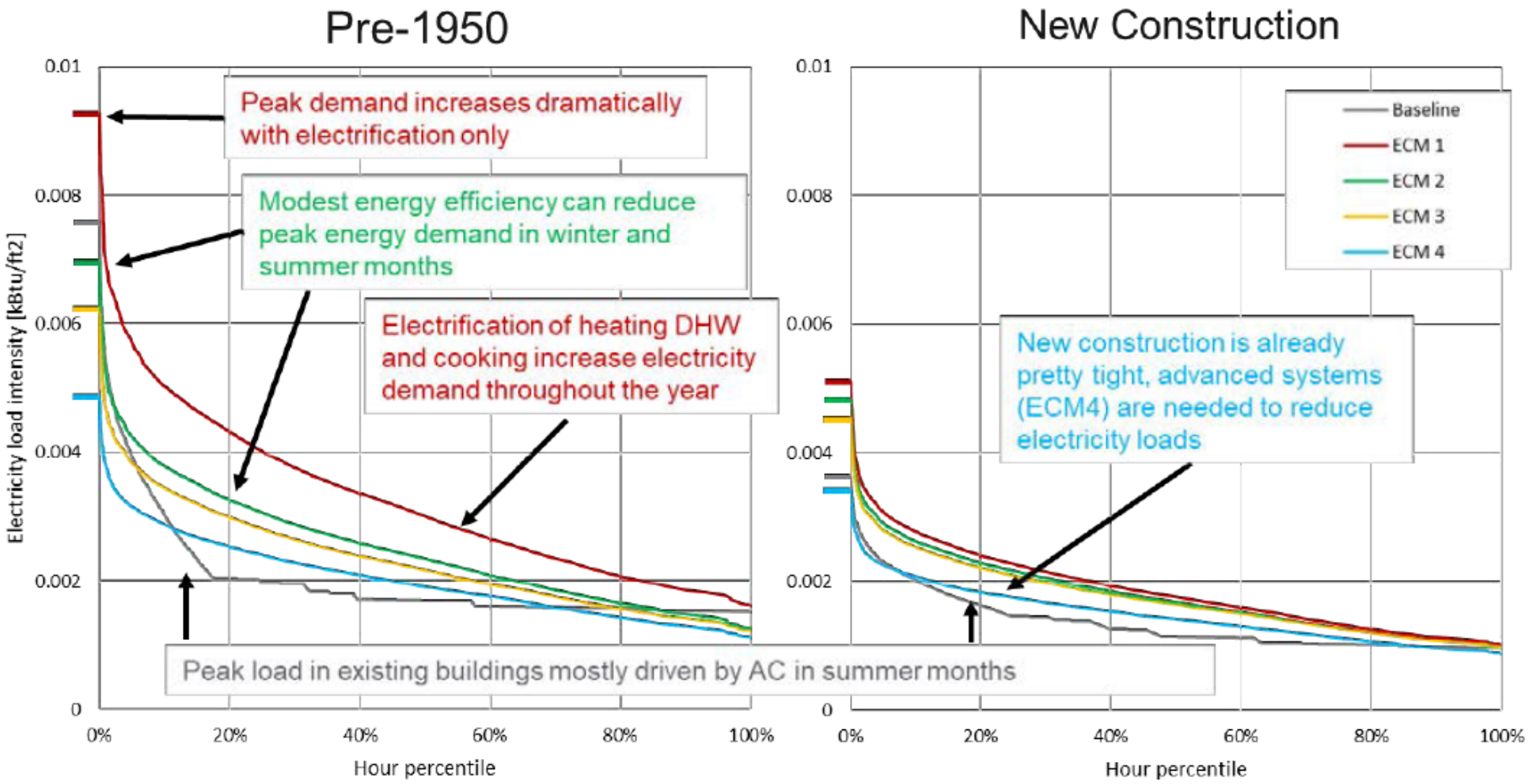
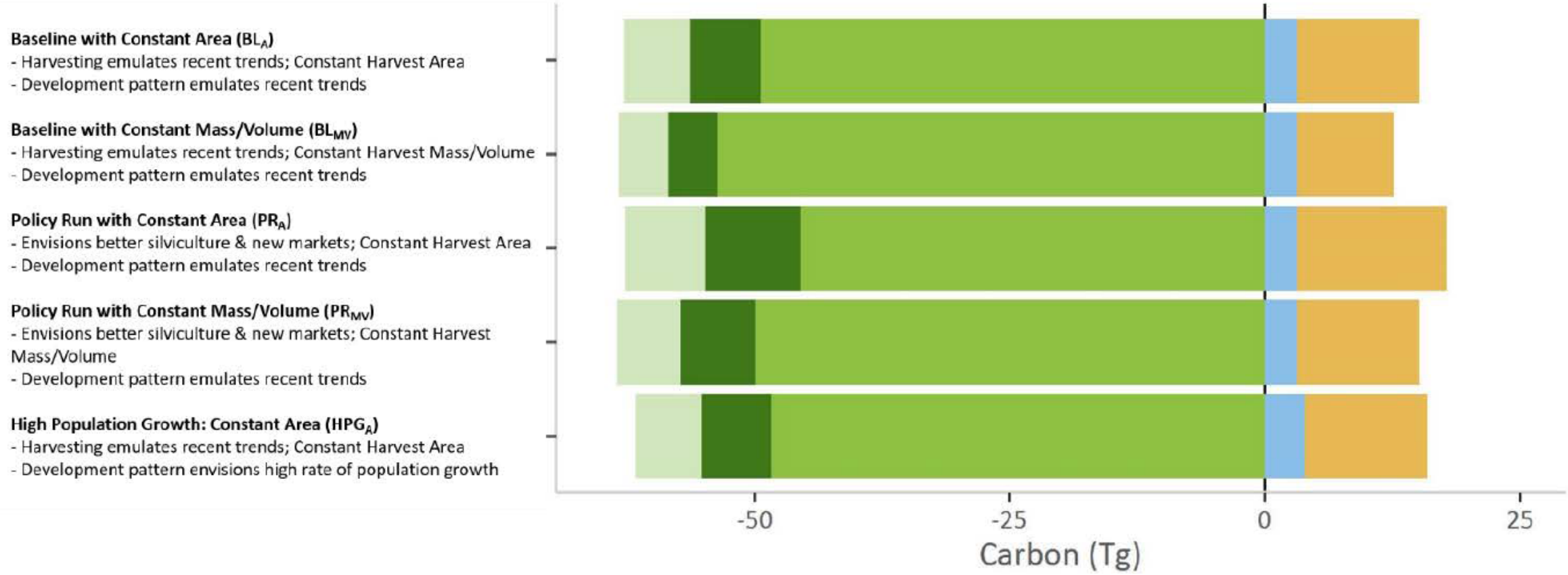


*Figure 20. Simulated changes in terrestrial carbon stocks between 2020 and 2050 as affected by five alternative land-use scenario overview and impact on live carbon and emissions by year 2050.*



# Transportation and Climate Initiative
# Cap and Invest Program "TCI-P"

Presented to: LBE Council

Christine Kirby
Assistant Commissioner
January 12, 2021

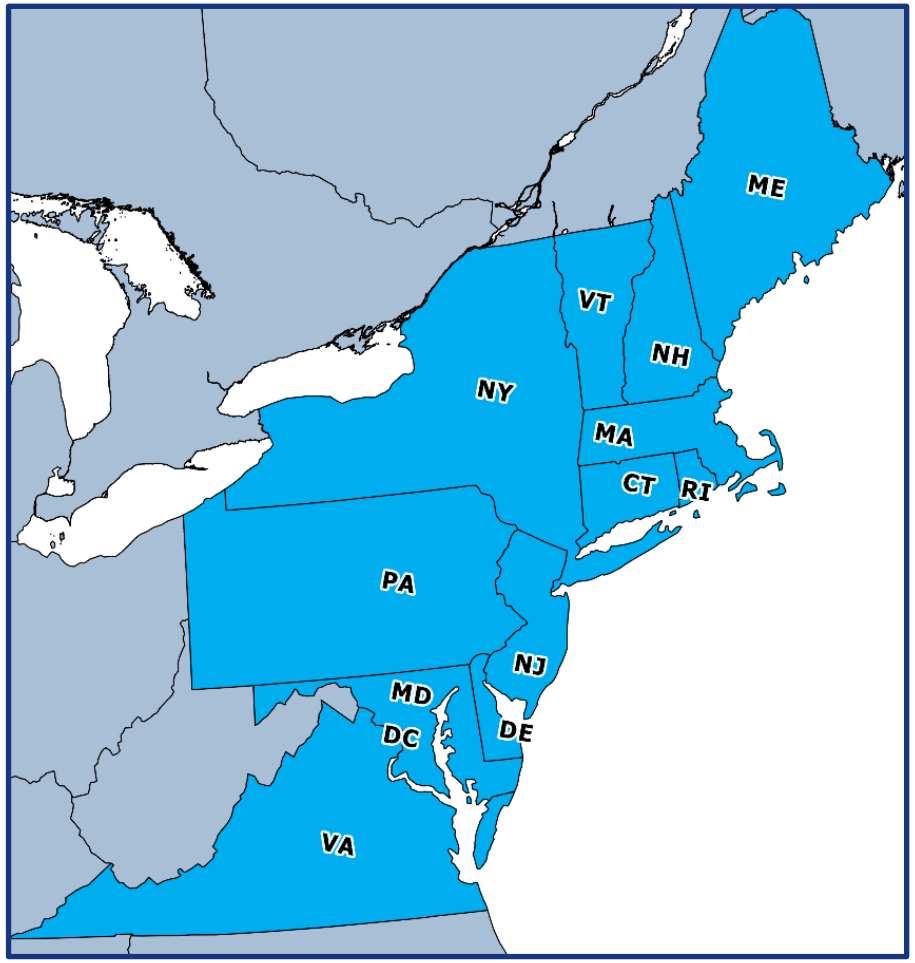
TRANSPORTATION & CLIMATE INITIATIVE
Of the Northeast and Mid-Atlantic States

MassDEP

# Transportation & Climate Initiative

- 12 northeast and mid-Atlantic states and the District of Columbia
- Working together to reduce GHG emissions from transportation
- Georgetown Climate Center provides facilitation, conducts research, and supports the states

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

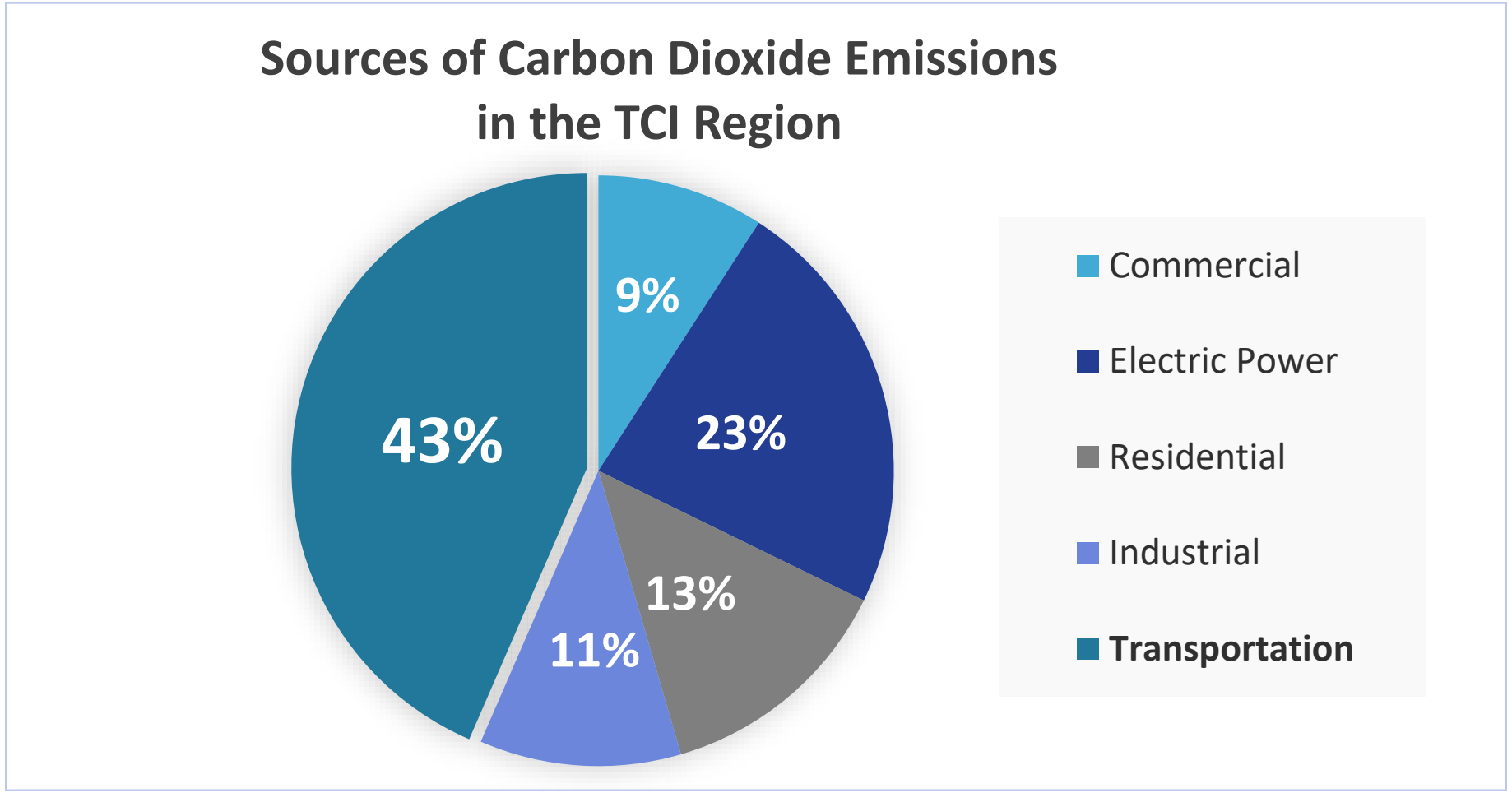


# Georgetown Climate Center:
## A Resource for State and Federal Climate Policy

- Launched in 2009 as a resource to states
- Builds on the success of “RGGI”
- Works at the nexus of federal-state policies
- Supports states through research, facilitation, and convening



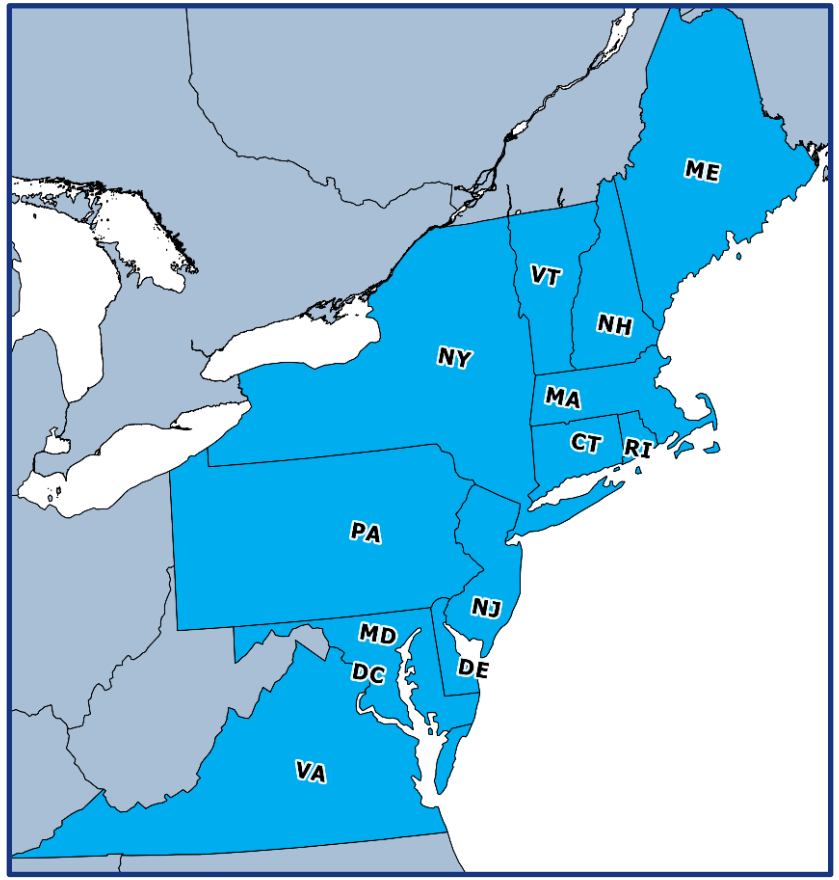
# Transportation is the Largest Source of Carbon Pollution in the TCI Region




2017 Data, U.S. Energy Information Administration

# Scale of the TCI Opportunity

- 72 million people
- $5.3 trillion in GDP
- 52 million registered vehicles
- Modeled TCI cap (254 MMT $CO_2$) would cover more than three times the carbon pollution covered by RGGI cap



# TCI States Engaged with People, Communities, and Businesses

- Three regional TCI workshops with participation of 1,000 people
- 4,300 submissions to TCI public input portal
- Community engagement by individual states
- Common themes: Investments in low carbon transportation, promote equity and public health

  *Now more important than ever*

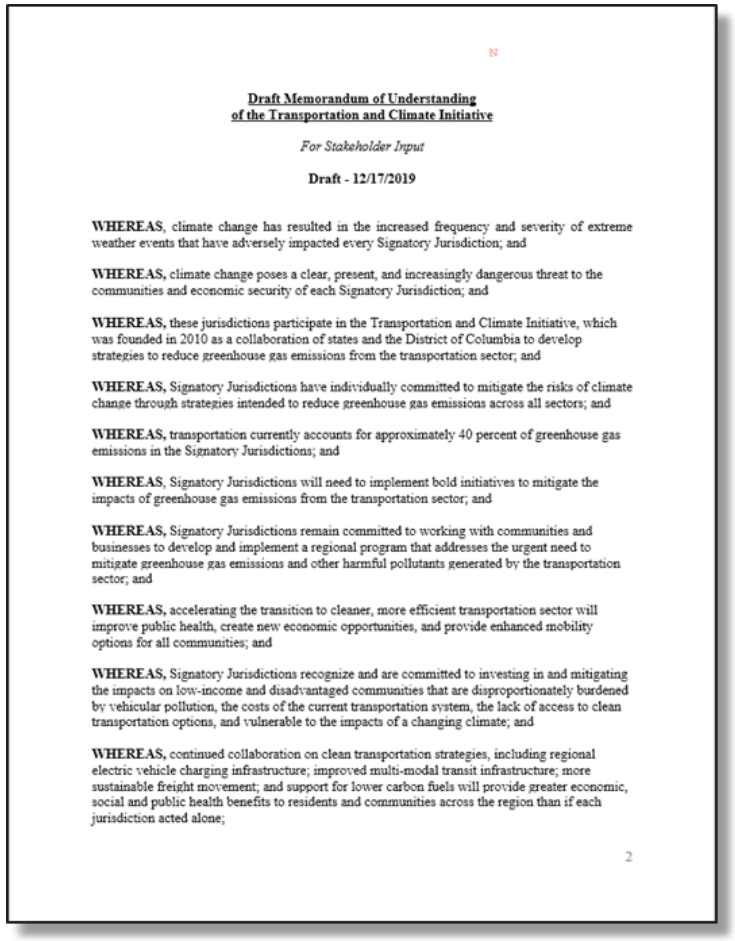
# December 2018 Statement

December 18, 2018 statement by nine states and Washington DC committing to:

*"…design a regional low-carbon transportation policy proposal that would cap and reduce carbon emissions from the combustion of transportation fuels through a cap-and-invest program or other pricing mechanism… [and]… to complete the policy development process within one year, after which each jurisdiction will decide whether to adopt and implement the policy."*

# Draft Memorandum of Understanding

- Draft MOU released in December 2019 Included:
  - Program Goals & Schedule
  - Elements of a Model Rule
  - Investments & Equity
  - Regional Organization
  - Program Monitoring & Review
- Invited Input through February 28, 2020
- Final MOU: Late Spring 2020 (pushed to late 2020)



**Draft Memorandum of Understanding**
**of the Transportation and Climate Initiative**

*For Stakeholder Input*

**Draft - 12/17/2019**

**WHEREAS**, climate change has resulted in the increased frequency and severity of extreme weather events that have adversely impacted every Signatory Jurisdiction; and

**WHEREAS,** climate change poses a clear, present, and increasingly dangerous threat to the communities and economic security of each Signatory Jurisdiction; and

**WHEREAS,** these jurisdictions participate in the Transportation and Climate Initiative, which was founded in 2010 as a collaboration of states and the District of Columbia to develop strategies to reduce greenhouse gas emissions from the transportation sector; and

**WHEREAS,** Signatory Jurisdictions have individually committed to mitigate the risks of climate change through strategies intended to reduce greenhouse gas emissions across all sectors; and

**WHEREAS,** transportation currently accounts for approximately 40 percent of greenhouse gas emissions in the Signatory Jurisdictions; and

**WHEREAS**, Signatory Jurisdictions will need to implement bold initiatives to mitigate the impacts of greenhouse gas emissions from the transportation sector; and

**WHEREAS,** Signatory Jurisdictions remain committed to working with communities and businesses to develop and implement a regional program that addresses the urgent need to mitigate greenhouse gas emissions and other harmful pollutants generated by the transportation sector; and

**WHEREAS,** accelerating the transition to cleaner, more efficient transportation sector will improve public health, create new economic opportunities, and provide enhanced mobility options for all communities; and

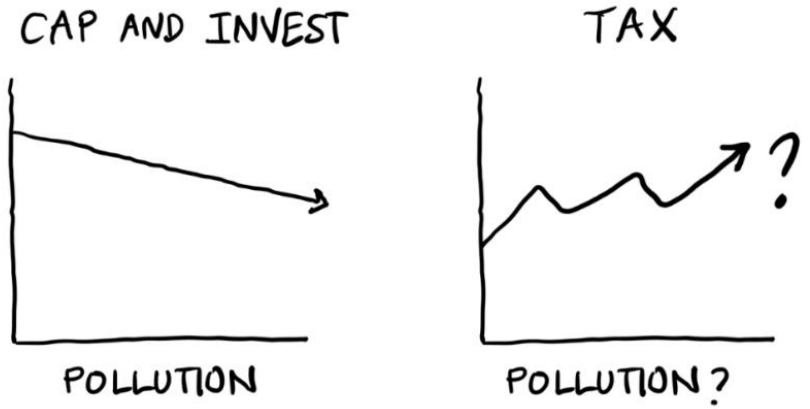
**WHEREAS,** Signatory Jurisdictions recognize and are committed to investing in and mitigating the impacts on low-income and disadvantaged communities that are disproportionately burdened by vehicular pollution, the costs of the current transportation system, the lack of access to clean transportation options, and vulnerable to the impacts of a changing climate; and

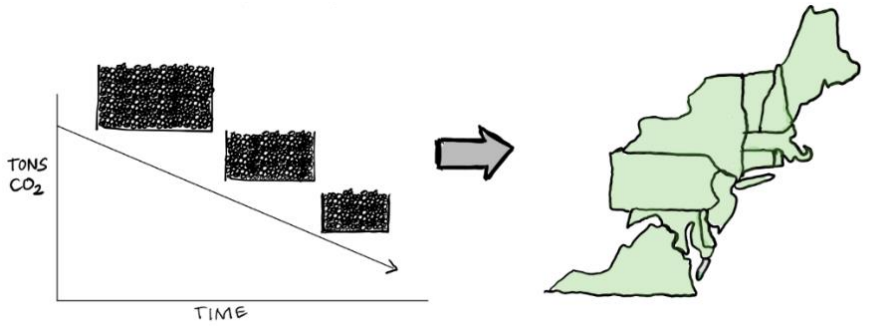
**WHEREAS,** continued collaboration on clean transportation strategies, including regional electric vehicle charging infrastructure; improved multi-modal transit infrastructure; more sustainable freight movement; and support for lower carbon fuels will provide greater economic, social and public health benefits to residents and communities across the region than if each jurisdiction acted alone;

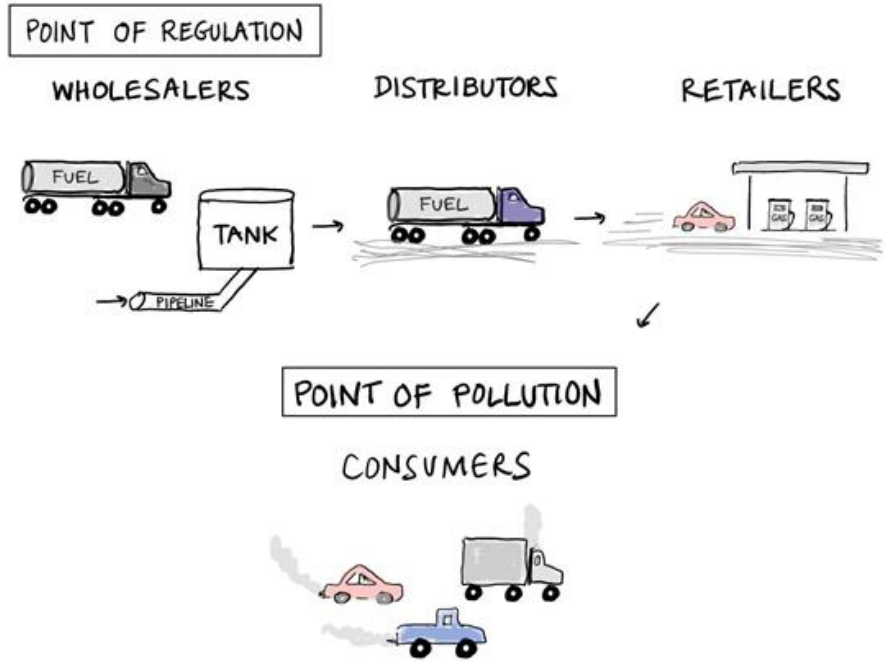
2

# Features of Regional Cap & Invest Approach

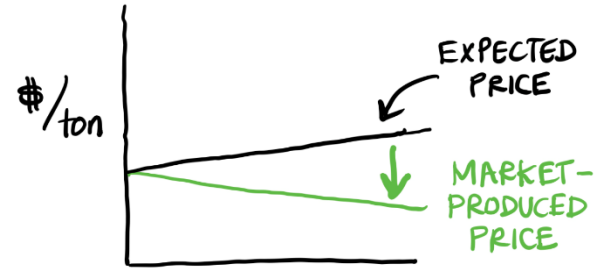
- Guarantees Pollution Reduction
- Regional Consistency of Allowance Prices
- Offers Flexibility in Compliance
- Drives Innovation and Investments in Low Carbon Transportation Programs



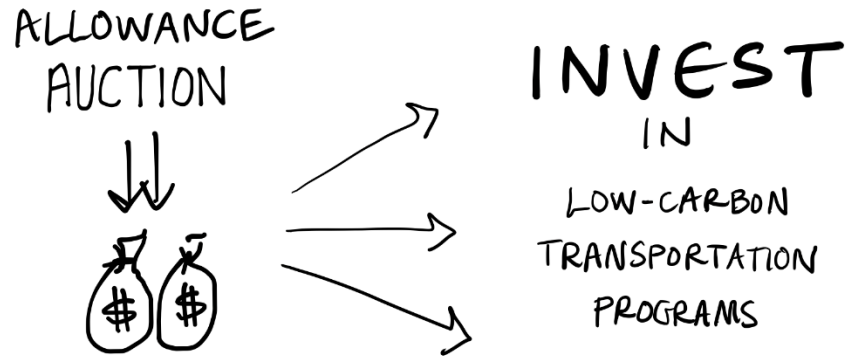

## THE MARKET SETS THE CARBON PRICE IN A CAP-AND-INVEST SYSTEM




HISTORICALLY, THESE KINDS OF MARKETS HAVE DELIVERED LOWER-THAN-EXPECTED PRICES

## CAP AND INVEST OFFERS FLEXIBLE COMPLIANCE


- LOWER-CARBON FUELS require fewer allowances
- Time flexibility, including unlimited banking of allowances & multi-year compliance



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- Program sets a cap that declines by 30% from 2023 to 2032, projecting a reduction of covered emissions by at least 26% for participating jurisdictions
- Estimated gas price impacts would start at 5 cents/gallon in 2023
- Projected to create $250 million in revenue for the region, with $150 million from Massachusetts
- Equity provisions include dedicating at least 35% of each jurisdictions revenues to overburdened and underserved communities

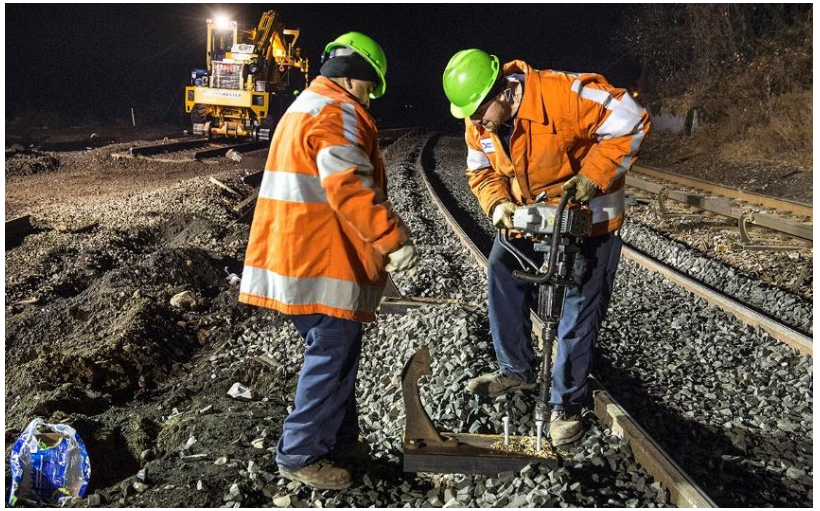
# Range of Clean Transportation Investments in Modeled TCI Scenarios

- Modeled **annual clean transportation investments by strategy** in 2032
- Combined $1.84 billion to $6.92 billion in modeled scenarios

| | | |
|---|---|---|
|  | **$554 million to $2 billion** | Electric cars, light trucks and vans |
|  | **$425 million to $1.6 billion** | Low & zero-emission buses and trucks |
|  | **$333 million to $1.2 billion** | Transit expansion and upkeep |
|  | **$259 million to $970 million** | Pedestrian and bike safety, ride sharing |
|  | **$148 million to $554 million** | System efficiency |
|  | **$148 million to $554 million** | Indirect/ Other |

# Reducing Pollution Delivers Multiple Benefits





# Preliminary Public Health Benefits

- Fewer asthma symptoms
- Fewer premature deaths
- Fewer traffic-related injuries
- Total estimated public health benefits:
  **$3 billion to $10 billion**

# TCI Program Development Timeline

- **December 17, 2019** – Release of a regional policy proposal in the form of a draft Memorandum of Understanding (MOU), accompanied by modeling results that estimate the energy and emissions implications of different cap levels and investment scenarios, as well as potential costs and benefits of different program design options.
- **January/February 2020** – Gather and consider public input on Draft MOU
- **September 2020:** Public Engagement Webinars
  - **September 16: "**Program design, modeling, and the implications of COVID-19"
  - **September 29: "**Ensuring environmental justice and equity in a regional low-carbon transportation program"
- **December 2020** – MA, CT, RI & DC release a final Memorandum of Understanding.
- **Fall/Winter 2020-2021** – Participating jurisdictions develop a "model rule."
- **2021** – Participating jurisdictions take any legislative steps that could be needed to implement the regional program and conduct rulemaking processes to adopt regulations.
- **2022** – Program implementation begins with emissions reporting.
- **2023** – The first compliance period begins.

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Of the Northeast and Mid-Atlantic States

# Updates to MassEVIP (Electric Vehicle Incentive Program)

| Program | Deadline | Equipment | Max incentive amount | Eligibility |
|---|---|---|---|---|
| Direct Current Fast Charging* | 3/19/21 | Fast chargers | 80% of hardware & installation (100% for public facilities, 60% for educational campuses), up to $50k per station | Property owners with publicly accessible parking; educational campuses with 15+ students |
| Public Access Charging | Rolling | Level 1* + 2 chargers | 80% of hardware & installation (100% for public facilities*) up to $50k per street address | Property owners or managers with publicly accessible parking<br>Public must have access for min. 12 hours/day, 7 days/week |
| Workplace and Fleets Charging | Rolling | Level 1* + 2 chargers | 60% of hardware & installation, up to $50,000 per street address | Employers and fleet operators with 15 or more employees in non-residential places of business* |
| Multi-Unit Dwelling and Campus* Charging | Rolling | Level 1 + 2 chargers | 60% of hardware & installation, up to $50,000 per street address | Multi-unit dwellings with five or more residential units and educational campuses with at least 15 students |
| Fleets Incentives* | Rolling | BEV, PHEV, and ZEM (motorcycles) | BEV: $7,500<br>PHEV: $5,000<br>ZEM: $750 | Municipalities, state agencies and public universities and colleges. No EV charging station required.* |

*New for this iteration

*Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth*

DOER
Massachusetts Department of Energy Resources

# State Facility Decarbonization Plans

UMassAmherst
The Commonwealth's Flagship Campus

# Carbon Mitigation Planning

Fall 2020

# The Charge

BE REVOLUTIONARY™

“In conformity with the adoption of our new tag line “Be Revolutionary,” we should set an aggressive timeline for reaching a completely renewable energy future.

**I am asking the Task Force to study, or oversee a study, that would ask what it would take to get to 100% reliance on renewable energy sources for heating, cooling, and electricity usage on our campus by 2030.**

You may think of this as a serious engineering feasibility study. Much as many might have a “gut feeling” that these timelines are unrealistic, I would like to see a study conducted from a scientific/engineering point of view. This could be done by involving our own students, faculty, physical plant professionals, and outside consultants if necessary. We owe our student body such a study.

Thank you.” – Chancellor Subbaswamy

# This study is just a start.

**Provides a framework for an energy transition**

This is a rigorous assessment of the work needed to transition the campus to 100% renewable energy.

**A tool to create a carbon neutral future**

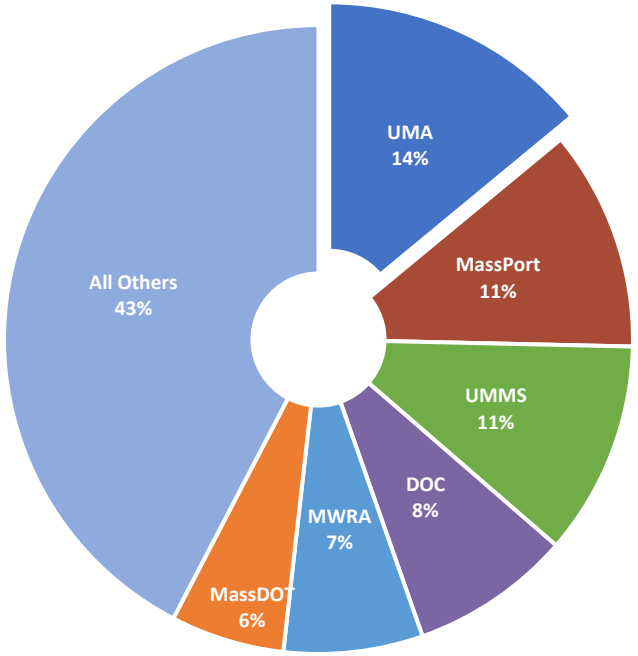
The study creates a vision and analysis to engage the community, and for the administration to assess capital planning and financing options.

# Is it possible to get to 100% reliance on renewable energy sources?

| 2025 | 2030 | 2032 |
|---|---|---|
| **No** | **Maybe** | **Yes** |
| The study finds that while theoretically possible, it would be impractical due to the scale of change required on campus. | The study shows that the campus can achieves more than 80% reductions by 2030, but final stages of transformation will still be underway. | The study shows that it is possible to implement and reach 100%, but only if we start now! |

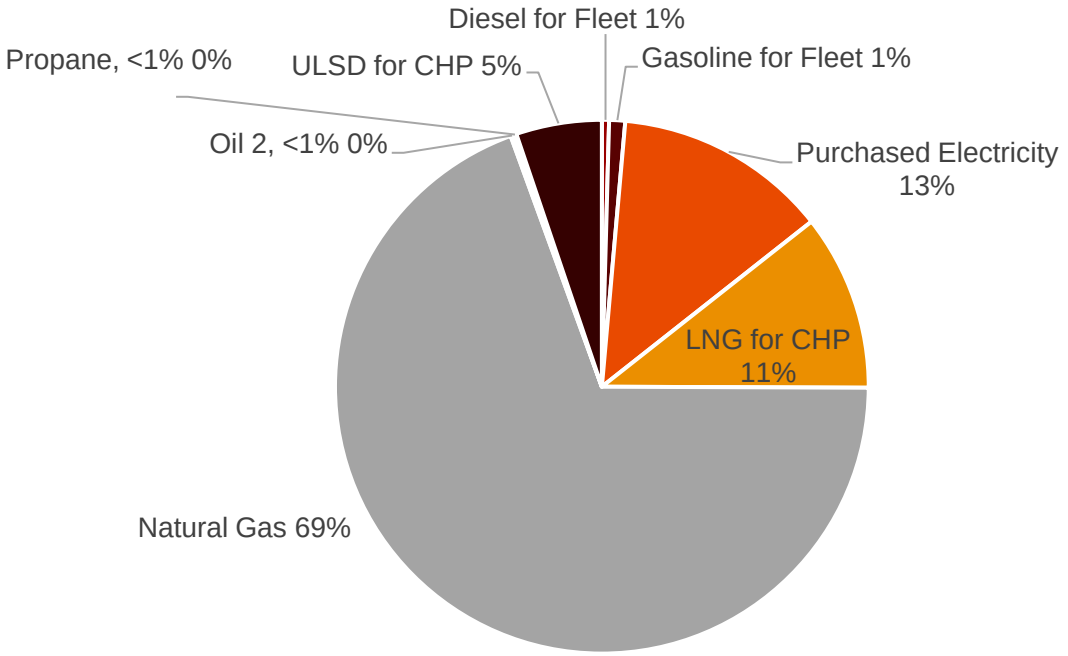
# UMA emissions impact

## Statewide Emissions % Share




**% Contribution from Top 6 Emitters Compared to All Others in FY19**

## UMA Emission Sources




280+ buildings need heating, cooling and electricity

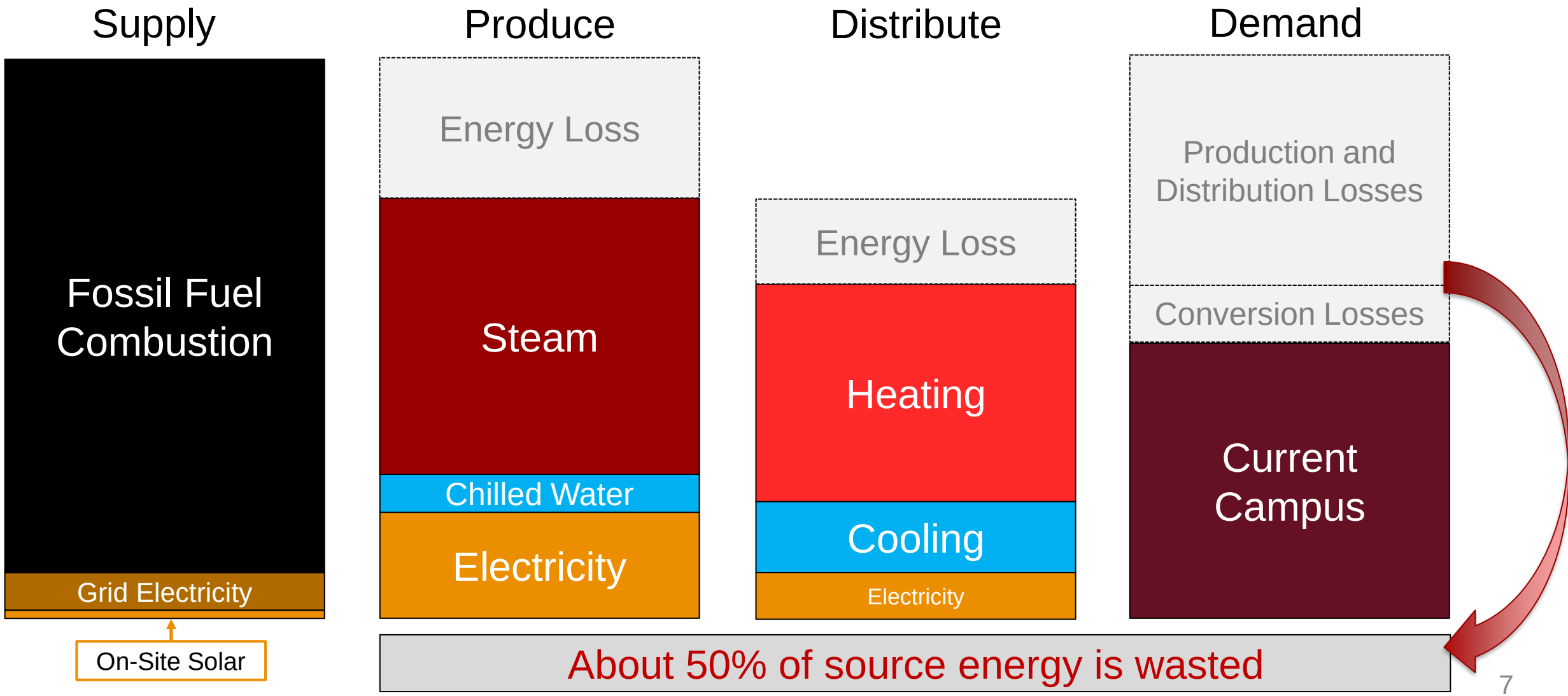
70% of energy used for heating campus with steam

# What will it take to get to 100% renewable energy?

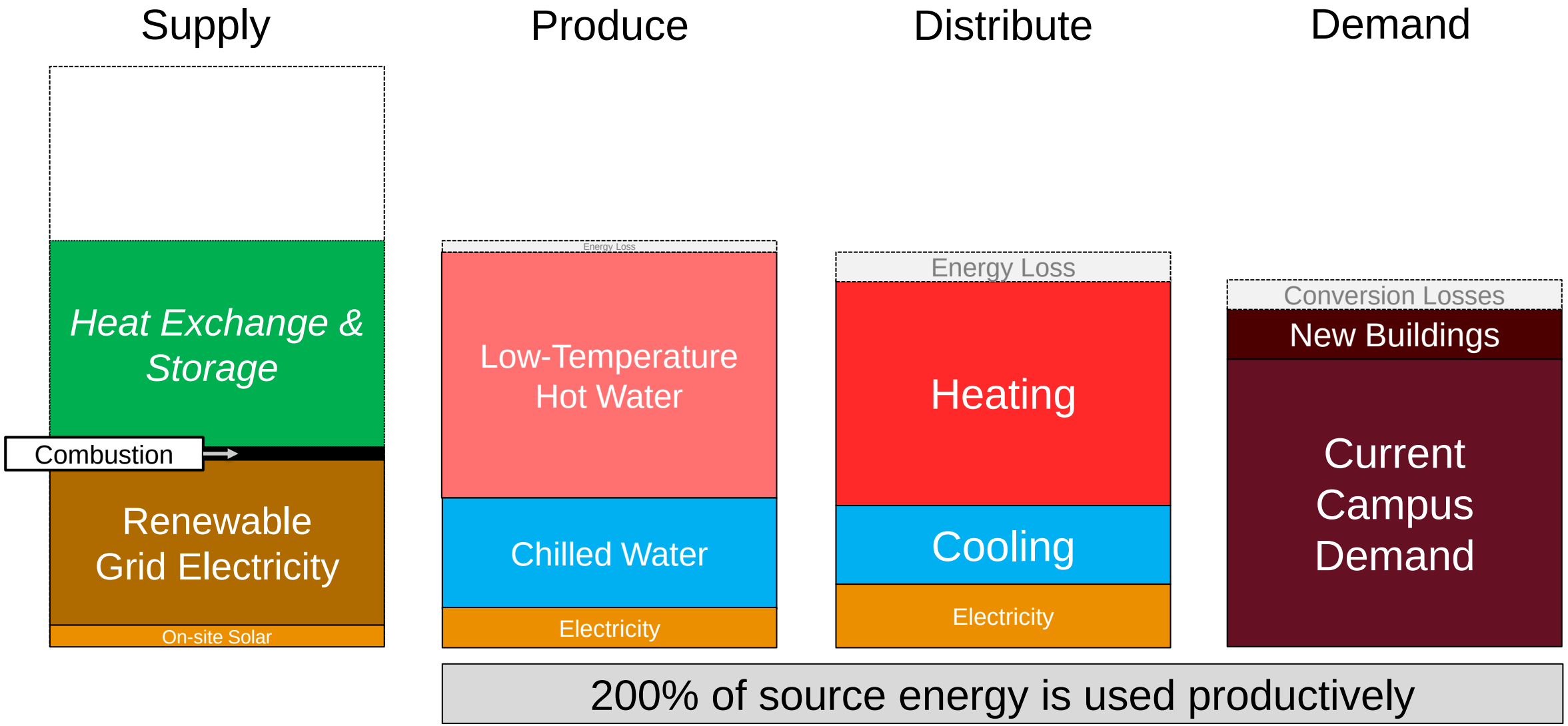
UMassAmherst

| | | |
|---|---|---|
| 1 | **Transition Away From Steam** | Replace the campus circulatory heating system from inefficient steam to efficient low-temperature hot water. |
| 2 | **Stop Burning Fossil Fuels** | Leverage the low-temperature hot water system to avoid combustion. A modern system can trade and store energy using a variety of renewable thermal technologies. |
| 3 | **Accelerate Energy Efficiency** | Upgrade and renovate buildings to lower energy demand and make them compatible with low-temperature hot water. |
| 4 | **Expand the Use of Renewable Energy** | Expand on-site solar, ground-source heating and cooling and use more electricity from the rapidly greening grid. |
| 5 | **Integrate the Transition Into UMass Amherst Culture** | The energy transition provides a once in a generation opportunity for research, education and higher-ed leadership aligned with the strategic motto: “Be Revolutionary” |

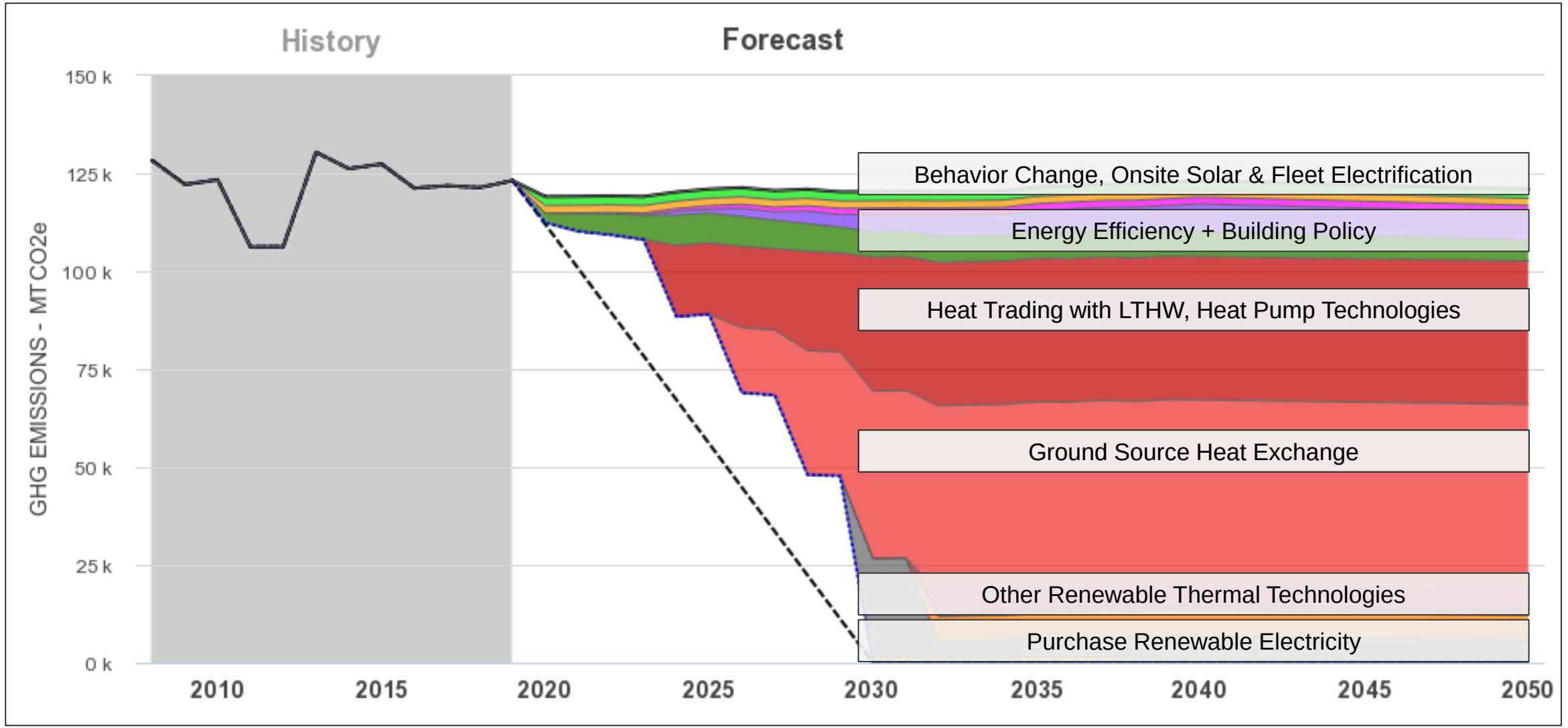
# Current District Energy System



# Future District Energy System

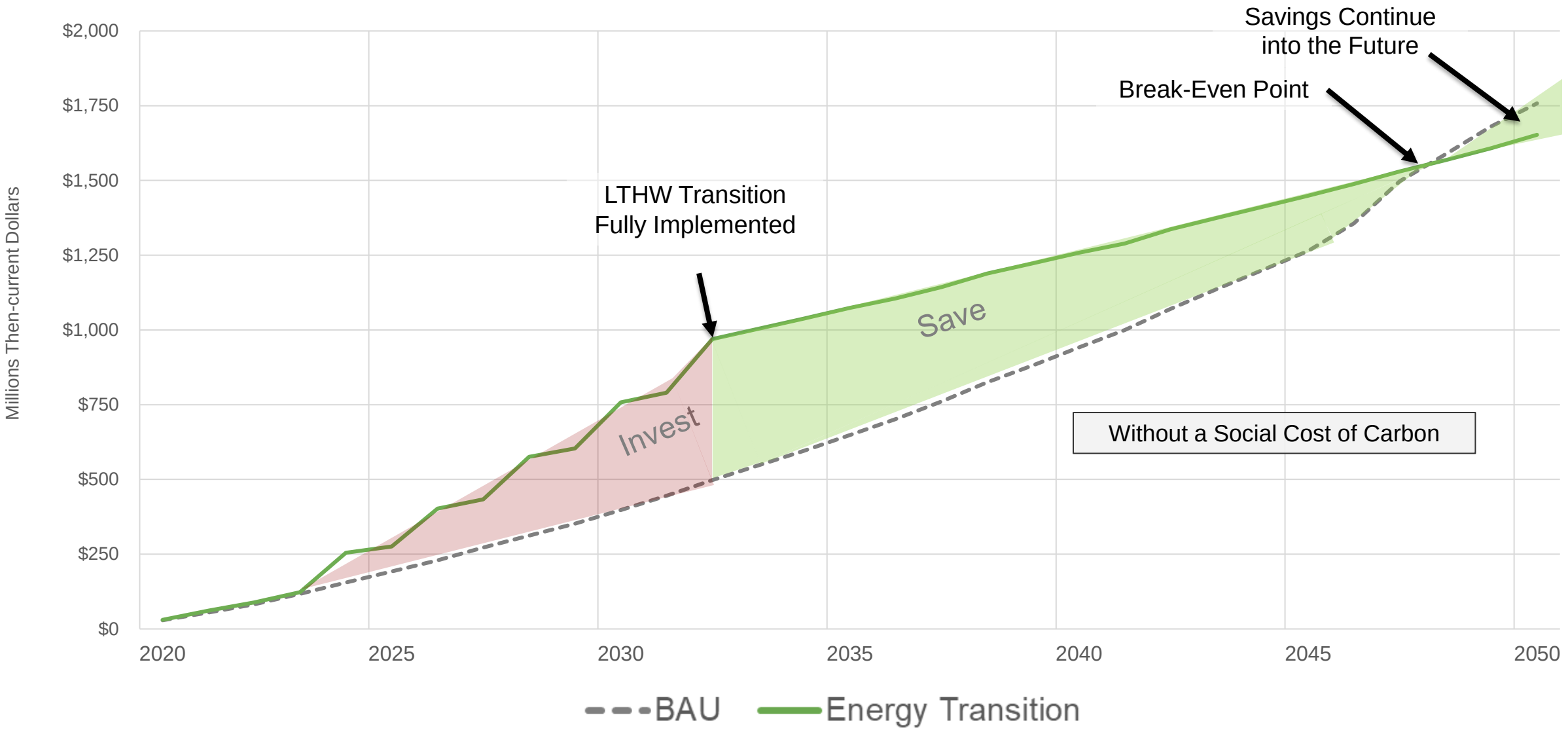


# Energy Transition Recommendation



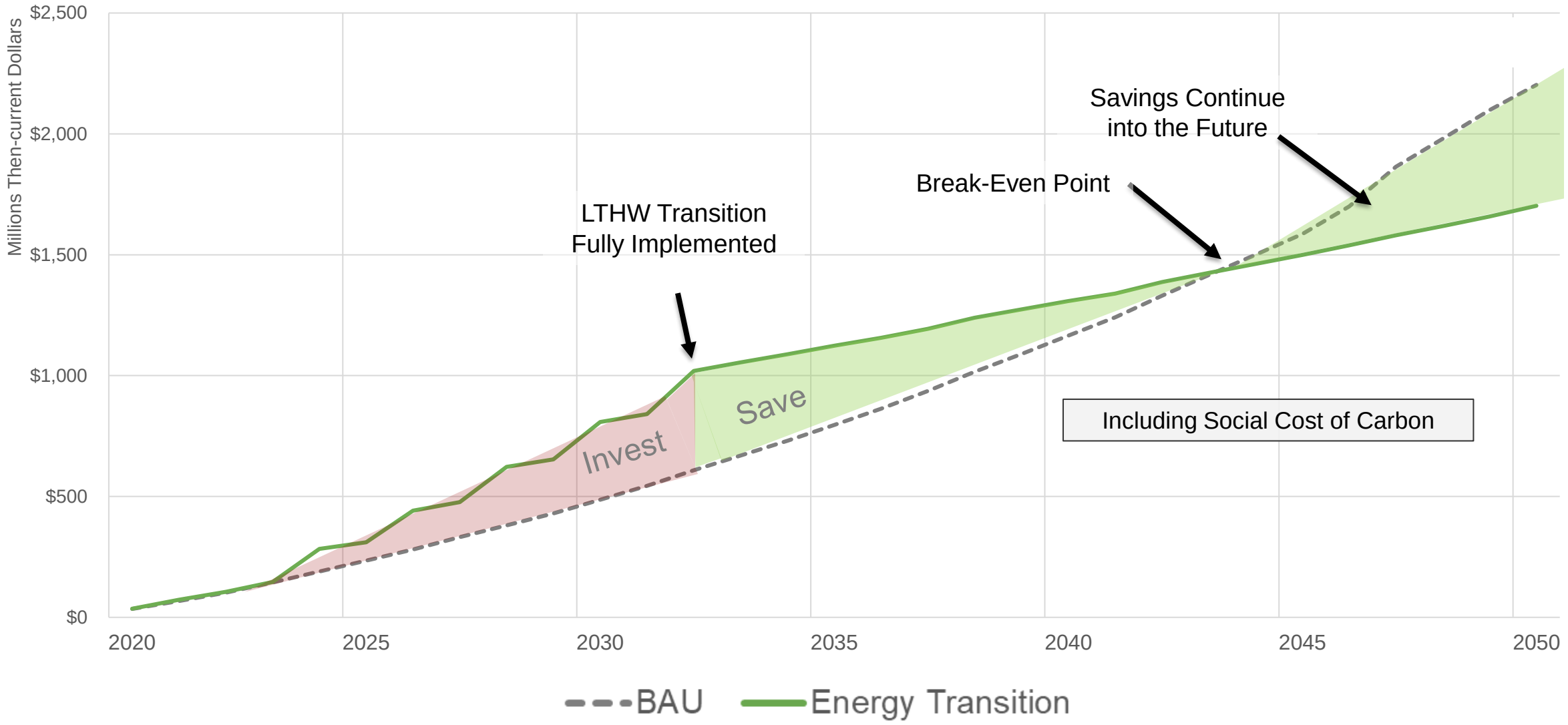
# Financial Implications

## Cashflow - BAU vs Energy Transition Through 2050



# Financial Implications

## Cashflow - BAU vs Energy Transition Through 2050



# Carbon Mitigation Task Force

# Study Process

# Carbon Mitigation Taskforce Members

UMassAmherst

## Students

| Student | Representing |
|---|---|
| Kimberly Acevedo | Graduate Student Senate |
| Anna Morel-Paletta | SGA, Sustainability |
| Jonathan Blum | SGA, Economics |
| Caroline Williams | MASSPIRG 100% Renewable Energy Campaign |
| Angie Gregory | Masters in Sustainability Science |

## Staff

| Staff | Office/Department |
|---|---|
| Ezra Small, (Operations Co-Chair) | Physical Plant |
| Ludmilla Pavlova-Gillham | Campus Planning |
| Ted Mendoza | Design & Construction Management |
| Ray Jackson | Physical Plant |
| Diana Noble | Transportation Services |
| Gary Ritter | Environmental Health & Safety |

## Faculty

| Faculty | Department |
|---|---|
| Dwayne Breger (Academics Co-Chair) | Enviro Conservation and Clean Energy Extension |
| Krish Thiagarajan Sharmin | Mechanical and Industrial Engineering |
| Ben Weil | Building Construction Technology |
| Robert Pollin | Economics |
| Ajla Aksamija | Architecture |
| Scott Auerbach | iCons, Chemistry |

# Consulting Services Request for Proposal

- RFP Issued July 2019
- 13 Respondents, 5 brought to campus for interviews
- Budget proposals ranged from under $200,000 to over $1M, though most were between $200-$300k.
- CMTF made recommendation to Chancellor
- Consultant was contracted and ready to start in Jan/Feb 2020

# The consultant team

MEP
A SALASO'BRIEN COMPANY

Lead Engineering Firm

BRAILSFORD & DUNLAVEY
INSPIRE. EMPOWER. ADVANCE.

Scenario Planning and Data Visualization

Competitive Energy SERVICES

Renewable Energy Procurement

GREENER U

Facilitation & Engagement

# Climate Action Solutions

## A Menu of Options

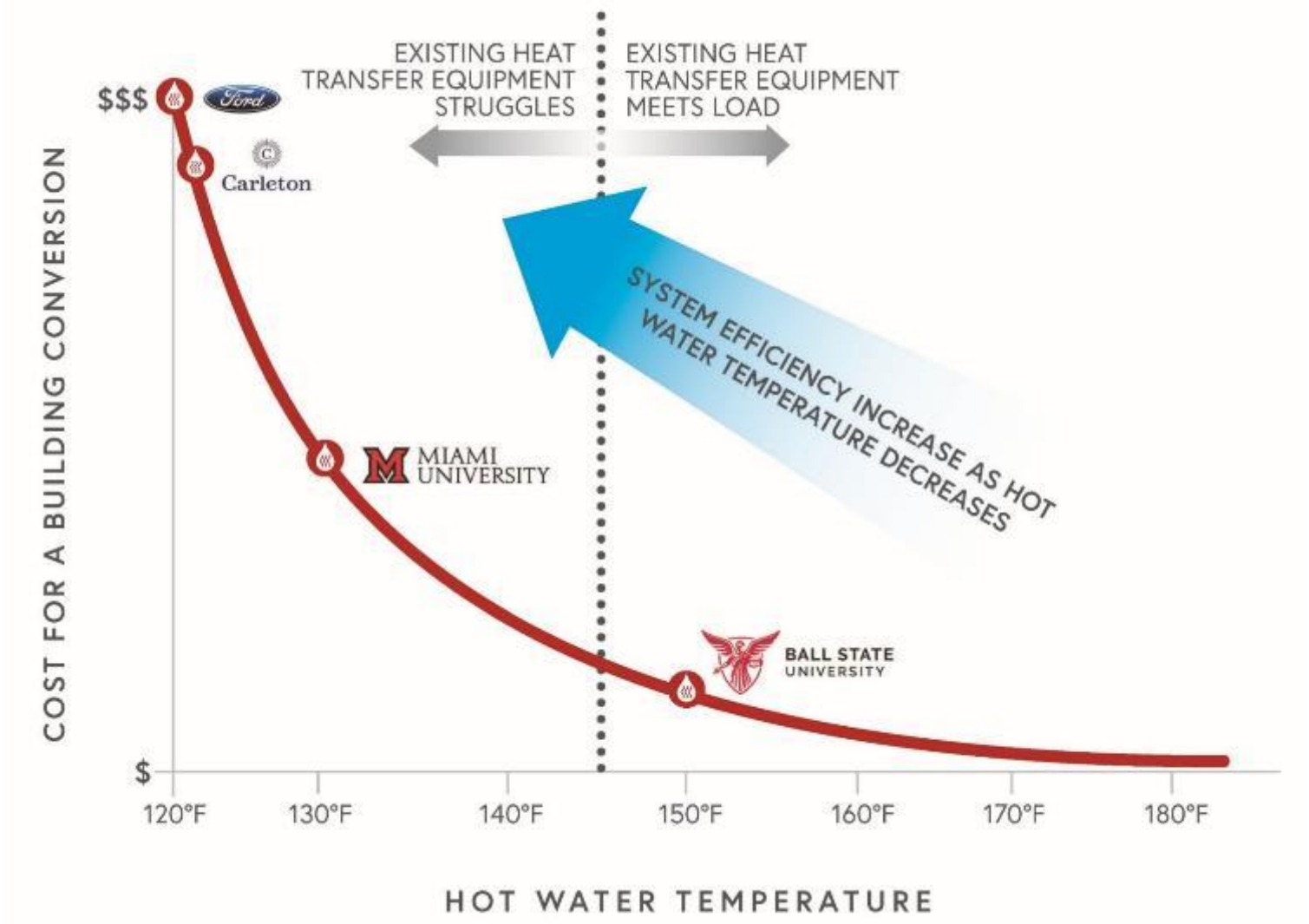
UMassAmherst

Scope 1 & 2 Solutions

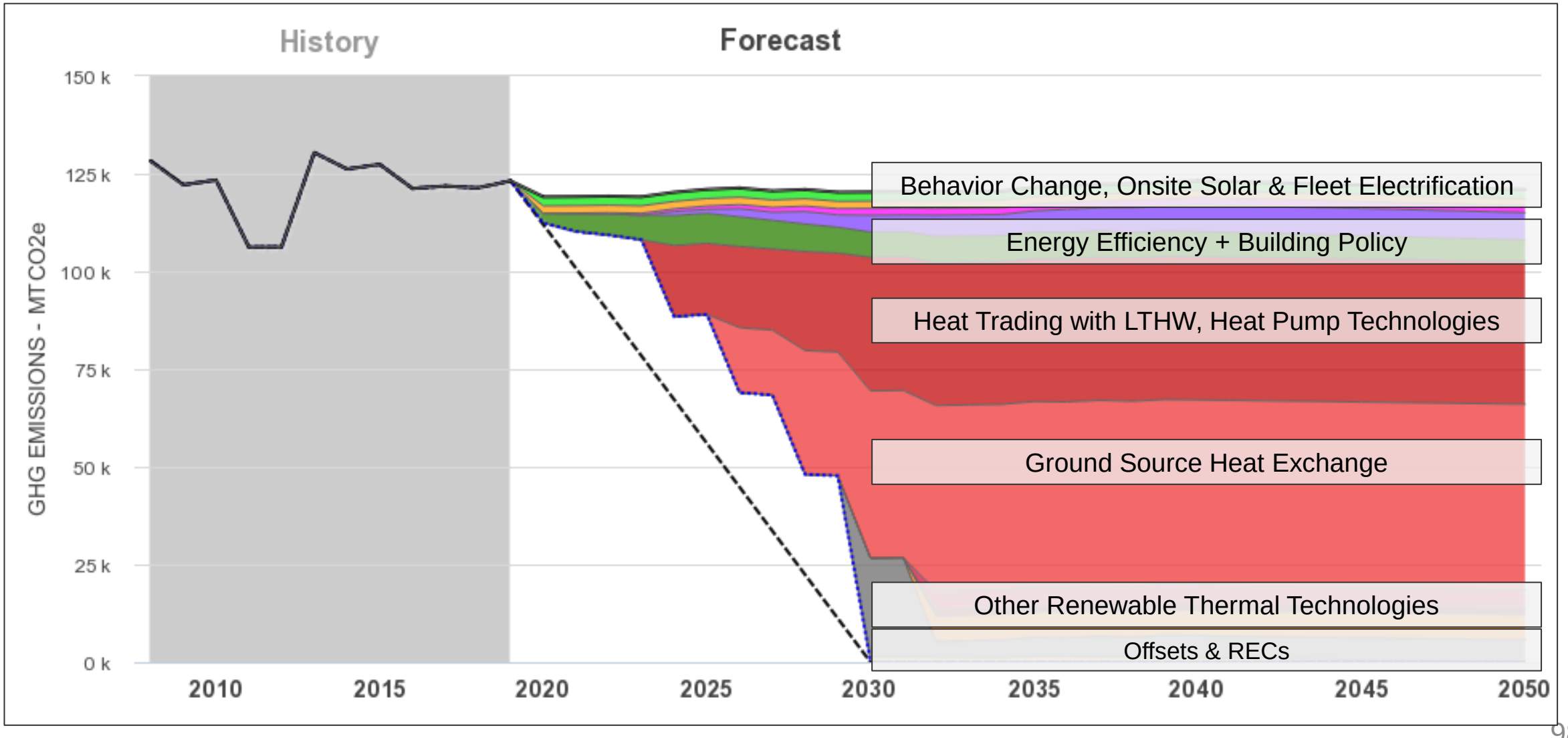
Scope 3 Solutions

| Education & Behavior Change | Procurement Policy | Space Planning & Management | Strategic Energy Management | Renewable & Low-carbon Energy | District Energy Solutions | Transportation | Grounds Management, Policies & Procedures | Offsets / RECs | Waste Management |
|---|---|---|---|---|---|---|---|---|---|
| Student Engagement | Business Travel | Space Use Optimization | Campus-wide ECMs | On-site Renewables | Ground Source Heating / Cooling | Intra-campus connectivity | Irrigation | Green Power Purchases (RECs) | Waste Diversion |
| Improved Commuting | Air Travel | No-Net Growth Policies | Retro and Continuous Commissioning | Off-site Renewables | Central CHP | Inter-campus connectivity | Equipment Practices | Land Management | Waste Reduction |
| Avoided Travel | Fleet Fuel Switch | Zero-net Energy Buildings | Meter Monitoring Verification | Energy Storage | Building-level CHP | Parking | Landscape Design | Mission-linked Offsets | Composting |
| Lab / Researcher Engagement | Efficient Lab Equipment | Green Building Standards | Revolving Loan Fund | Fuel Cells | Hot-water heating | Human Powered Transportation | | Other Offsets | |
| | | | ESCOs | Biomass | Central Chilled Water | | | | |
| | | | Utility Rebate Programs | Biogas | Distributed Equipment Upgrades | | | | |
| | | | Utility Contract Optimization | Hydro | Central Plant Upgrades | | | | |
| | | | Demand-side Management | Modular Nuclear | Distribution Efficiency | | | | |
| | | | Expanded Internal Implementation Staff | Other Alternative Fuels | | | | | |

# Temperature
vs.
# Investment
vs.
# Efficiency



# Energy Transition Recommendation



## What we currently do know

Becoming carbon neutral actions will include:

1. Purchase renewable power from the grid
2. Transition away from steam for the heating system
3. Implement disruptive infrastructure changes to adopt a low-temperature hot water system
4. Obtain additional funding beyond current budget
5. Change renovation and new construction standards

## What we currently do not know

Unknown aspects to implementing a plan:

1. Community support, interest, and concerns
2. Impact from the pandemic on long term operations
3. State funding and support to become carbon neutral
4. Availability of emerging future technologies for low-carbon operations

# UMass Dartmouth

Carbon Reduction and Energy Mater Plan 2020

Jamie Jacquart
Assistant Director of Campus Sustainability

RAMBOLL Bright ideas. Sustainable change.

UMass | Dartmouth

# Decarbonization Commitments

# Campus and State Commitments

## Baseline of GHG emissions from 2004: 25,622 Metric Tons

- Campus: Second Nature Climate Commitment: 2007
  - 80% reduction by 2050
  - (40% by 2020)
- State: Global Warming Solutions Act: 2008
  - All state facilities will reduce by 80% by 2050
- Campus: Chancellor's Carbon Commitment: 2019
  - 100% reduction by 2030, 2040 at the latest
- State: Global Warming Solutions Revision: 2020
  - 100% reduction by 2050

# Chancellor's Carbon Commitment - 2019

The University's good faith commitment to achieving zero carbon emissions by 2030, or alternatively 2050:

- Energy and capital planning decisions will be framed towards achieving that goal;
- Budgetary decisions relating to energy and capital planning will be considered from a Life-Cycle Cost Analysis perspective;

# Primary Drivers of Value Change

- Science
- Our students
- Research (our own faculty)
- System and State commitments
- Sunrise Movement

# Progress to date

# Reductions overview

- Switched from #6 fuel oil to natural gas in 2010
- Instituted and Energy Savings Contract $25M
- Installed a co-generation plant
- Increased square footage of campus from 1.6M sq. ft. to 3.9M sq. ft.
    - Library infill project
    - Charlton College of Business & Pavilion
    - School for Marine Science & Technology East
    - New Residence Hall not yet been included
    - Still heating old residence halls
- Current reductions achieved of 13%

# UNIVERSITY of Massachusetts Dartmouth

## Energy Conservation Measures

### Heating Plant Upgrades

*Steam Service Valves and Controls*

*Maintenance Related Upgrades – Pipe Insulation*

### HVAC Upgrades

*Premium Efficiency Motors*

*New HVAC System*

*Mechanical Upgrades*

*Reduce Ground Water Leakage*

*Variable Frequency Drives*

*Auditorium Absorption Chiller Replacement*

### Water Conservation

*Domestic Water Upgrades*

### Co-Generation Plant

*Generate 1.6 MW's of electricity and steam for heat/air-conditioning*

### Building Controls

*Re-commission / Expand Existing BMS Controls*

*Add Central Building Management Controls*

*Electric and Steam Sub-meters*

### Lighting Improvements

*Lighting Upgrades*

*Lighting Controls*

*Exterior LED Area Lighting*

### Building Envelope Improvements

*Weatherization*

### Other Technologies

*Kitchen Hood Controls*

*Energy Conservation Through Behavior Change®*

UMass | Dartmouth

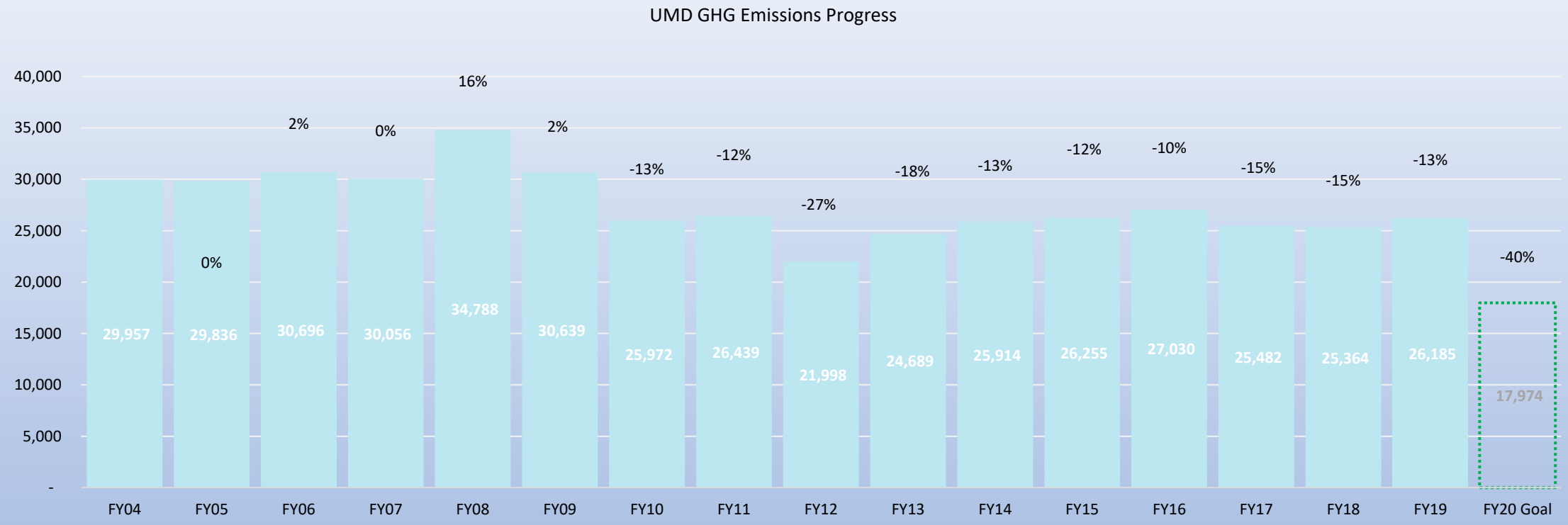
# Challenges

# Brutalist Architecture

- Large window to wall ratio
- Overhangs with exposed roof, 3 sides and floors
- Single pane windows (R-value of 1)
- Historic exterior and interior walls (R-value of 1.1)

# UMass Dartmouth Annual GHG Emissions:

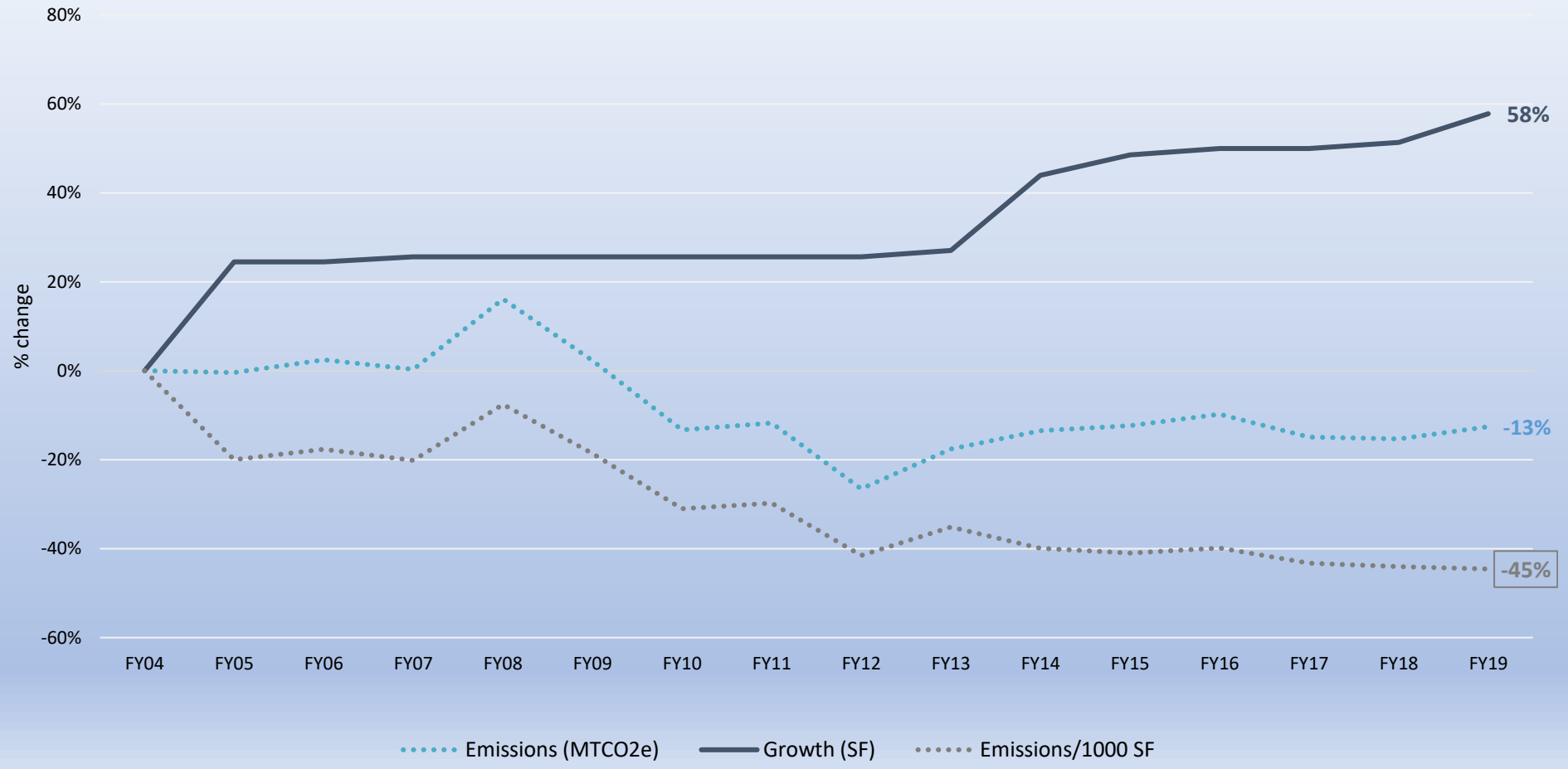
## FY'08 to FY'19




**Therefore, we needed TRANSFORMATION,**

**not incremental improvements**

# UMD Growth versus Emissions



# Energy Master Planning Process

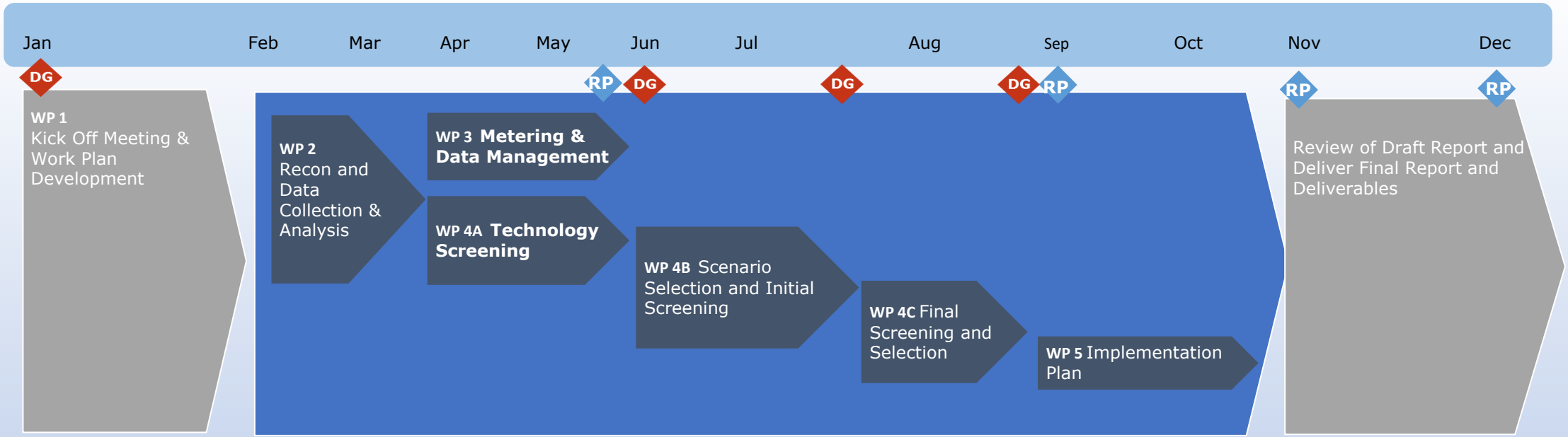
# UMASS DARTMOUTH

# ENERGY MASTER PLAN

Tim Erwin – Ramboll

RAMBOLL Bright ideas. Sustainable change.

UMass | Dartmouth




## DG-1 KICK-OFF MEETING

- Kick-off meeting 1/8/20
- Meet with project stakeholders
- Review project objectives
- Review project approach
- Review project schedule

## INTERIM REPORT 1

At the conclusion of WP-3 the first interim report will be drafted to capture:

- Data collected
- Energy analysis
- Load projections

## INTERIM REPORT 2

After the conclusion of WP-4C the second interim report will be drafted to capture:

- The logic by which the scenarios were screened
- Comparative results of the viable scenarios

## INTERIM REPORT 3

After the conclusion of WP-4C the third interim report will be drafted to capture:

- Results of final screening
- Unit sizing, quantities, load profiles, utility consumption estimates of preferred solutions

## DRAFT REPORT

- Draft report was provided on November 10, 2020
- Comments have been received and are being incorporated

## DG-2 SCENARIO GENERATION MEETING

- Agree on viable technologies
- Agree on viable scenarios to be evaluated under WP-4B

## DG-3 SCENARIO SELECTION MEETING

- Agree on 1-2 Alternative Scenarios for further screening in addition to status quo and upgrade scenarios

## DG-4 DEVELOPMENT REVIEW MEETING

- A preferred solution will be selected during DG-4
- Information developed in WP-5 will used for the cost estimate

## FINAL REPORT

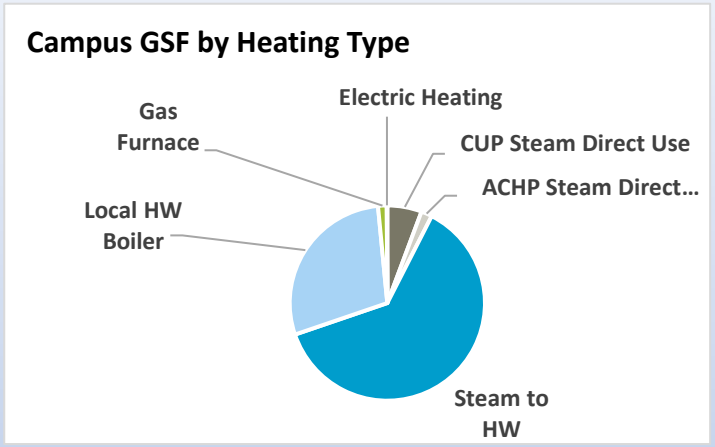
- Final Report is anticipated by the end of 2020.

Weekly progress meetings

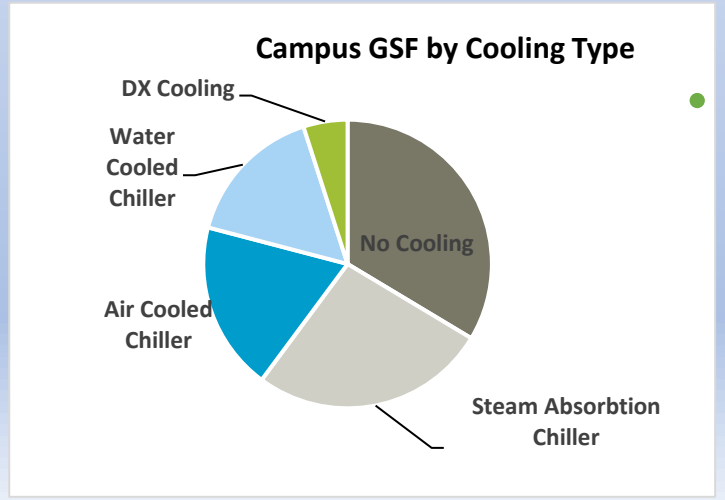
# Energy Master Planning and Results

# Data Analysis Findings

How does your campus compare?

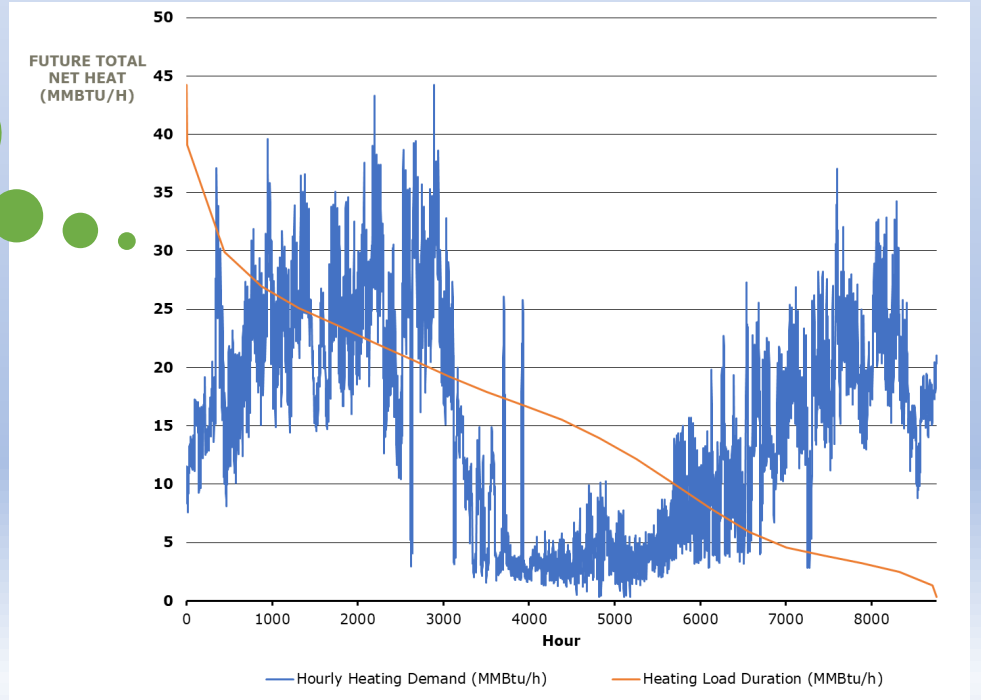



| | Total EUI (kBtu/SF) |
|---|---|
| 2004 Baseline[1] | 164.2 |
| 2012 EO484 Goal (20% reduction) | 131.4 |
| 2020 EO484 Goal (35% reduction) | 106.7 |
| 2020 Performance (Campus Weather Normalized) | 159.9 |
| CBECS Weighted Campus Benchmark | 127.5 |




What will your energy demand be?

How does your campus operate?




RAMBOLL Bright ideas. Sustainable change.

UMass | Dartmouth

# Technologies Considered

- **Fuel Based Based**
  - Gas turbine (simple cycle)
  - Gas turbine (combined cycle)
  - Gas engine
  - Solid oxide fuel cell CHP
  - Gas boiler
  - Oil boiler
  - Gas-fired Rankine steam turbine
- **Renewables**
  - Photovoltaics
  - Wind turbine
  - Large Solar Thermal
- **Nuclear**
  - Micro (in development)

- **Renewable Fuel**
  - Bio-oil fired gas turbine (simple cycle)
  - Bio-oil engine
  - Biomass ORC cogeneration unit (wood chips)
  - Biomass ORC cogeneration unit (wood pellets)
  - Biomass HOB (wood chips)
  - Biomass HOB (wood pellets)
  - Bio oil boiler
  - Biogas production - anaerobic digester

- **Electrification**
  - Electric boiler
  - HP (air-to-water) - large scale
  - HP (air-to-water) - small scale
  - GSHP open loop (2300 m depth)
  - GSHP closed loop, horizontal, individual
  - GSHP closed-loop, vertical
  - Heat Pump (sewage water-to water)
  - Heat Pump (Seawater to water)
  - Heat recovery chiller
  - Conventional chiller

# Technologies Recommended

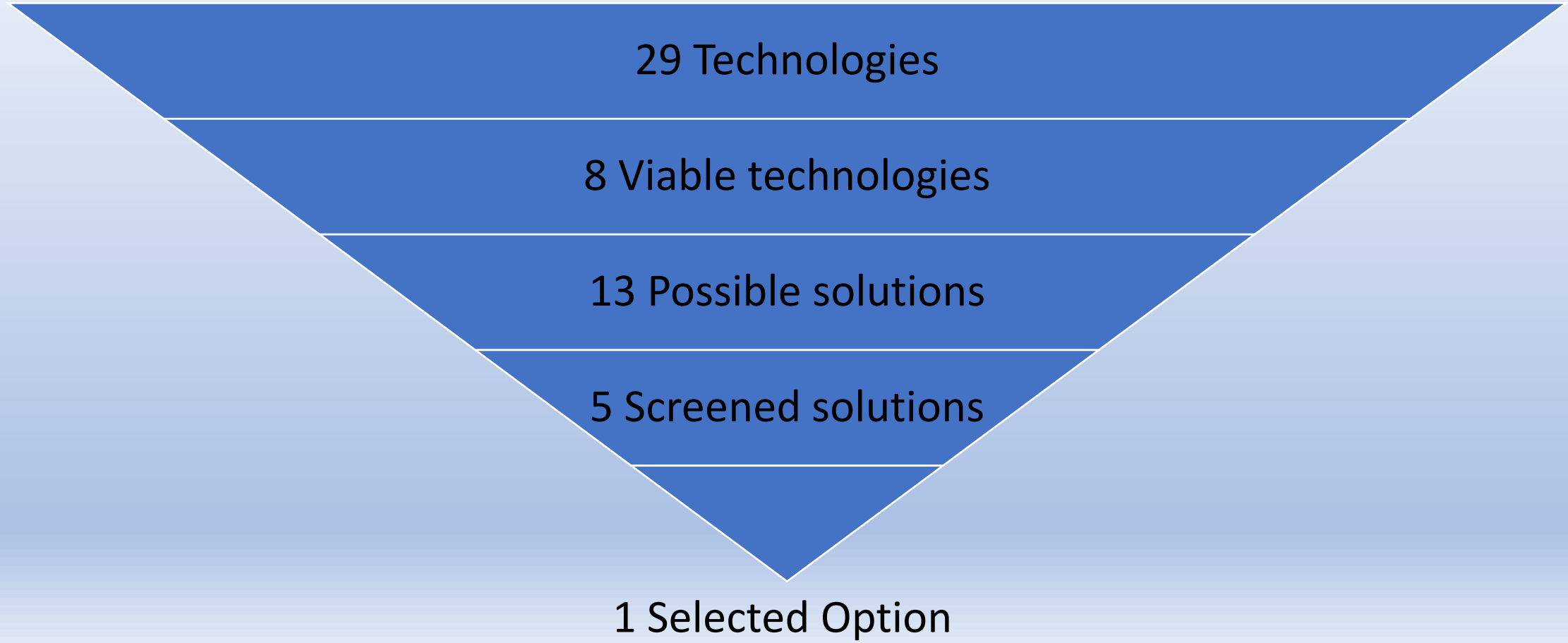
- ~~Fuel Based Based~~
  - ~~Gas turbine (simple cycle)~~
  - ~~Gas turbine (combined cycle)~~
  - ~~Gas engine~~
  - ~~Solid oxide fuel cell CHP~~
  - ~~Gas boiler~~
  - ~~Oil boiler~~
  - ~~Gas-fired Rankine steam turbine~~
- **Renewables**
  - Photovoltaics
  - Wind turbine
  - Large Solar Thermal
- ~~Nuclear~~
  - ~~Micro (in development)~~

- **Renewable Fuel**
  - ~~Bio-oil fired gas turbine (simple cycle)~~
  - ~~Bio-oil engine~~
  - ~~Biomass ORC cogeneration unit (wood chips)~~
  - ~~Biomass ORC cogeneration unit (wood pellets)~~
  - ~~Biomass HOB (wood chips)~~
  - ~~Biomass HOB (wood pellets)~~
  - Bio oil boiler
  - ~~Biogas production - anaerobic digester~~

- **Electrification**
  - ~~Electric boiler~~
  - HP (air-to-water) - large scale
  - ~~HP (air-to-water) - small scale~~
  - ~~GSHP open loop (2300 m depth)~~
  - ~~GSHP closed loop, horizontal, individual~~
  - GSHP closed-loop, vertical
  - ~~Heat Pump (sewage water-to-water)~~
  - ~~Heat Pump (Seawater-to-water)~~
  - Heat recovery chiller
  - Conventional chiller

29 technologies considered ➔ 8 technologies considered viable

# Solution Screening and Selection Process

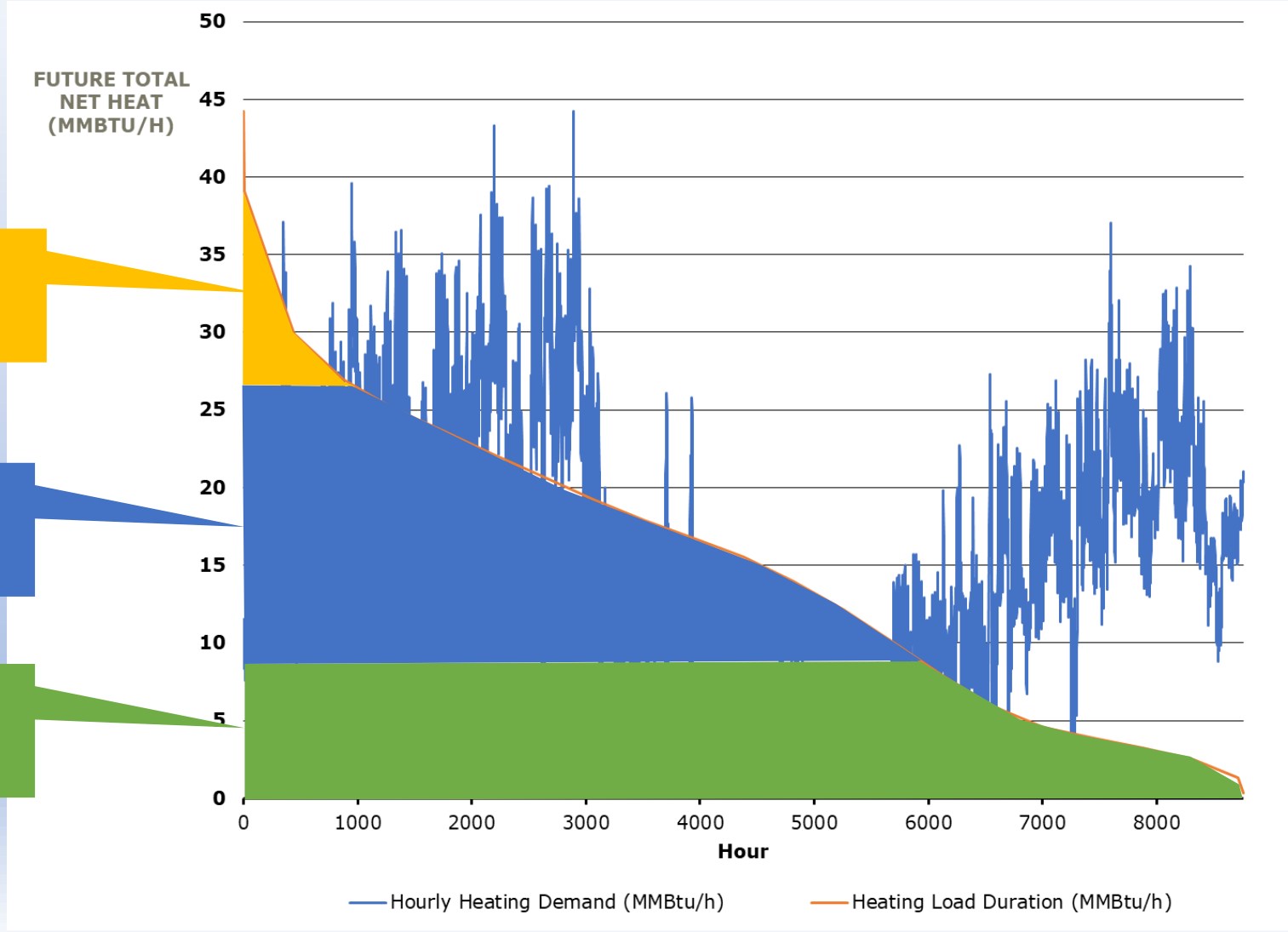


# Selected Scenario

**Peak Load**
- Renewable Combustion Fuel (Bio Diesel)

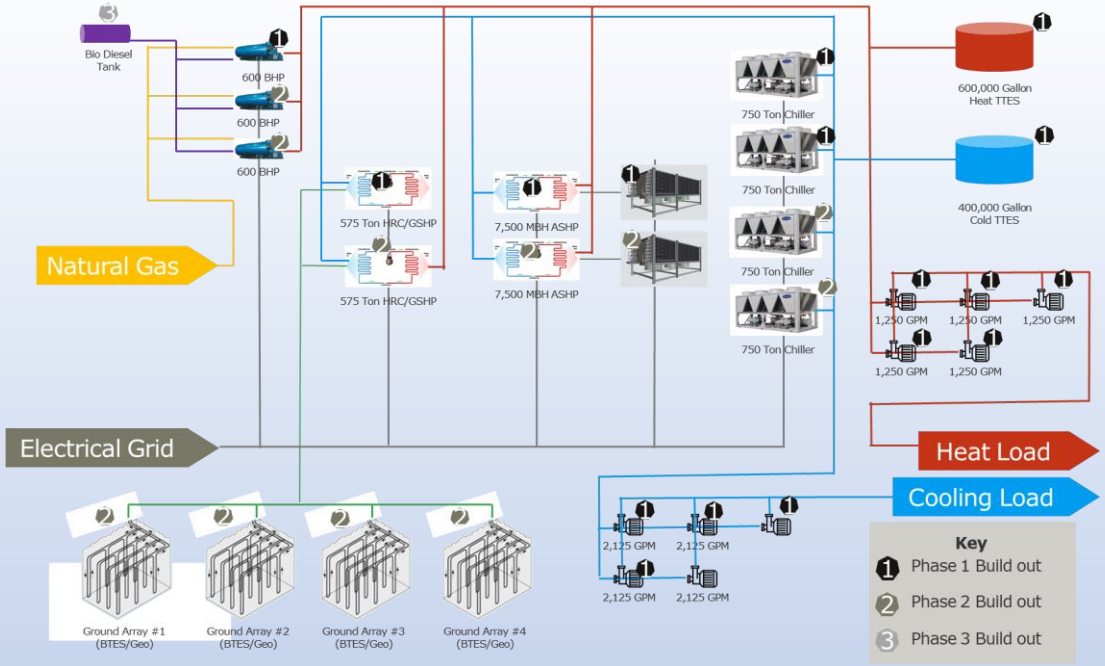
**Intermediate Load**
- Geothermal Heat Pump
- Air Source Heat Pump

**Base Load**
- Heat Recovery Chillers
- Geothermal Heat Pump



# Implementation Plan

- Size assets
- Generate phased process flow diagram
- Identify geographical layout
- Generate preliminary electrical 1-line
- Generate implementation schedule




| ID | Task Mode | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|---|
| 1 | | **UMassD Energy Master Plan Schedule** | **2580 days** | **Fri 1/1/21** | **Thu 11/21/30** | |
| 2 | | **Manual Schedule Inputs** | **0 days** | **Fri 1/1/21** | **Fri 1/1/21** | |
| 3 | | Completion of Energy Master Plan | 0 days | Fri 1/1/21 | Fri 1/1/21 | |
| 4 | | **Phase 1 - Enabling and Centralization** | **2083 days** | **Fri 1/1/21** | **Tue 12/26/28** | |
| 5 | | Funding authorization from state for Phase 1 | 36 mons | Fri 1/1/21 | Thu 10/5/23 | 3 |
| 6 | | **Engineering** | **480 days** | **Fri 10/6/23** | **Thu 8/7/25** | |
| 20 | | **Procurement** | **483 days** | **Fri 11/29/24** | **Tue 10/6/26** | |
| 38 | | **Construction** | **780 days** | **Wed 12/31/25** | **Tue 12/26/28** | |
| 53 | | Phase 1 Complete | 0 days | Tue 12/26/28 | Tue 12/26/28 | 46,45,49,52,47, |
| 54 | | **Phase 2 - Earnest Shift from Fossil Fuels to Electrification** | **1660 days** | **Fri 10/6/23** | **Thu 2/14/30** | |
| 55 | | Funding authorization from state for Phase 2 | 24 mons | Fri 10/6/23 | Thu 8/7/25 | 5 |
| 56 | | **Engineering** | **440 days** | **Fri 8/8/25** | **Thu 4/15/27** | |
| 70 | | **Procurement** | **500 days** | **Fri 10/2/26** | **Thu 8/31/28** | |
| 88 | | **Construction** | **580 days** | **Fri 11/26/27** | **Thu 2/14/30** | |
| 112 | | Phase 2 Complete | 0 days | Thu 2/14/30 | Thu 2/14/30 | 111,93,98,101, |
| 113 | | **Phase 3 - Alternate Fuel Sourcing for Full Carbon Neutrality** | **1380 days** | **Fri 8/8/25** | **Thu 11/21/30** | |
| 114 | | Funding authorization from state for Phase | 48 mons | Fri 8/8/25 | Thu 4/12/29 | 55 |
| 115 | | **Electricity Procurement** | **262 days** | **Fri 4/13/29** | **Mon 4/15/30** | |
| 120 | | **Bio Diesel - Procurement** | **262 days** | **Fri 4/13/29** | **Mon 4/15/30** | |
| 125 | | Sole Sourced Engineering | 3 mons | Fri 4/13/29 | Thu 7/5/29 | 114 |
| 126 | | **Procurement** | **280 days** | **Fri 7/6/29** | **Thu 8/1/30** | |
| 141 | | **Construction** | **199 days** | **Mon 2/18/30** | **Thu 11/21/30** | |
| 148 | | Phase 3 Complete | 0 days | Thu 11/21/30 | Thu 11/21/30 | 147,124,119 |
| 149 | | Project Complete | 0 days | Thu 11/21/30 | Thu 11/21/30 | 53,112,148 |

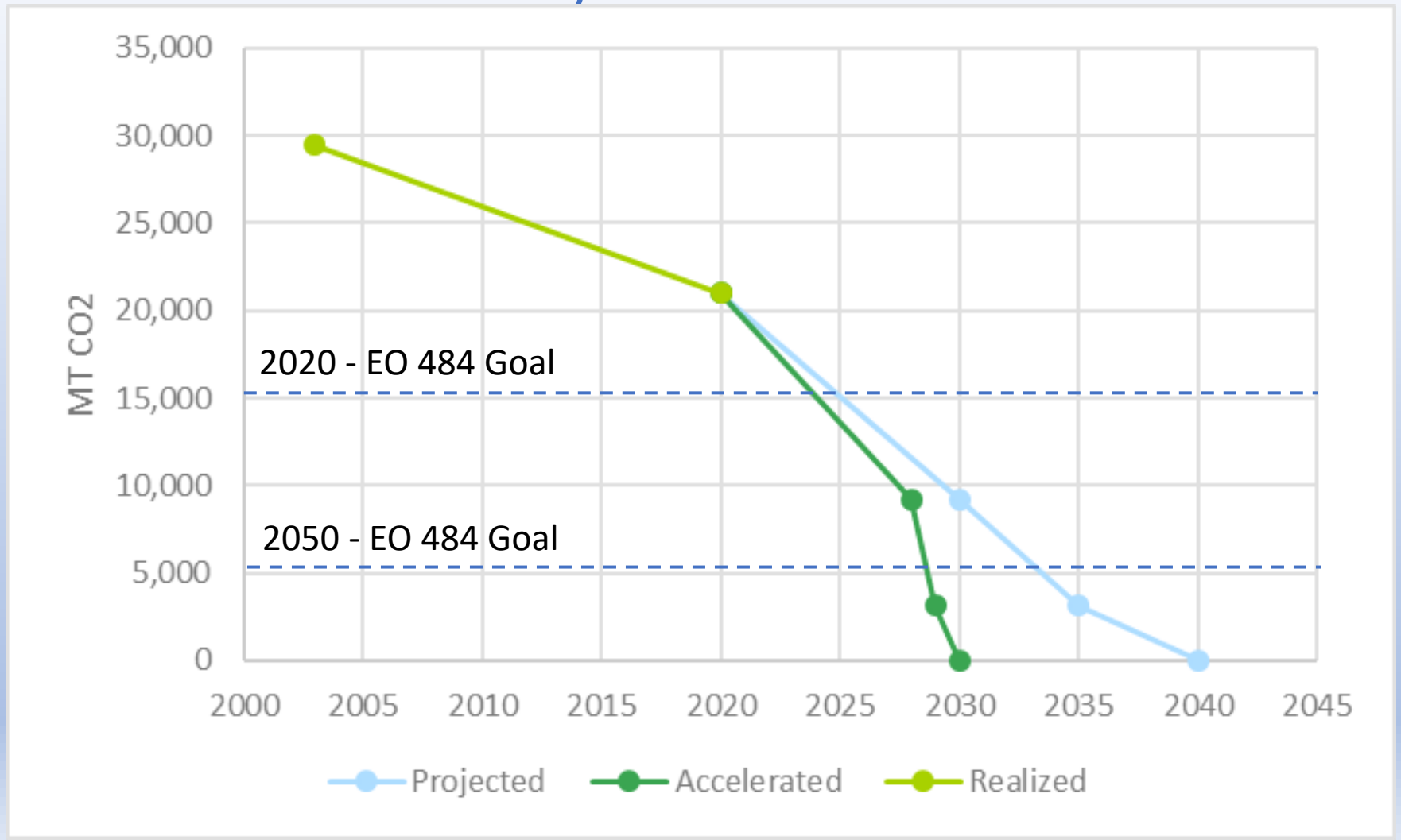


# Implementation Costs

| (Values in Millions of Dollars) Escalation = 4.5% | Phase 1 | Phase 2 | Phase 3 | Total |
|---|---|---|---|---|
| Value in 2020 | $49.06 | $44.30 | $0.58 | $84.94 |
| Funding Year | 2025 | 2030 | 2035 | - |
| Escalated | $61.13 | $68.80 | $1.12 | $131.05 |

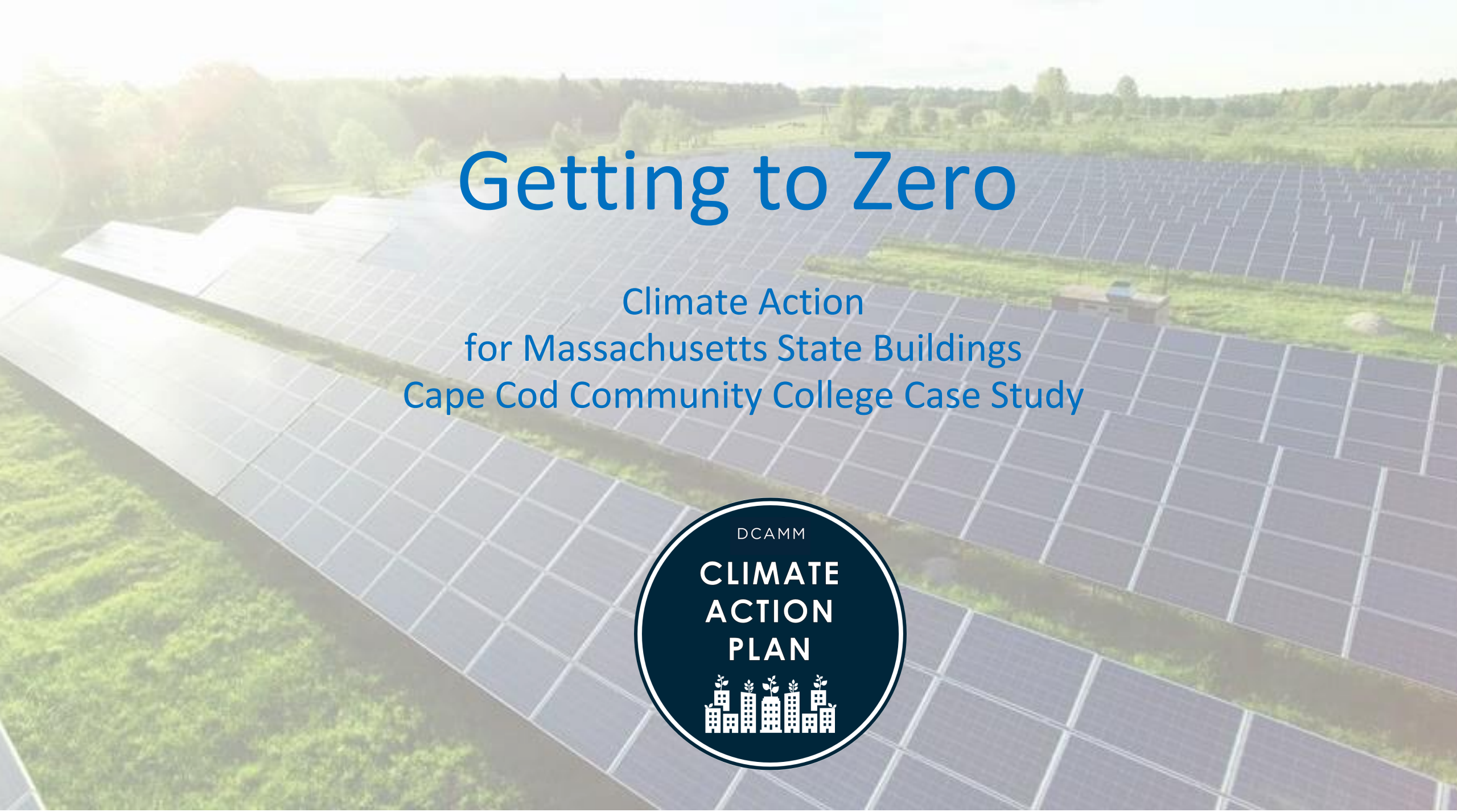
Phase 1: Implementation of district low-temperature hot water and chilled water
Phase 2: Implementation of geothermal seasonal storage system and supporting infrastructure including Netzero plant
Phase 3: Switch from gas to alternative peaking fuel

# Pathway to NetZero Carbon



# Recommendations and Next Steps

- Assess funding options for implementation
- Complete geotechnical test borings to confirm ground conditions and seasonal storage capability
- Finalize purchasing strategy to enable net zero claim (i.e. renewable energy credits and carbon offsets)
- Align near-term replacement of building-level heating and cooling systems with recommended strategy
- Implement thermal energy efficiency measures where possible in planned building renovations and new construction
- Advance system design



# Getting to Zero

## Climate Action
## for Massachusetts State Buildings
## Cape Cod Community College Case Study

DCAMM
CLIMATE ACTION PLAN

# Getting to Zero: DCAMM Plan

DCAMM CLIMATE ACTION PLAN

| | |
|---|---|
| Budget Carbon | Measure Progress<br>Count Carbon |
| Build for the Future | Efficiency<br>Zero Net<br>Low Carbon Fuels<br>Resiliency |
| Accelerate Progress | Goals<br>Collaboration |
| Improve Continuously | Skills<br>Evaluation |

# Three Projects at Cape Cod Community College

## New Science Building -- Remove Old Science Building -- 25A Energy Project

DCAMM CLIMATE ACTION PLAN

| | | |
|---|---|---|
| Budget Carbon | Measure Progress<br>Count Carbon | ☑ |
| Build for the Future | Efficiency<br>Zero Net<br>Low Carbon Fuels<br>Resiliency | ☑ |
| Accelerate Progress | Goals<br>Collaboration | ☑ |
| Improve Continuously | Skills<br>Evaluation | ☑ |

# New Science Building (and demo of old)

## Make Efficiency the First Fuel

- Target EUI = 57
- Current MA LEED Plus standard

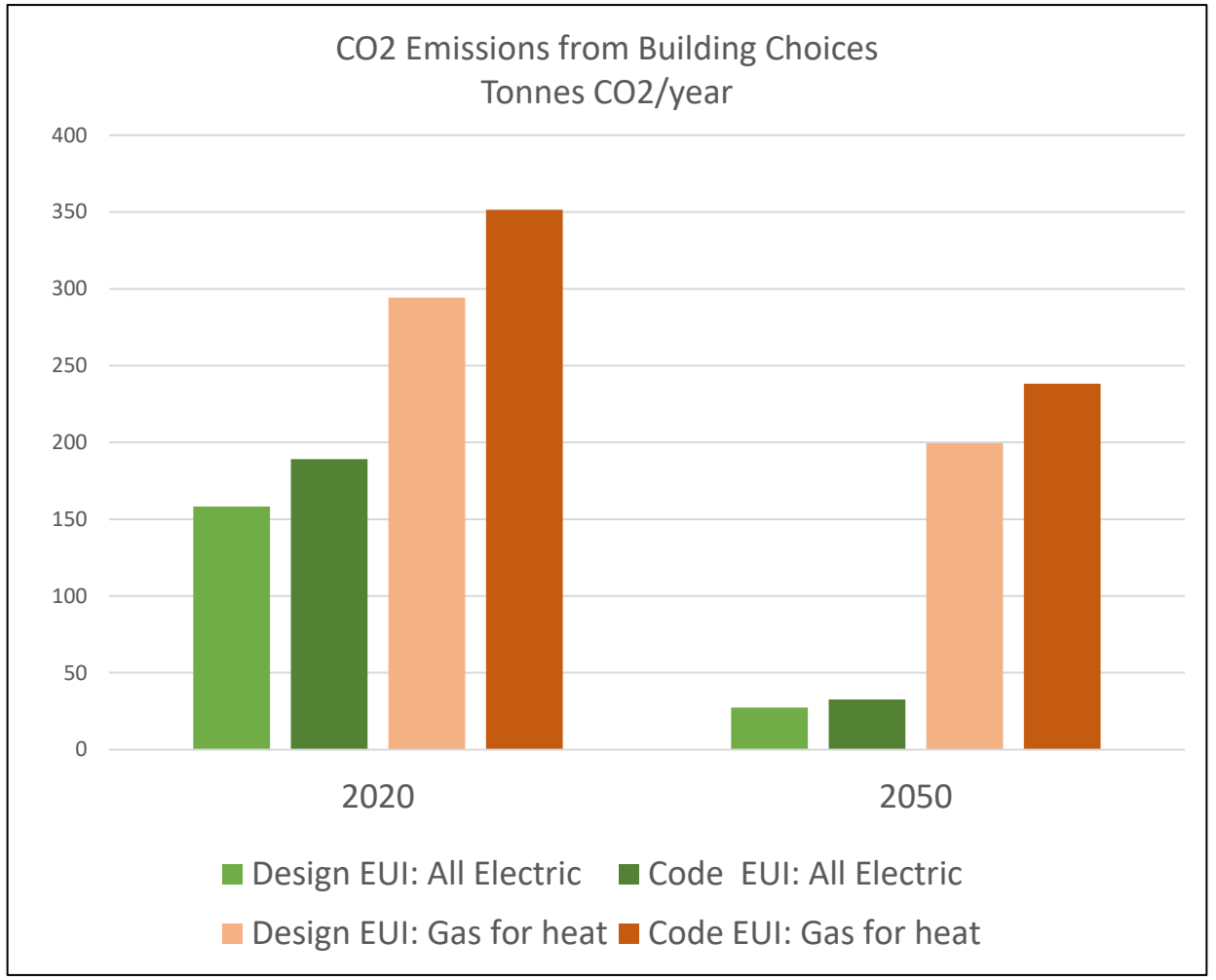
## Strategic Electrification

- Air to Water Heat Pump
- Back up natural gas boiler

## On-site generation:

- Capacity to achieve a ZNEB
- Roof of the “pavilion” should be solar ready (code)

# All Electric Building Cuts Emissions

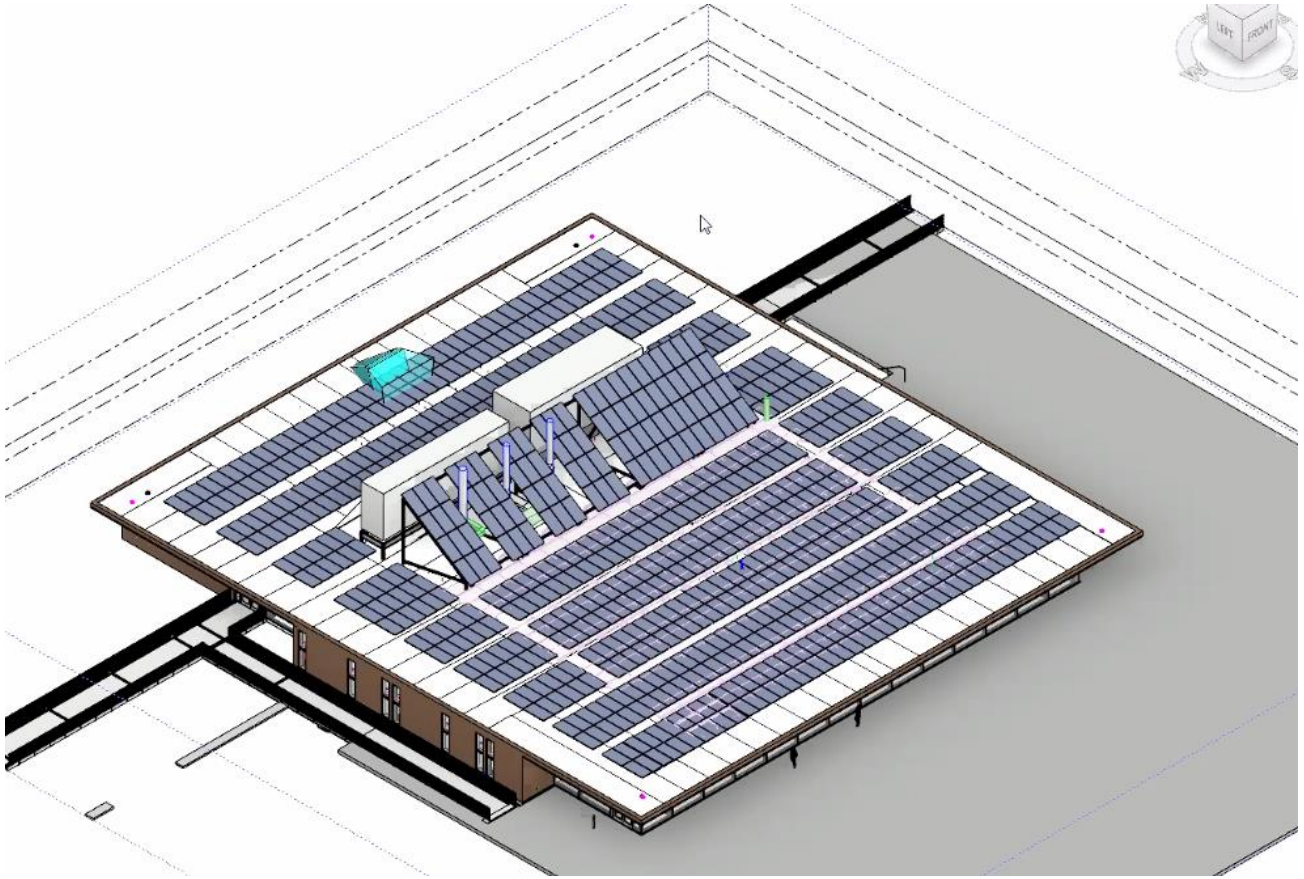



CLIMATE ACTION

# Reducing Embodied Carbon

- Wood decking (CLT) in lieu of steel
  - Lower embodied carbon
  - Aesthetically pleasing
  - Price difference unknown
- Thermally modified wood cladding
- Structural timber was not cost effective

# Solar PPA Results in Net Zero Building



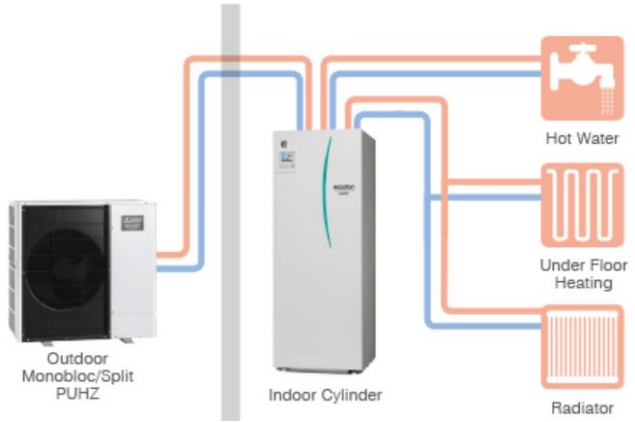

# Energy Project:  Why Cape Cod Community College?

- Commitment of the College to sustainability
- New building management system (BMS) was a priority
- Existing electric resistance heat
- Motivated facility team

# Efficiency + Infrastructure + Electrification Planning

- Efficiency Measure
- Planning for emerging electric technology

  hot water
- Infrastructure sized for future electrification




# Campus-wide Energy Project

| System | Existing | Future |
|---|---|---|
| Heating | Electric resistance (most buildings) | Air Source Heat Pump<br>VRF |
| Air Conditioning | Portable, Window Units or None (most buildings) | |
| Ventilation | None/Little | Demand Control<br>Destratification fans |
| Heat Recovery | None | Energy Recovery Units |
| Controls | Few | BAS<br>Kitchen hood and cooler |
| Other | | Solar thermal DHW<br>Domestic Water Upgrades<br>VFDs<br>Retro-commissioning |

**Predicted Savings: $175,000/ year**

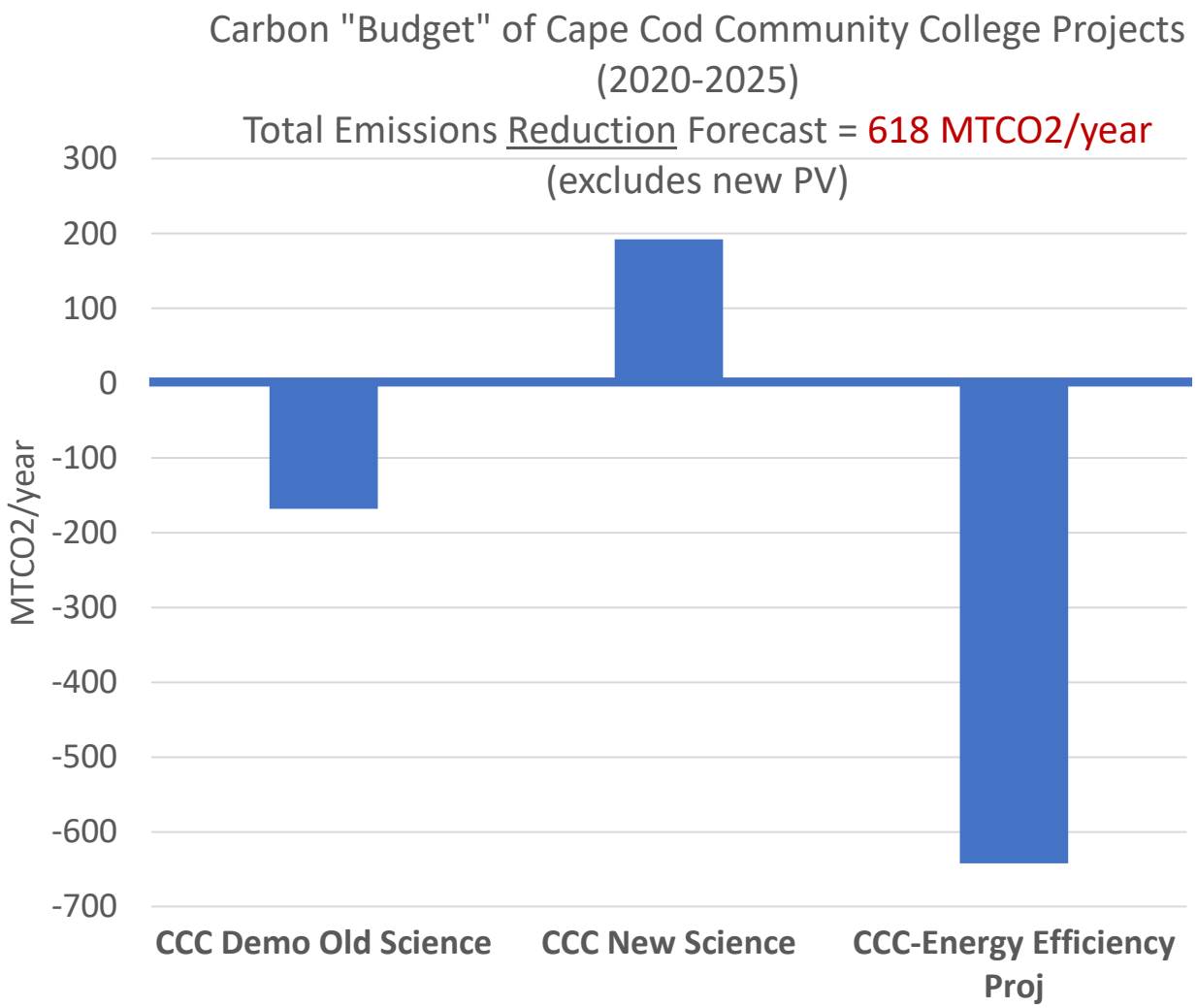
# Improved Ventilation and Humidity Control → Increase energy

## Ventilation systems are not functioning or have failed

Frozen Ventilation Louvers

## Humidity control is ineffective

# Reduced Campus Carbon from Fuel and Electricity



# Net Zero Campus is Within Reach

Solar Potential = 2 MW

# DCAMM CLIMATE ACTION PLAN

Fred Mitchell
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# Next LBE Council Meeting

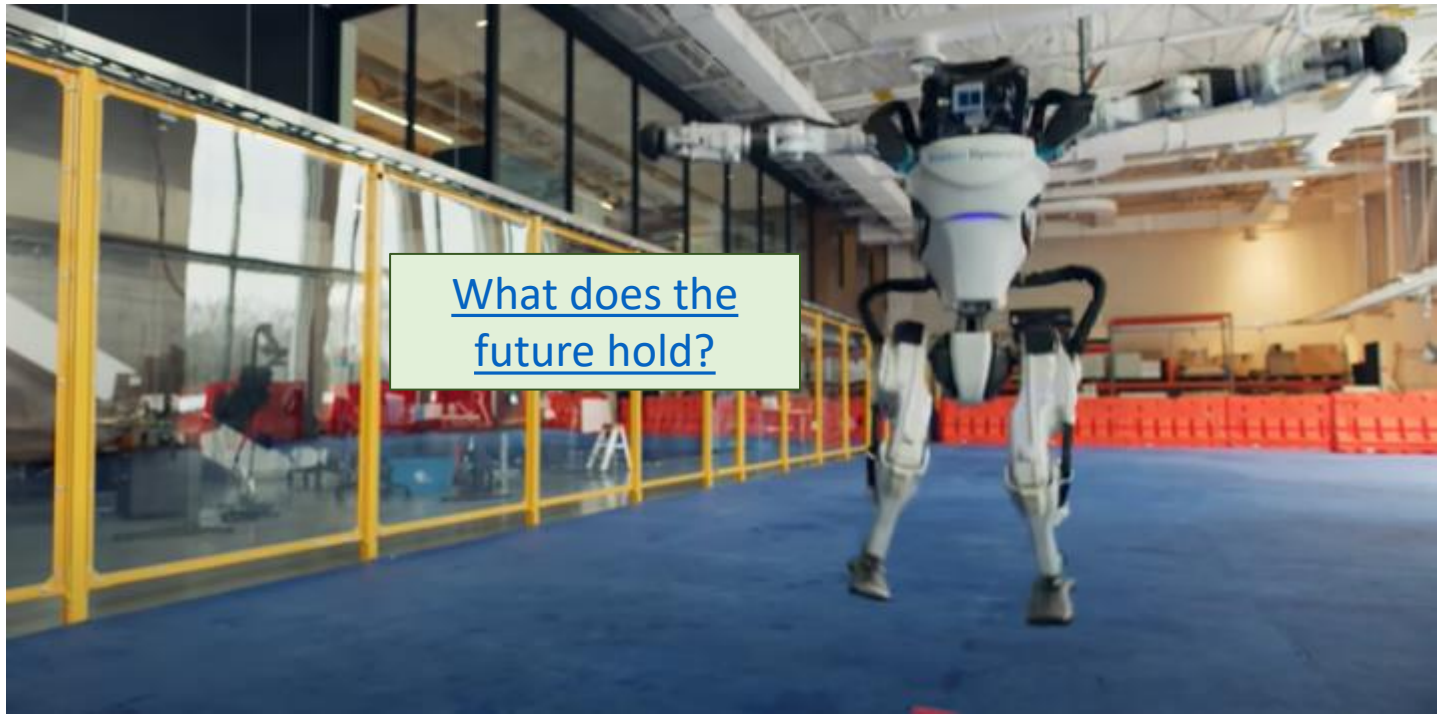
## Save the Date!

**Tentative:**

Tuesday, March 9

10:00 am–12:00 pm

Upcoming Tentative Meeting Dates:
May 11
July 13
Sept 7






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

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