

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENERGY RESOURCES

Elizabeth Mahony, Commissioner

Climate Policy On the Ground: *Decarbonizing State Buildings in Mass.*

Decarbonizing Campuses and Communities
May 3, 2023

2050 CECP KEY BENCHMARKS

Achievement of the Commonwealth's greenhouse gas emissions limit of at least 85% below the 1990 baseline level and net-zero emissions in 2050

TRANSPORTATION

97%

of light-duty vehicles (5 million) electrified

93%

of medium- and heavy-duty vehicles (over 350,000) electrified or non-emitting



NON-ENERGY AND INDUSTRIAL

52%

of industrial energy use electrified

90%

reduction in solid waste disposal



BUILDINGS

80%

of homes (over 2.8 million) heated and cooled by electric heat pumps (including those with on-site fuel backups)

87%

of commercial space is heated by either electricity or alternative fuels

NATURAL AND WORKING LANDS

40%

of lands and waters in MA permanently conserved

64,400 acres

of new riparian and urban tree cover



ELECTRIC POWER

2.5-fold

increase in electric load compared to 2020

97%

of electricity consumed is from clean and renewable sources



JOB AND HEALTH BENEFITS

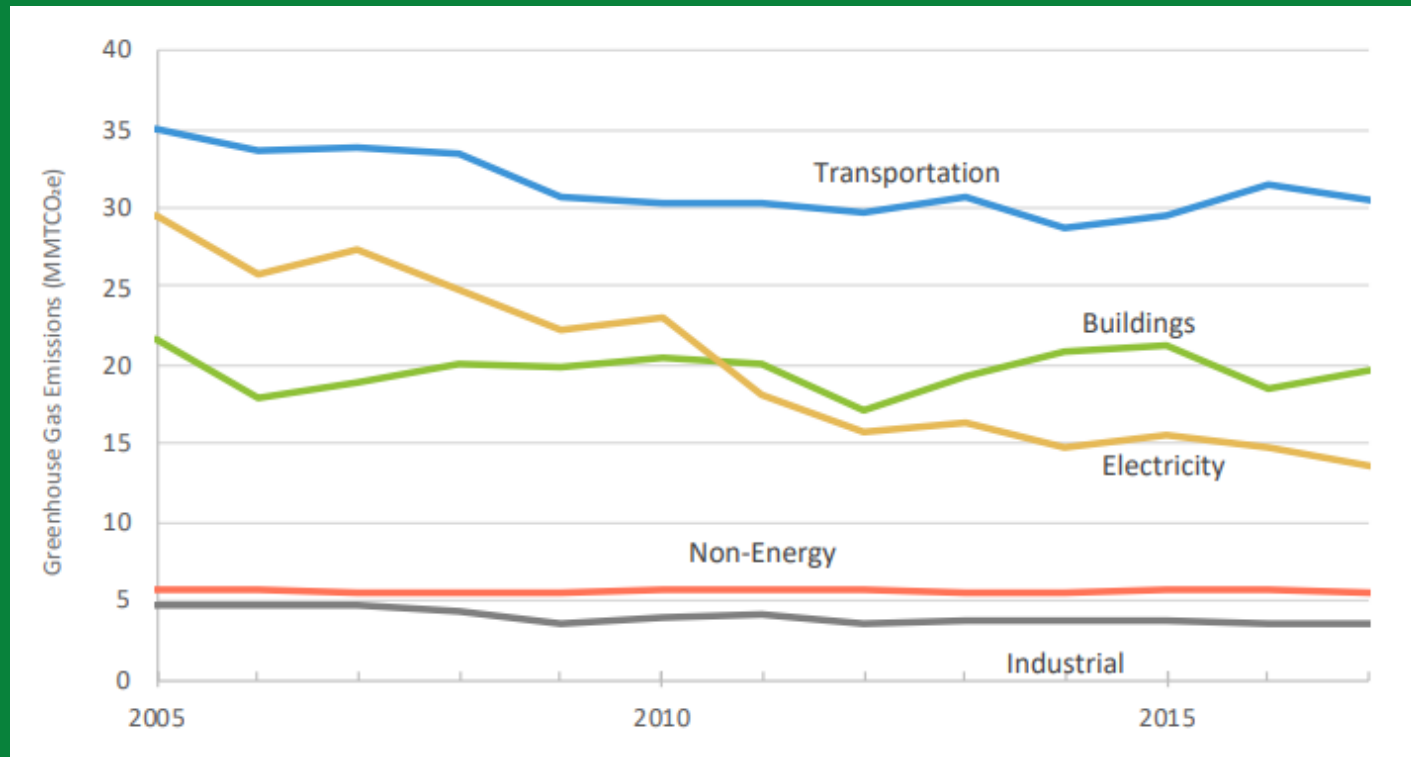
65,000

additional full-time jobs created from the clean energy transition

Up to **\$4.7 billion** in health benefits

Setting the Context for Decarbonization Targets

- ❖ The grid is getting greener, while emissions from transportation and building sectors have seen much smaller reductions in emissions



2022: Ramping up Climate Action ...



An Act Driving Clean Energy and Offshore Wind supports clean energy development, transportation electrification, and building decarbonization



\$3.76 billion [Economic Development Bill](#) funds a host of initiatives, including EVs, charging stations, clean energy investments, green space, food security, and more



[MA Climate Change Assessment](#) released in December details how people, environments, and infrastructure will be affected by climate change



New **Appliance Efficiency Standards** went into effect January 1st, 2023



[Clean Energy and Climate Plan for 2030 and 2050](#) sets emissions limits and sector sub-limits



[Commission on Clean Heat](#) report on policy recommendations to decarbonize heat



LBE accomplishments are the result of the collective efforts of all state entities, who strive to meet the goals of applicable executive orders while supporting long-term statewide policies and goals

Mission Statement

The LBE program aims to substantially reduce GHG emissions and environmental impacts of state owned and managed buildings, facilities, and campuses

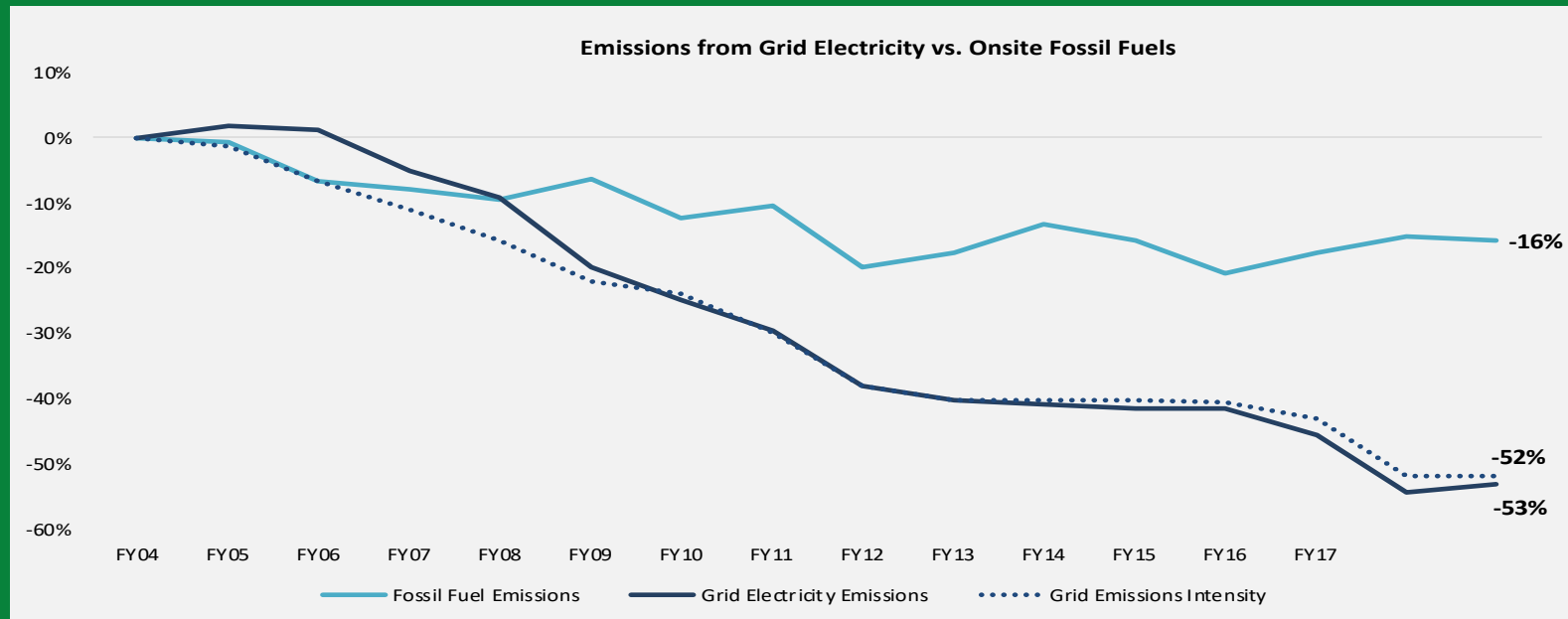
Executive Order 594: Leading by Example

Decarbonizing and Minimizing Environmental Impacts of State Government

MA Leading by Example Targets				
Objective	2025	2030	2040	2050
Reduce emissions from onsite fossil fuels*	-20%	-35%	-60%	-95%
Zero emission vehicles (ZEVs) in light-duty state fleet	5% of fleet (325 vehicles)	20% of fleet (1,625 vehicles)	75% of fleet (3,250 vehicles)	100% of fleet (6,500 vehicles)
Reduce fuel oil use*	-90%	-95%	TBD	TBD
Energy use intensity (site EUI) reduction*	-20%	-25%	TBD	TBD
EV charging stations at state facilities	350 stations	500 stations	TBD	TBD
<p>New light-duty vehicles: Starting in fiscal year 2023, all acquisitions of vehicles with a Gross Vehicle Weight Rating (GVWR) of 8,500 pounds or less must be ZEVs. Starting in fiscal year 2025, all acquisitions of vehicles with a GVWR of 14,000 pounds or less, must be ZEVs.</p> <p>New heavy-duty vehicles: Starting in fiscal year 2030, all acquisitions of vehicles with a GVWR of more than 14,000 pounds must be ZEVs..</p> <p><i>*Over 2004 baseline</i></p>				

Setting the Context for Decarbonization Targets

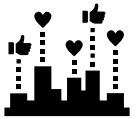
- ❖ 75% of current state government emissions reductions can be attributed to changes in the grid emissions intensity
- ❖ Onsite fossil fuel emissions are most challenging to address, under the direct control of state action, and constitute the majority (and growing) portion of emissions within the state portfolio



State Facility Decarbonization Roadmaps and Studies



Over the last 2 years 18 state facilities have completed or are in the process of conducting decarbonization studies or roadmaps



These facilities, which include all five UMass campuses, several community colleges, prisons, and park visitor centers, account for approximately 61% of state government emissions



These studies/roadmaps are important first steps to demonstrate what's feasible for specific designs and projects to achieve decarbonization goals








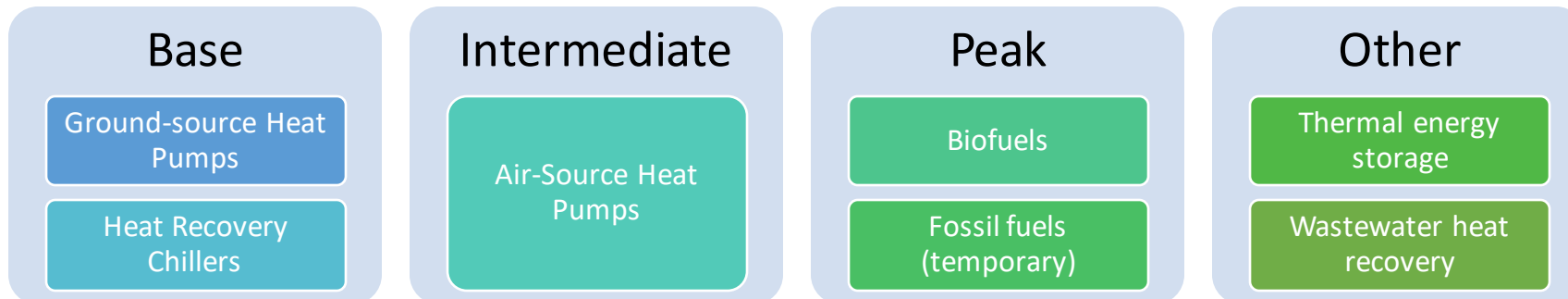
Existing Infrastructure

- Central power plants
- Primarily fueled by natural gas
- High pressure steam
- Multiple buildings of varying ages and performance
- Broad range of building typologies and operational characteristics

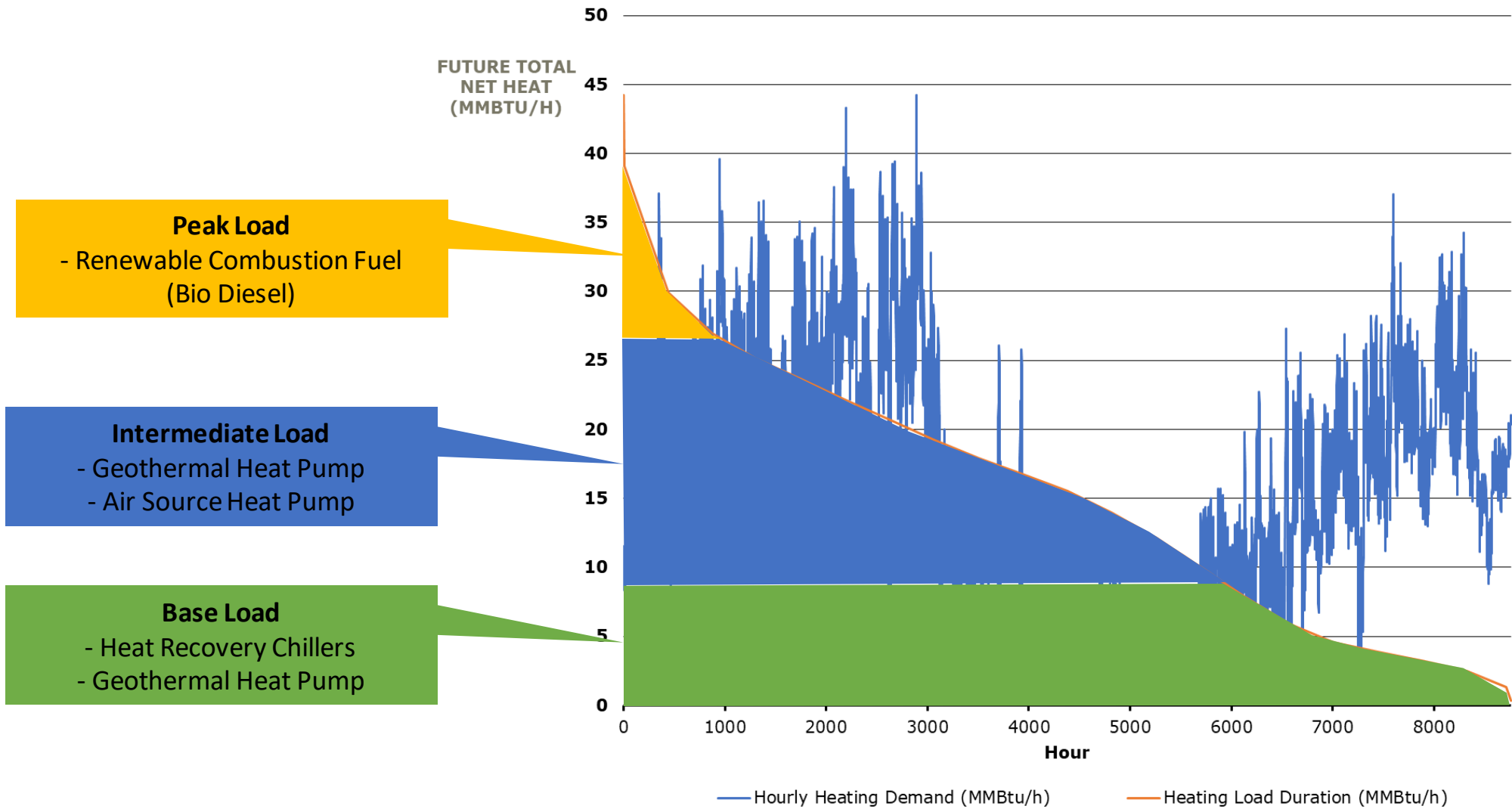
Decarbonization Study Process

Decarbonization Solutions for State Facilities

-  Convert from steam to low-temperature hot water (LTHW)
-  Reduce energy use intensity (particularly thermal energy) across all buildings where possible
-  Options include ground and air source heat pumps, thermal storage, simultaneous heating and cooling
-  Open to new strategies: biofuels, hydrogen, seawater heat pumps, micro nuclear
-  Implement in phases, incorporate into existing master plans and new construction/renovations



Meeting Demand with Multiple Technologies



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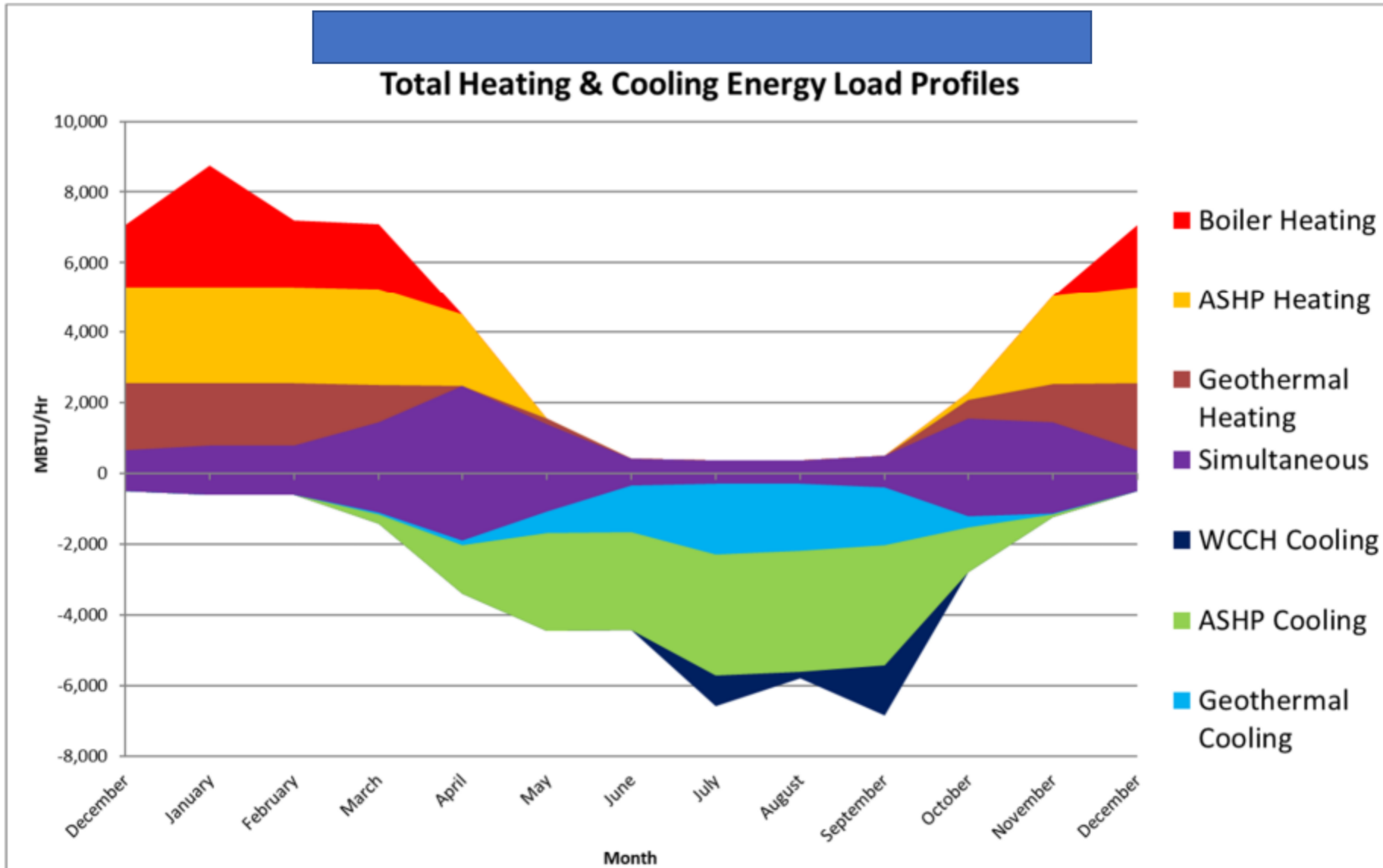


Figure 9: Centralized Option Thermal Profile

Phases for Implementation

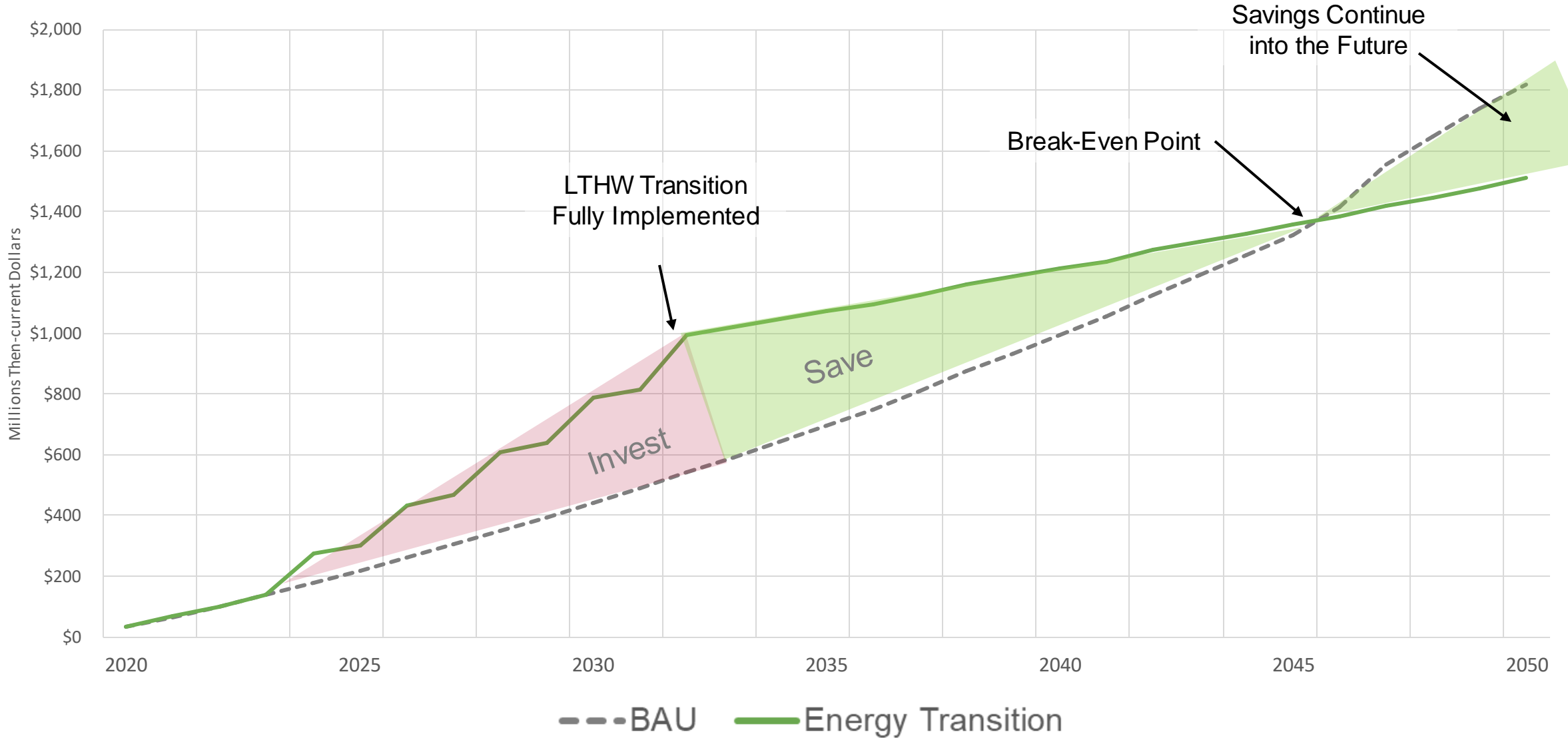
- Dividing work into phases provides guidance on work that needs to be done first
- Phase schedules intended to align with other plan schedules (e.g., master plan, energy retrofits, deferred maintenance)

Initiative Year	Phase 1	Phase 2	Phase 3	TOTAL
	(2025 – 2030)	(2030 – 2035)	(2035 – 2040)	-
Central Heating Plant Upgrades and Demolition/Replacement	\$ 792,162	\$ 954,000	\$ -	\$ 1,746,162
Distribution Network	\$ 5,959,392	\$ -	\$ -	\$ 5,959,392
NetZero Energy Plant	\$ 14,474,445	\$ 8,390,814	\$ 408,875	\$ 23,274,134
Geothermal Borings and BTES	\$ -	\$ 18,026,338	\$ -	\$ 18,026,338
Thermal Tank Energy Storage Installation	\$ 2,108,026	\$ -	\$ -	\$ 2,108,026
Building Upgrades and Conversions	\$ 6,303,023	\$ -	\$ -	\$ 6,303,023
Emergency Backup Generation	\$ 1,861,364	\$ -	\$ -	\$ 1,861,364
Solar PV Car Canopies	\$ -	\$ -	\$ 10,625,000	\$ 10,625,000
SubTotal	\$ 31,498,412	\$ 27,371,151	\$ 11,033,875	\$ 69,903,438
General Conditions	\$ 1,522,498	\$ 1,555,057	\$ 31,451	\$ 3,109,006
Contractor OH&P	\$ 1,903,122	\$ 1,943,821	\$ 39,314	\$ 3,886,257
Design Contingency	\$ 6,984,806	\$ 6,174,006	\$ 78,628	\$ 13,237,440
Change Order Contingency	\$ 2,793,923	\$ 2,469,602	\$ 31,451	\$ 5,294,976
GM Contingency	\$ 873,101	\$ 771,751	\$ 9,828	\$ 1,654,680
Engineering	\$ 3,492,403	\$ 3,087,003	\$ 39,314	\$ 6,618,720
Construction Management	\$ 1,047,721	\$ 926,101	\$ 11,794	\$ 1,985,616
Escalation	\$ 12,328,532	\$ 24,497,066	\$ 10,542,737	\$ 47,368,335
Total	\$ 62,444,518	\$ 68,795,558	\$ 21,818,392	\$ 153,058,468

*Costs here are high-level estimates, included for demonstrative purposes only

Financial Implications

Cashflow - BAU vs Energy Transition Through 2050



Implementation Challenges



Significant Investments for new heating technologies and infrastructure will be required



Recommended measures not always cost-effective under current financial models



Construction/Implementation will be disruptive



Some technologies not yet commercially, cost-effectively available for the scale required at central heating plants

What Comes Next?



Integrate roadmaps into existing plans and protocols



Roadmaps into design studies



Learn from studies to reduce future study costs



Re-think and reframe financing challenge

Decarbonization is an investment to modernize our heating and cooling infrastructure, does it need a payback period?

From Roadmap to Commitments!

Following completion of their campus decarbonization study in 2022, UMass Amherst (the largest emitter in the state portfolio) announced a goal to fully decarbonize its campus within 10 years



Thank You!

Eric Friedman, Director

Leading by Example

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<https://www.mass.gov/orgs/leading-by-example>