



# 2025 Better Buildings SUMMER WEBINARS

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# Powering Progress: Strategies for Efficient & Reliable Central Plants

September 9, 2025

11:00am – 12:00pm ET



Bri Colon  
DOE

# Agenda

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Welcome & Polls

**2**

Key Takeaways from Central Plant Working Group

**3**

Commonwealth of Massachusetts

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Carleton College

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Q&A

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Enter Event Code

**#DOE**

# Polls 1 - 2

*What sector best describes your organization?  
What role/function do you play in your organization?*

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# Today's Presenters

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**Nora Hart**  
Lawrence Berkeley National  
Laboratory



**Betsy Isenstein**  
Commonwealth of Massachusetts



**Rob Hanson**  
Carleton College



Nora Hart

Lawrence Berkeley National Laboratory

# Central Plant Retrofit Working Group



## Working Group Report Out

Central Plant Retrofit

As part of the Better Climate Challenge, the Department of Energy hosted the **Central Plant Retrofit** Working Group from September 2024 to January 2025. Over the course of five sessions, more than 28 partners and allies shared insights into their challenges and successes in implementing cutting-edge approaches for central plant retrofits. The Central Plant Working Group explored innovative strategies for highly efficient central plant retrofits and upgrades and discussed resources that will help accelerate this transition.

### Key Takeaways

**Report Out** is live on the Better Buildings Solution Center!

The working group identified a need for owner guidance on how to conduct central plant retrofit assessments for efficiency and resiliency.

### Discussion Topics and Outcomes

Partners in the working group were at various stages of implementing central plant efficiency retrofits and have diverse energy efficiency and emission reduction goals for their portfolios. For all partners, implementing central plant efficiency retrofits is essential to achieving their goals. The following topics were priorities for partners.

#### System Characterization

The discussion covered the various characteristics and key components of central plants and the importance of characterizing existing systems. It is crucial to understand the age and condition of current equipment to plan for timely replacements and successfully complete retrofits that align with partners' goals. Partners were at different stages in this process; some had already assessed their central plants, while others needed support to do so. Partner efforts included developing master plans, conducting engineering studies, optimizing plants, and establishing all-electric district heating and cooling facilities.

#### Exploration of Challenges and Solutions

Participants shared their experiences and solutions regarding the implementation of efficient central plants. Challenges identified included meeting peak loads, high capital costs, creating business cases for upgrades, space constraints, selecting buildings for evaluation, modifying underground piping, steam-to-hot-water conversion in specialized settings, and the complexity of integrated systems. Solutions discussed involved lowering heating and cooling loads, reducing electrical peak demand through thermal storage and efficiency upgrades, and phasing retrofit replacements. Partners expressed a need for more information on reducing supply water temperatures, costing materials, heat recovery chillers, and equipment efficiencies.

Learn more at [betterbuildingsolutioncenter.energy.gov](https://betterbuildingsolutioncenter.energy.gov)



# Key Takeaways from Central Plant Retrofit Working Group

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## Challenges

Meeting peak loads

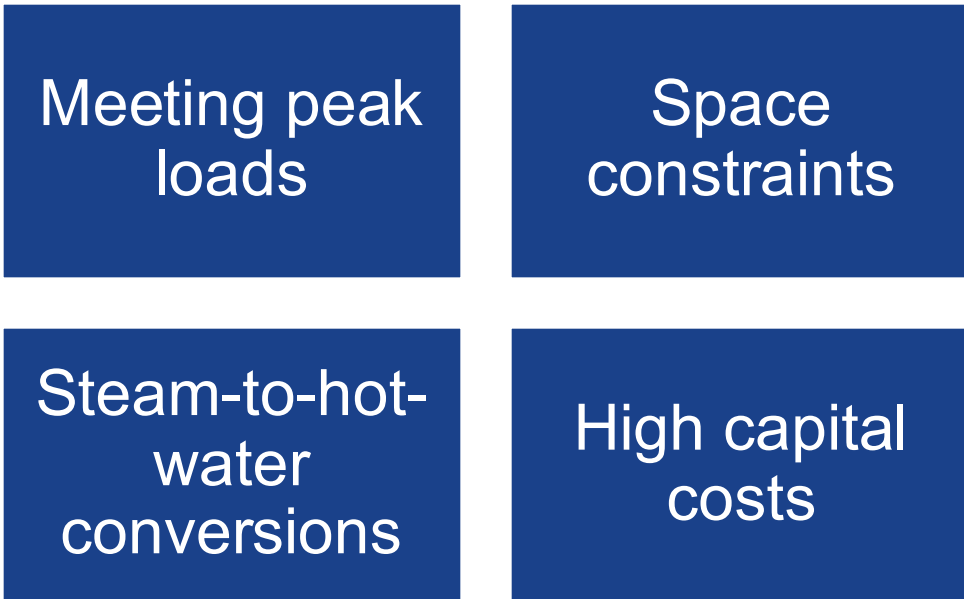
Space constraints

Steam-to-hot-water conversions

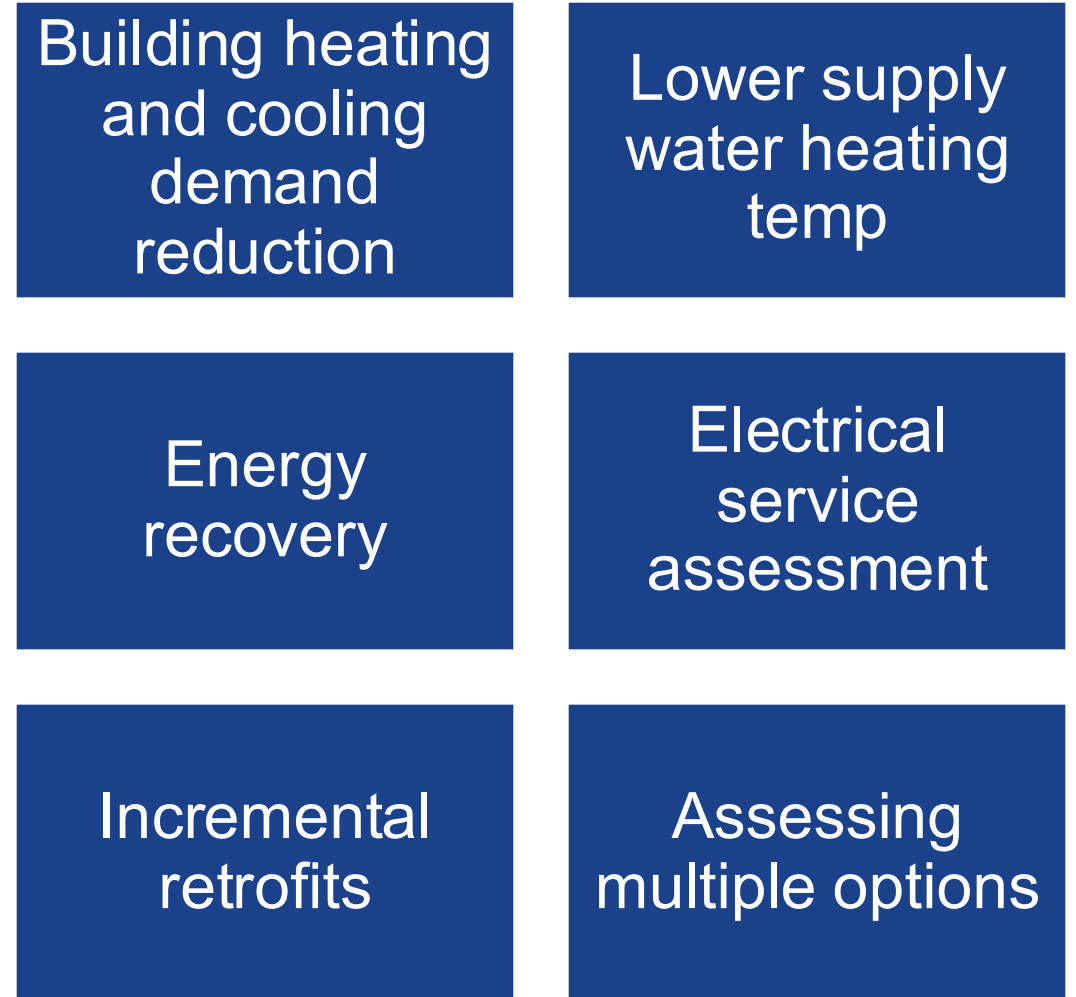
High capital costs

# Key Takeaways from Central Plant Retrofit Working Group

## Challenges



## Solutions





### **Phase 1:** Define Needs

Characterize and understand existing equipment, systems, useful life and loads

Define goals and develop a timeline and scope for additional phases.



### **Phase 2:** Optimize Existing System

Investigate and optimize existing systems to improve operations and prepare for additional phases.



### **Phase 3:** Explore and Evaluate Solutions

Explore and evaluate capital-intensive solutions to enhance energy efficiency and resilience at the central plant.

Select a solution to advance.



### **Phase 4:** Develop Implementation Plan and Schematic Design Package

Develop implementation plan and schematic design to prepare for full design and construction.

# Polls

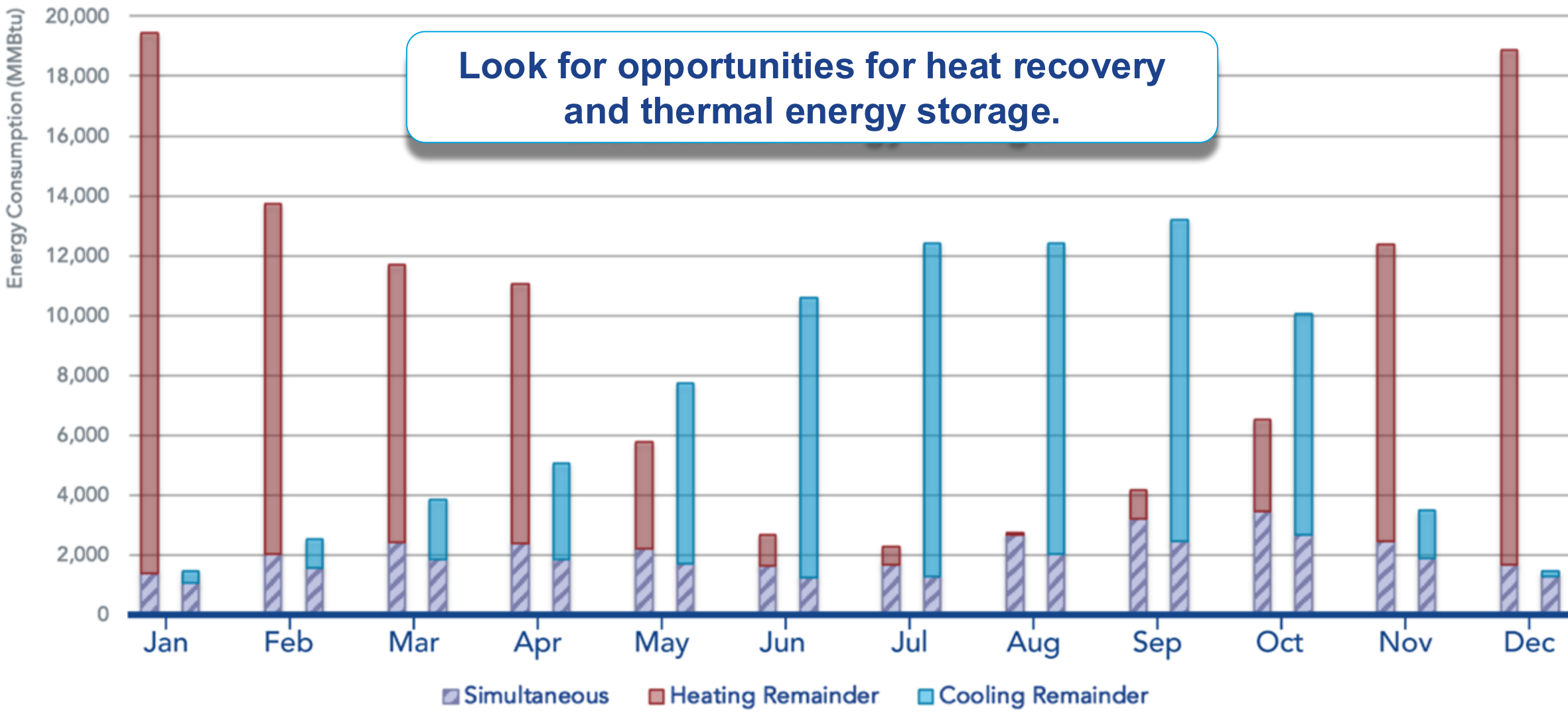
*Which phases have you completed or started in regard to assessing your central plant (Pick all that apply)?*

*What technologies are you thinking about implementing in your central plants (Pick all that apply)?*

Please go to [www.slido.com](http://www.slido.com) and enter code **#DOE** to respond

# Monthly Heating and Cooling Load

Look for opportunities for heat recovery and thermal energy storage.



Define evaluation criteria with critical stakeholders.

## Scenario Evaluation

Quantitative Evaluation Criteria	Weight	BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Lifecycle Cost [\$ over 40 years]	20%	3	3	5	4	3
Capital Costs [\$ over 40 years]	15%	4	4	2	3	4
Energy Costs [\$ over 40 years]	10%	1	3	5	3	3
Annual Energy [kWh/yr]	10%	2	2	5	4	3
Cumulative Emissions [tCO2e]	5%	1	2	5	4	3
Quantitative Criteria Score		<b>1.6</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>2.0</b>
Qualitative Evaluation Criteria						
Maintenance Complexity	15%	3	4	3	3	4
Risk & Resilience	15%	1	3	5	4	3
Site Disruption	6%	5	3	3	3	3
Environmental Impacts	2%	4	4	3	5	4
Fugitive Emissions	2%	4	4	5	5	4
Qualitative Criteria Score		<b>1.1</b>	<b>1.4</b>	<b>1.5</b>	<b>1.4</b>	<b>1.4</b>
<b>Overall Score for All Criteria (Weighted Average)</b>		<b>2.6</b>	<b>3.2</b>	<b>4.1</b>	<b>3.6</b>	<b>3.3</b>



**Plan for a phased implementation.**



Betsy Isenstein

Commonwealth of Massachusetts



# Powering Progress: Strategies for Efficient & Resilient Central Plants in Massachusetts

September 9, 2025



DIVISION OF  
CAPITAL ASSET  
MANAGEMENT &  
MAINTENANCE



Facilities Planning

Project Delivery

Property Management

Real Estate Services

Access & Opportunity

Contractor Services

**We work with state agencies** to create and manage forward-thinking, sustainable buildings to meet the needs of the Commonwealth's citizens and help achieve a zero-carbon future.

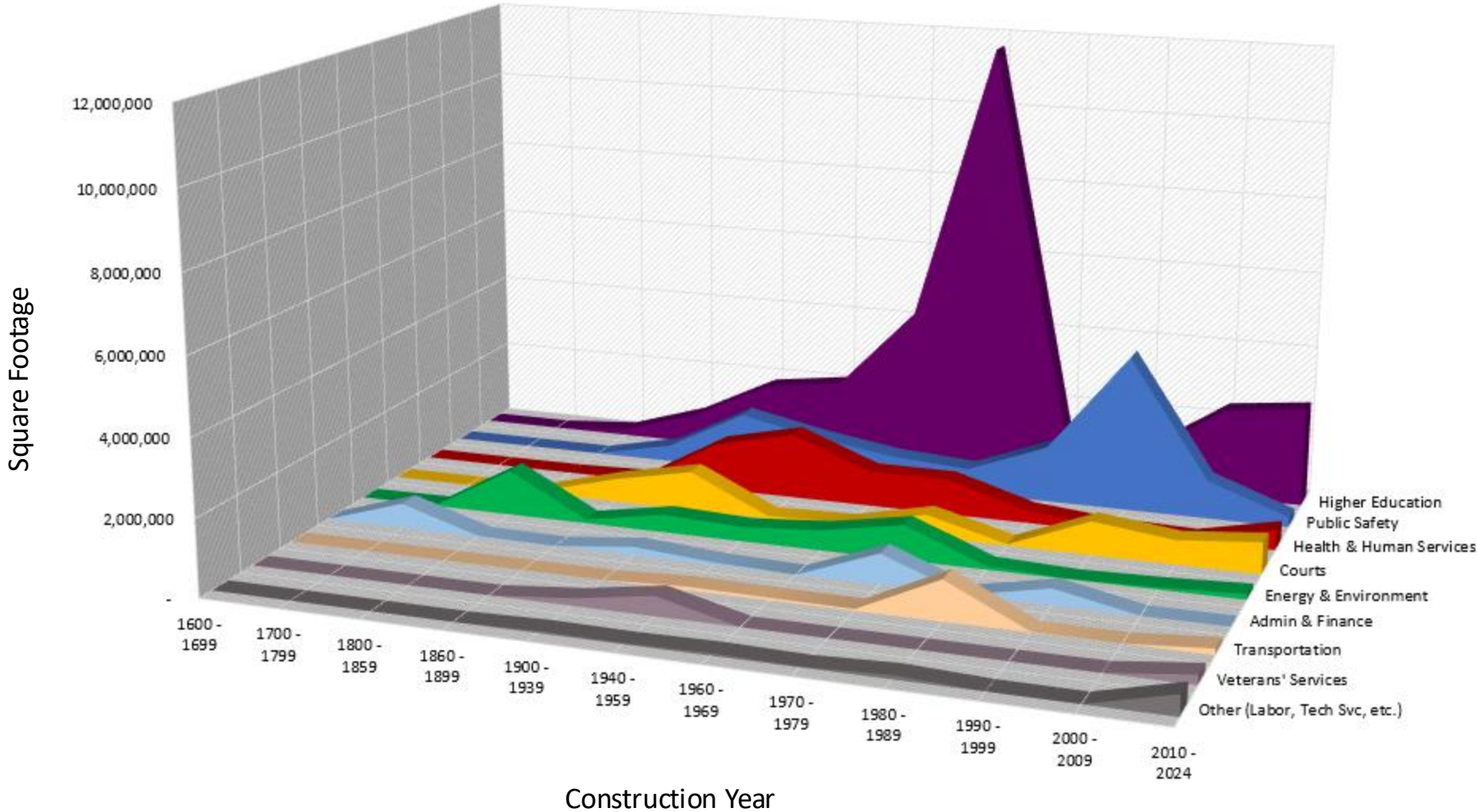
**We are partners with fellow agencies** to help them meet their strategic needs with fiscally responsible building and real estate solutions.

**We support the growth of the Commonwealth's economy** and actively engage with private sector partners to make it easier to do business with the Commonwealth.

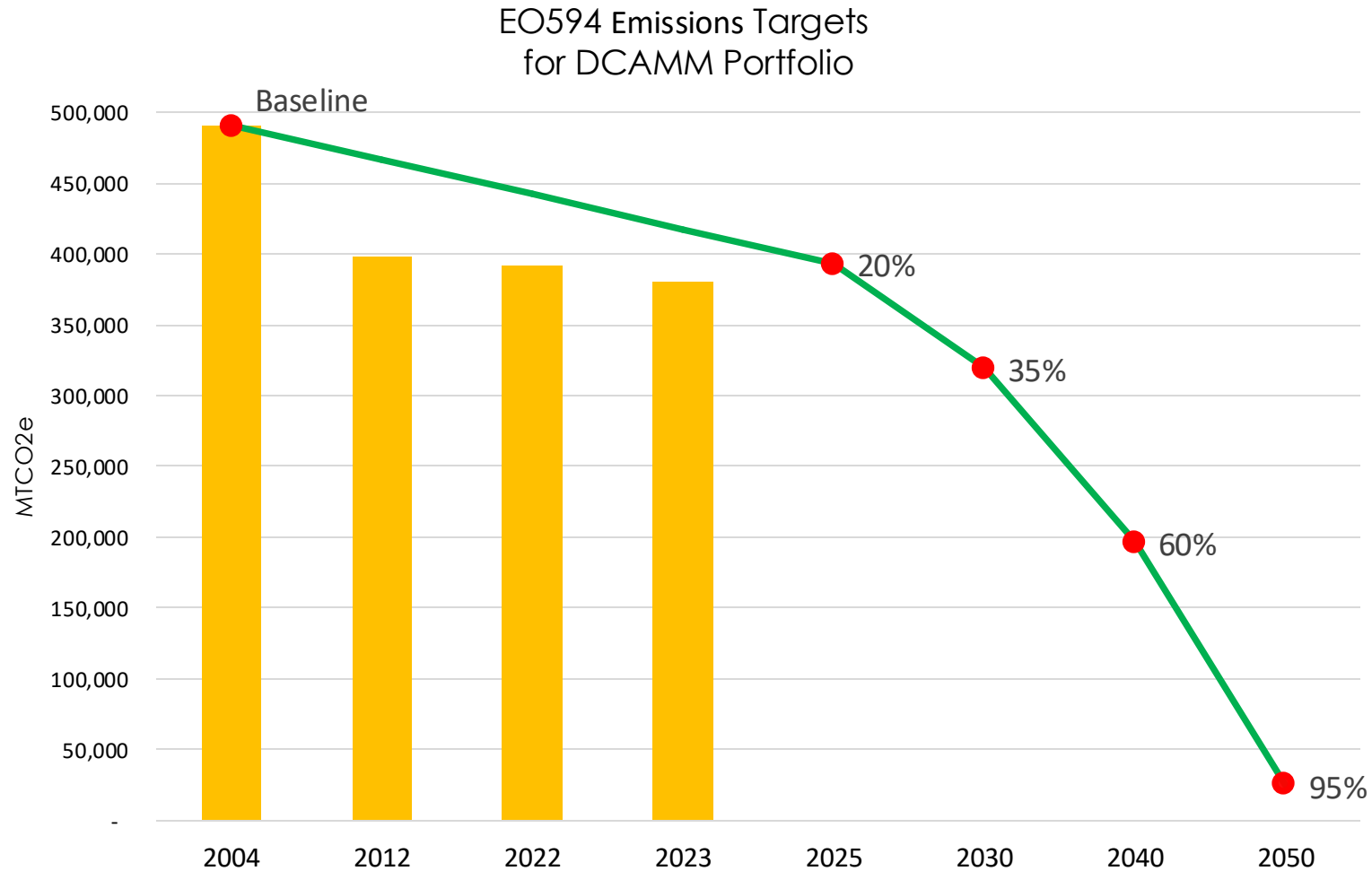
**We work to expand access, opportunity and equity** to create more inclusive services, planning and outcomes for all the citizens of the Commonwealth.



# DCAMM Overview: Portfolio Age



# The Problem: Emissions from Commonwealth Buildings



# Executive Order 594

## Decarbonizing and Minimizing Environmental Impacts of State Government

Move off fossil fuels to reduce greenhouse gas emissions

Incorporate facility and energy resilience

Never miss an opportunity to make this change or to prepare for it

Energy efficiency is decarbonization

New buildings are “easy”

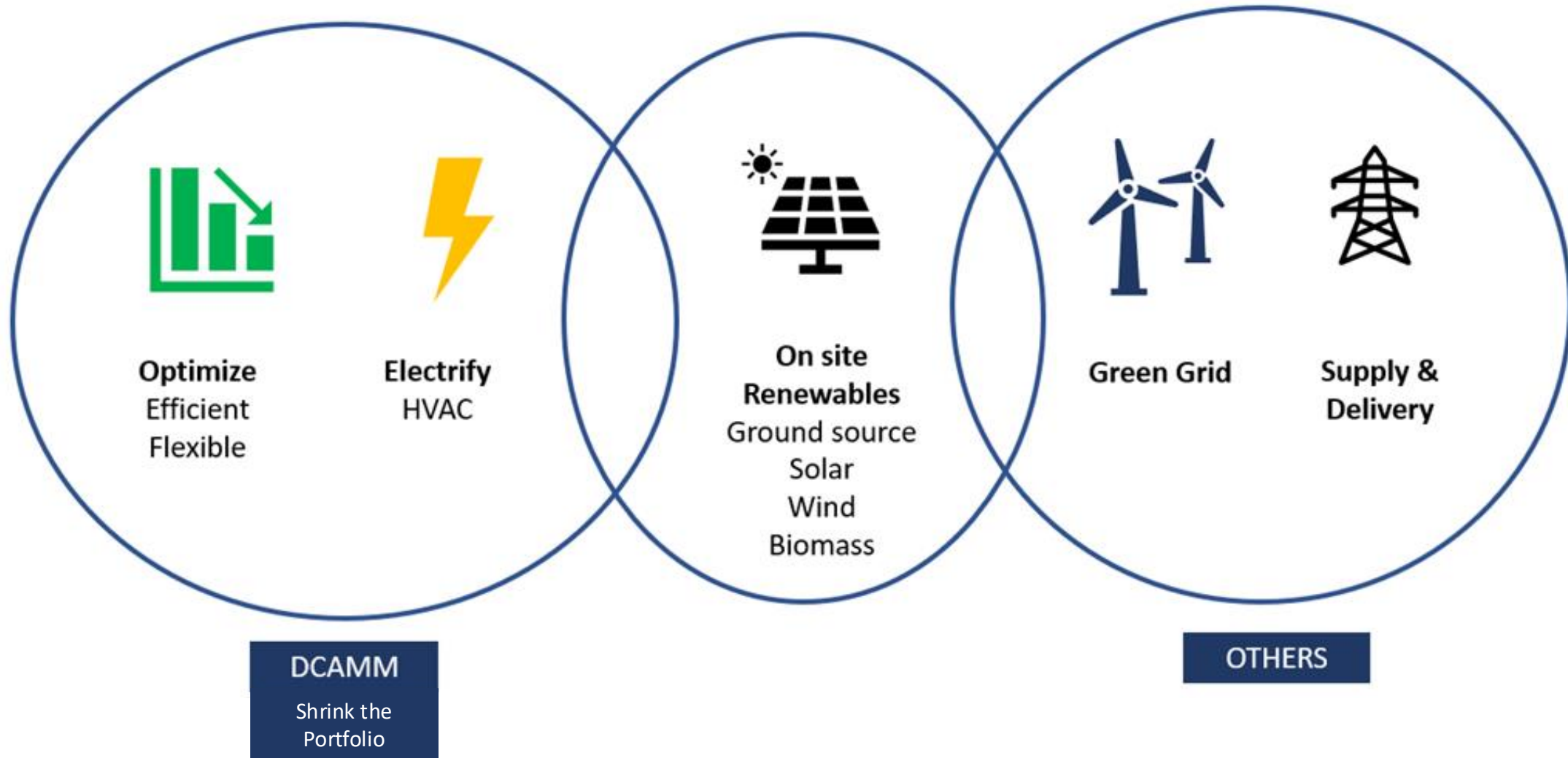
Renovations are more challenging



John J. Sbrega Health & Science Building  
Bristol Community College  
LEED Platinum – Net Zero



# Strategic Approach



# Planning Template

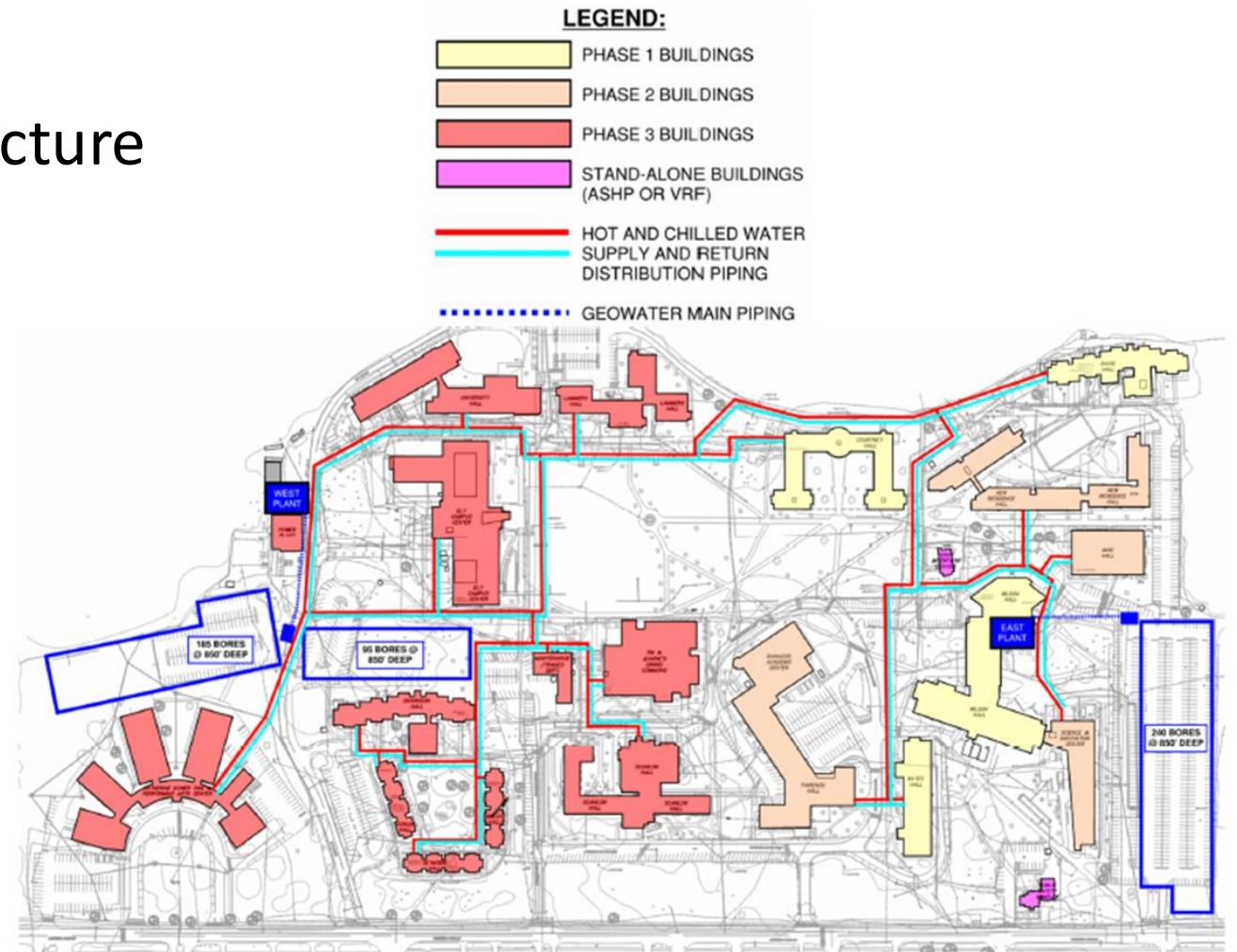
Sector _____	
Sector size (Sq. Ft.) _____	
Estimated 2025-2050 decarbonization cost in \$2024: \$ _____	
Planning approach	Campus roadmaps, comprehensive agency planning, facility condition assessments, building by building plans, etc. Progress on each approach. (One or more approaches based on building inventory)
Decarbonization existing or planned	Existing fossil fuel free (FFF) XXXXX SF in Y buildings, technology used
	New buildings FFF XXXXX SF of Y new buildings, technology used
	Rightsizing: closures, dispositions, decommissioning XXXXX SF of Y buildings
Unique considerations	Opportunities For example: Multiple funding sources Infrastructure renewal needed Strong commitment New cooling is needed Students are demanding action
	Challenges For example: Growth is likely to be focused in more energy-intensive uses Modern care and code requirements require more space Historic designations No swing space Difficult to retrofit buildings with 24/7 occupancy



# Roadmaps to 2050 to guide planning

## Location-specific plans

- Assess age/condition of infrastructure and building systems
- Assess electric utility capacity
- Anticipate roadblocks
- Combine with other investment
- Strategies to improve resilience
- Develop high level phasing









# Pilot #1: The Plan

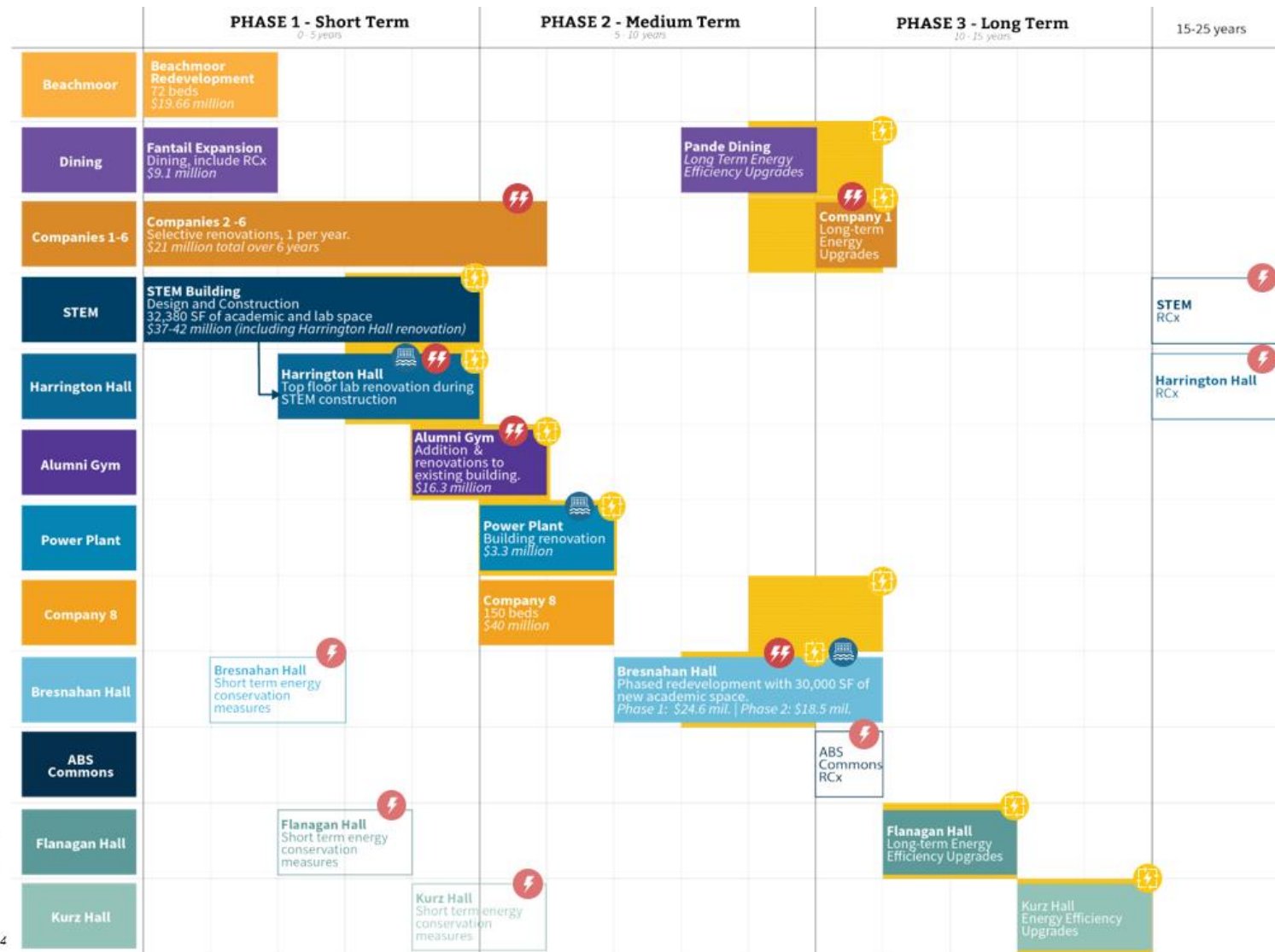
## PHASING

Decarbonization and resilience strategies will be incorporated into all renovations and new construction projects.

Projects connect to the campus energy loop following energy upgrades.

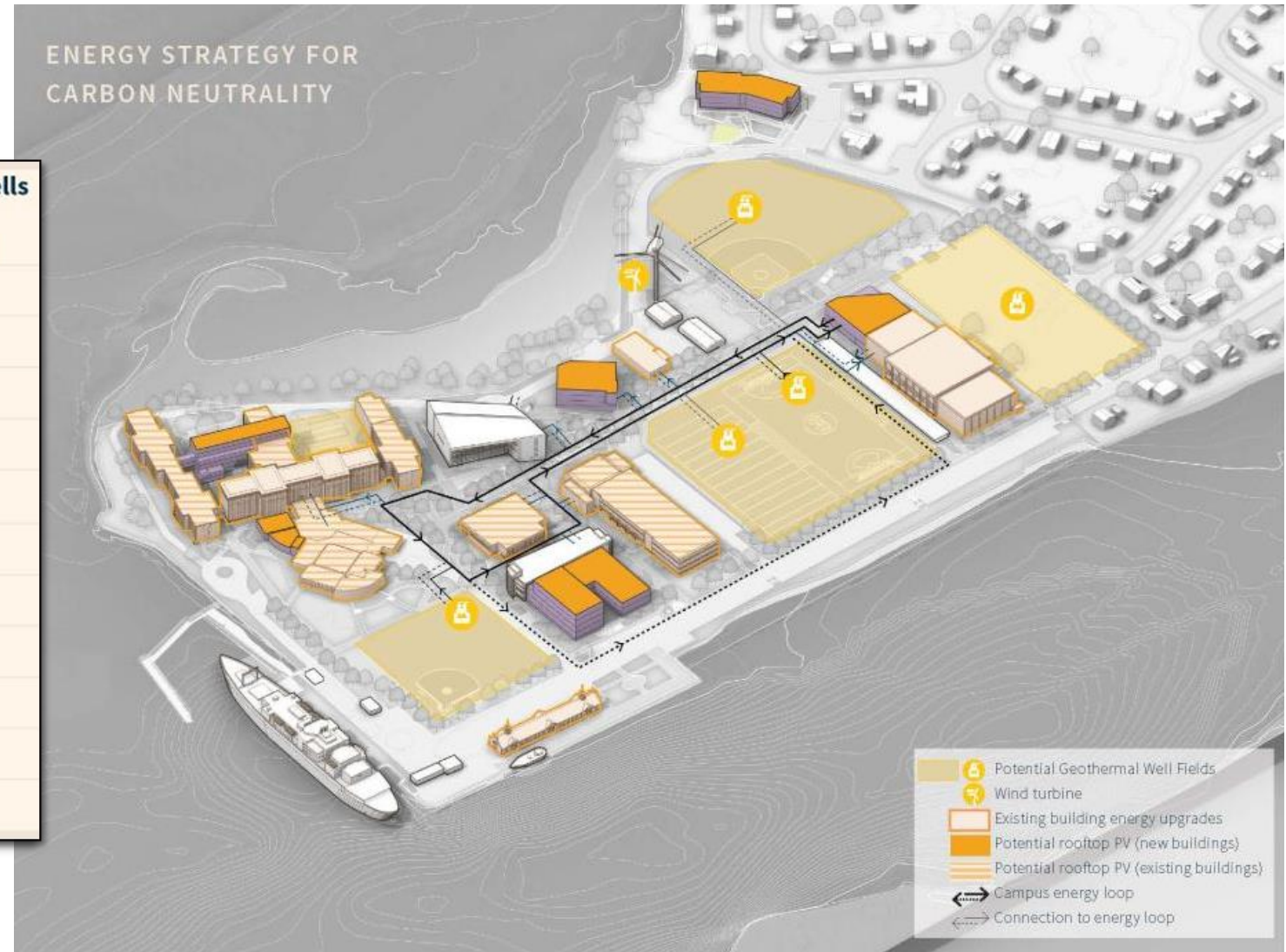
-  Floodproofing during renovation
-  Short term energy upgrade during renovation
-  Long term energy upgrade during renovation
-  Connection to energy loop

Project costs are high level estimates from Sasaki. TPC assumption of 1.4



# Pilot #1: The Project Concept

Building Name	Number of Wells BAU/Existing	Number of Wells at 25th Percentile
Pande Dining Hall	51	21
Clean Harbors	110	54
Kurz Hall	29	11
Power Plant	4	2
Flanagan Hall	9	4
Bresnahan Building	45	36
Harrington Building	62	36
Company 1 - 6	373	84
Company 7	54	10
New Science Building	40	25
<b>Total</b>	<b>775</b>	<b>283</b>



# Pilot #1: Project is enabling for new STEM Building

- Borefield w 252 wells
- Cross-campus energy transfer loop
- Heating and cooling for new STEM building
- Longterm campuswide infrastructure
- Harrington
  - Mechanical resilience measures
  - Heating and cooling
- ECMs throughout campus
  - Lighting/controls
  - Burner controls
  - VFDs
  - Demand control ventilation
  - Testing and balancing
  - Existing building commissioning



# New STEM Building at Mass Maritime

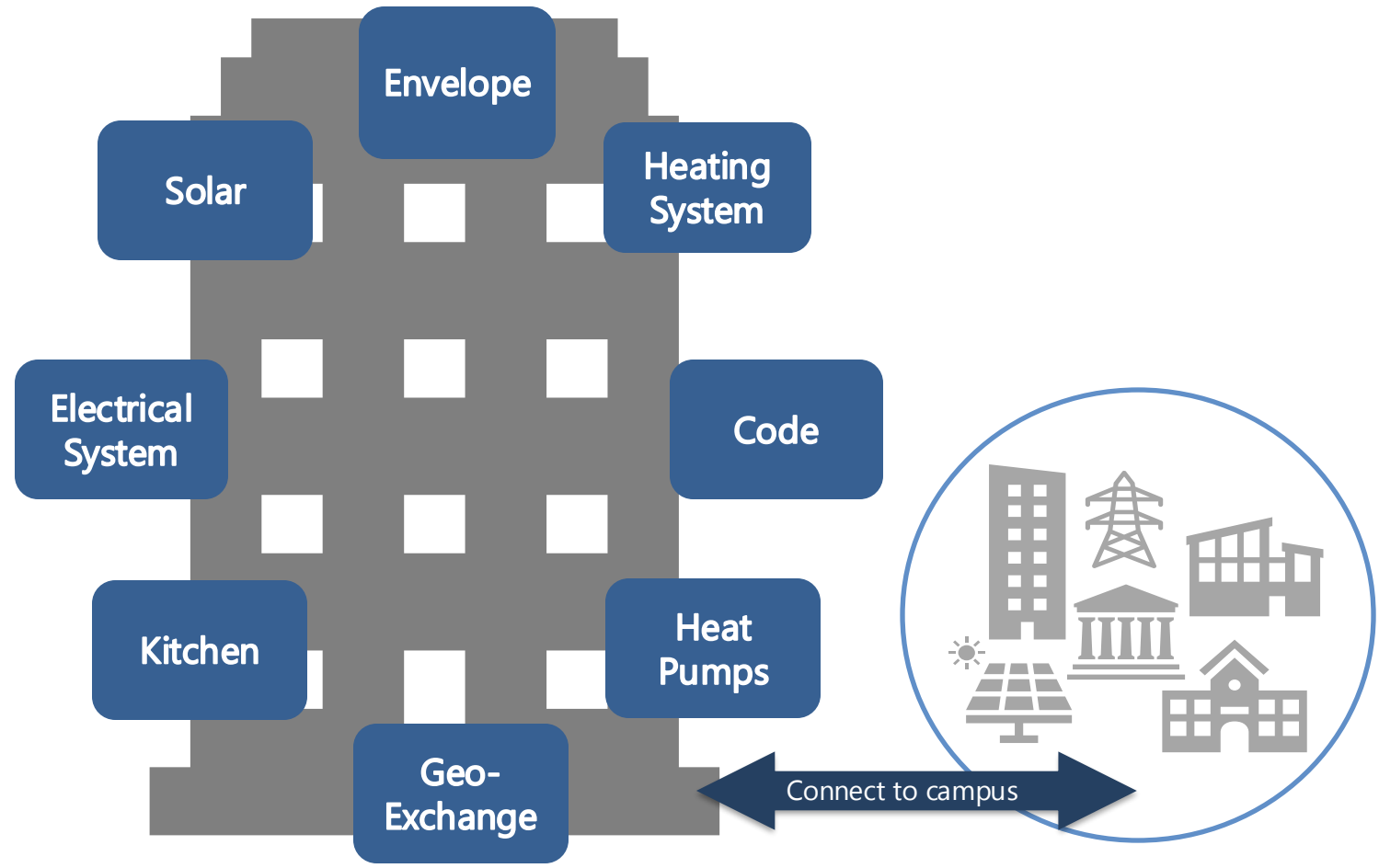
EUI Target – 54

LEED Target – Silver

- Central modular heat pumps
- Heating and cooling from campus energy transfer loop (Pilot #1)
- Fan coil units
- Energy recovery wheel
- PV ready
- Daylighting, vacancy, occupancy sensors
- Demand management and peak load curtailment strategies
- Majority of fume hoods are filtering ductless in lieu of ducted
- First level located 5' above existing grade  
(1' higher than 100-year flood event level added to 30" of sea rise or storm surge)



# It is complicated...



# but it is possible!

## DCAMM progress

- Complete - 2.2 million SF fossil fuel free
- In progress - 890,000 SF off fossil fuels
- 3 decarb pilot projects in design
- Renewables development continues
- 1 Passive House certified
- Projects set EUI targets
- Commissioning is standard
- Studying low carbon materials
- **Every project pursues efficiency, resilience, and emissions reductions**



MA Fish and Wildlife Headquarters  
LEED Platinum  
Net Zero for 10 years!



# Resources

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- [Executive Order 594](#)
- [Executive Order 594 guideline documents](#)





Rob Hanson  
Carleton College

Carleton

# **Carleton College District System: Conversion from Steam to Hot Water**

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Rob Hanson  
Campus Energy Manager

## Background: Campus

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- Private liberal arts college in Northfield, MN
- Founded in 1866
- Approximately 2,000 students
- 2.0 million SF total
- 1.8 SF million on central utilities (only partially chilled)
- 34 buildings served from the central plant
- 1,000 acres (800 acre Arboretum, 200 acre Campus)



## Background: Energy

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- Campus EUI ~70 kbtu/sf/yr
- GHG Emissions ~ 12,000 MTCDE/yr
- 1.65 MW wind turbine connected to campus
- 1.65 MW wind turbine connected to public grid
- 480 kW DC rooftop solar PV total
- 11 Passive House student townhouses (built in 2024 and 2025)

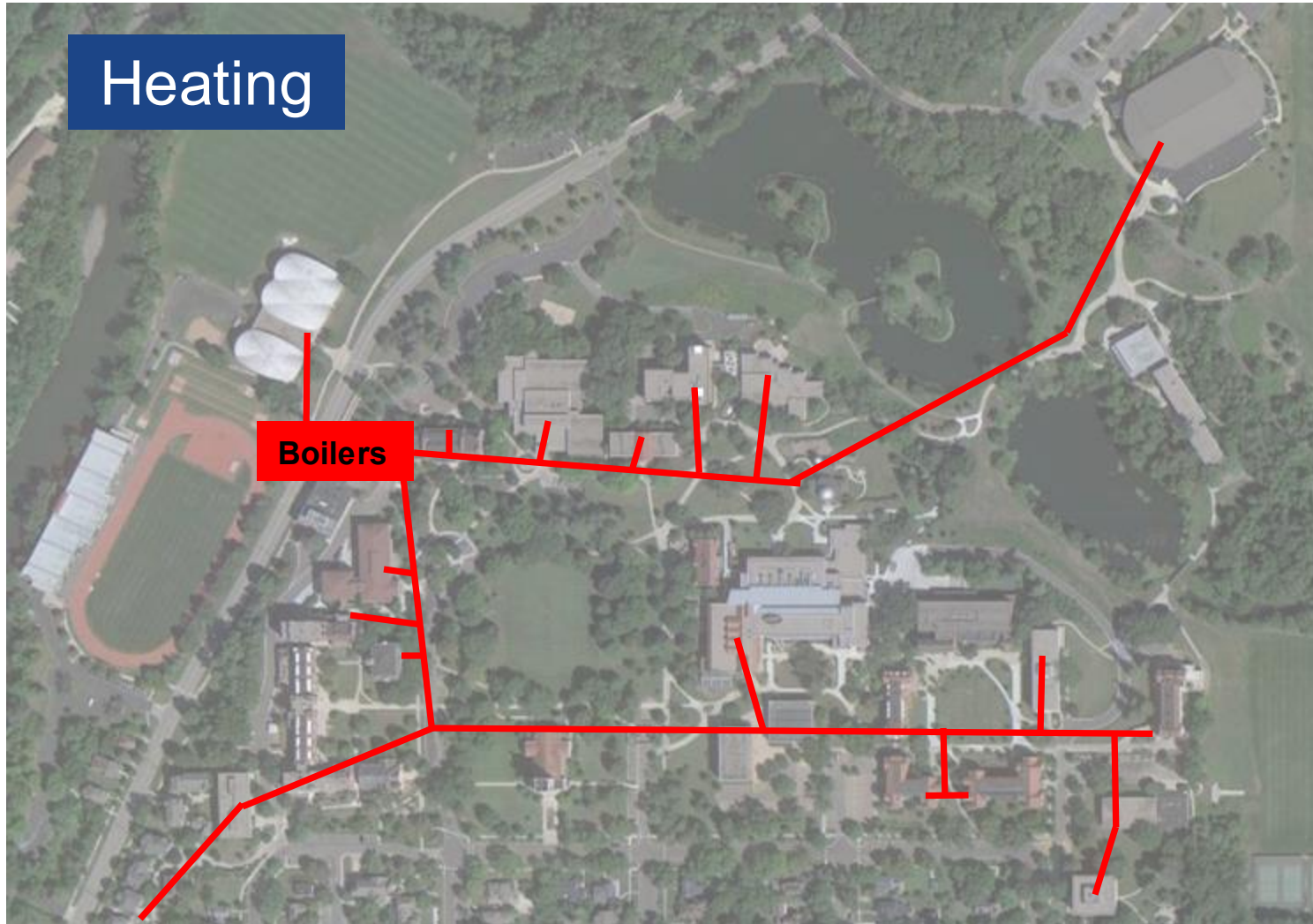


Carleton

# **Original District System**

Carleton

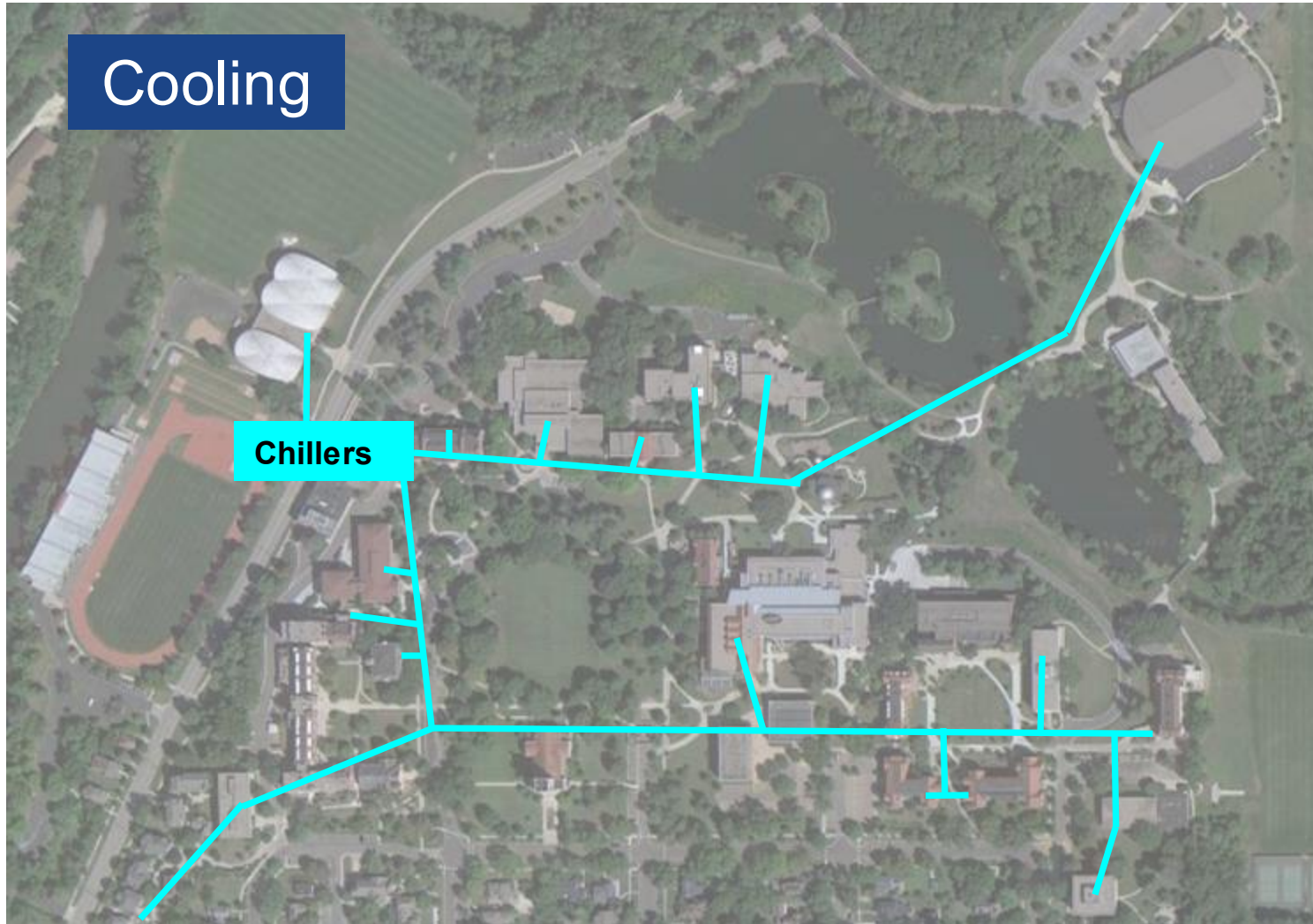
# District System: Pre-Conversion



Note: this map is conceptual. The pipe layout is more complex.

Carleton

# District System: Pre-Conversion

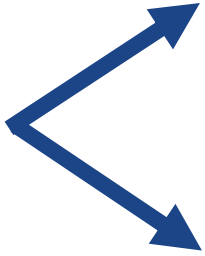


Note: this map is conceptual. The pipe layout is more complex.

Carleton

# **Steam to Hot Water Conversion**

# Carleton



# Carleton



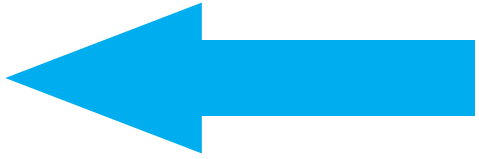
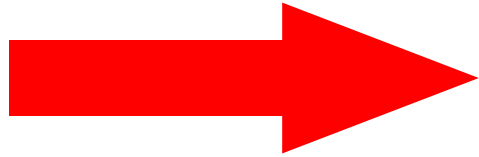
# Carleton



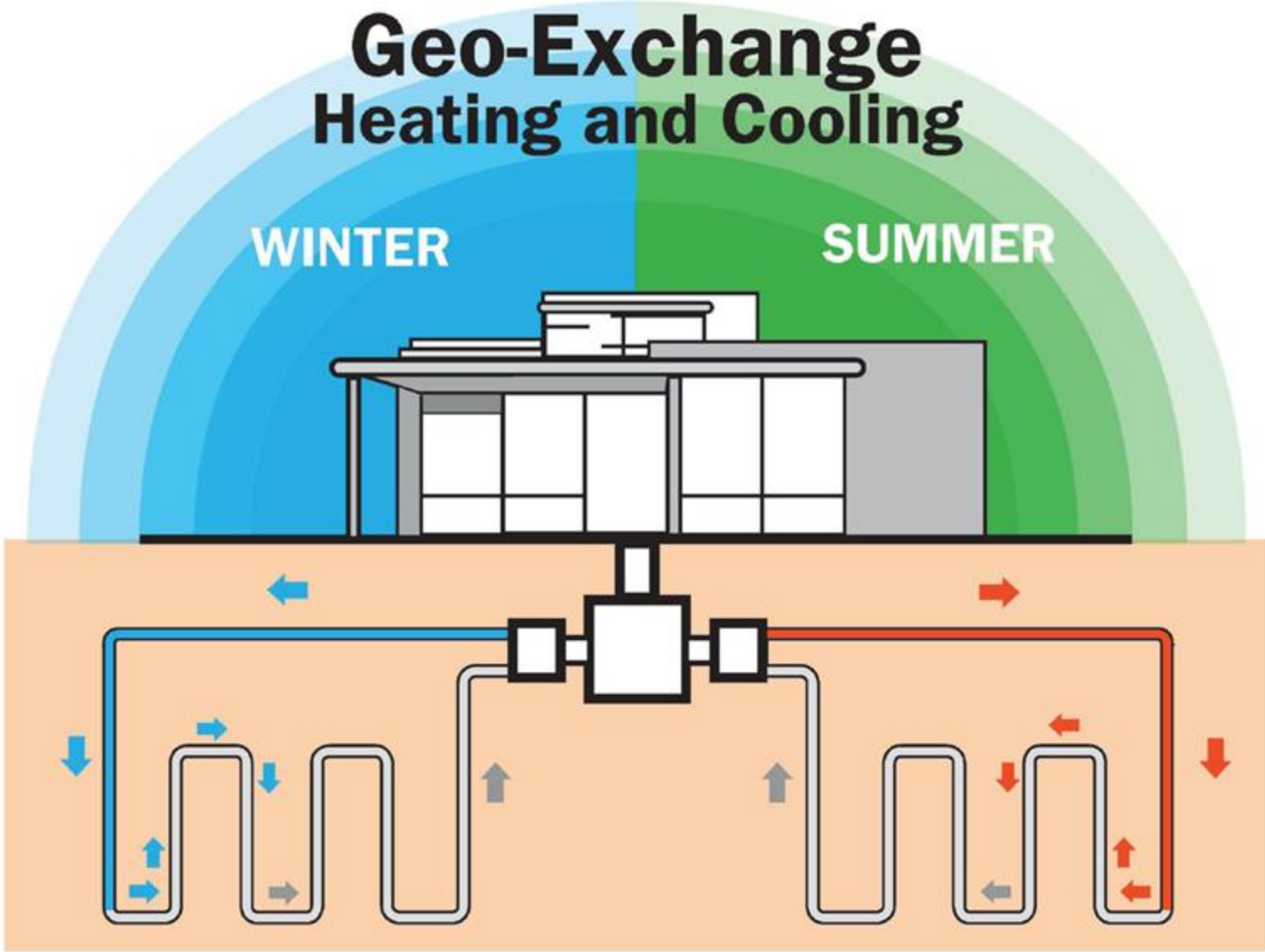
# **Post 2020: 3 HVAC Modes**

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# Simultaneous Heating and Cooling



# Geo-Exchange Heating and Cooling



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# Supplemental Heating and Cooling

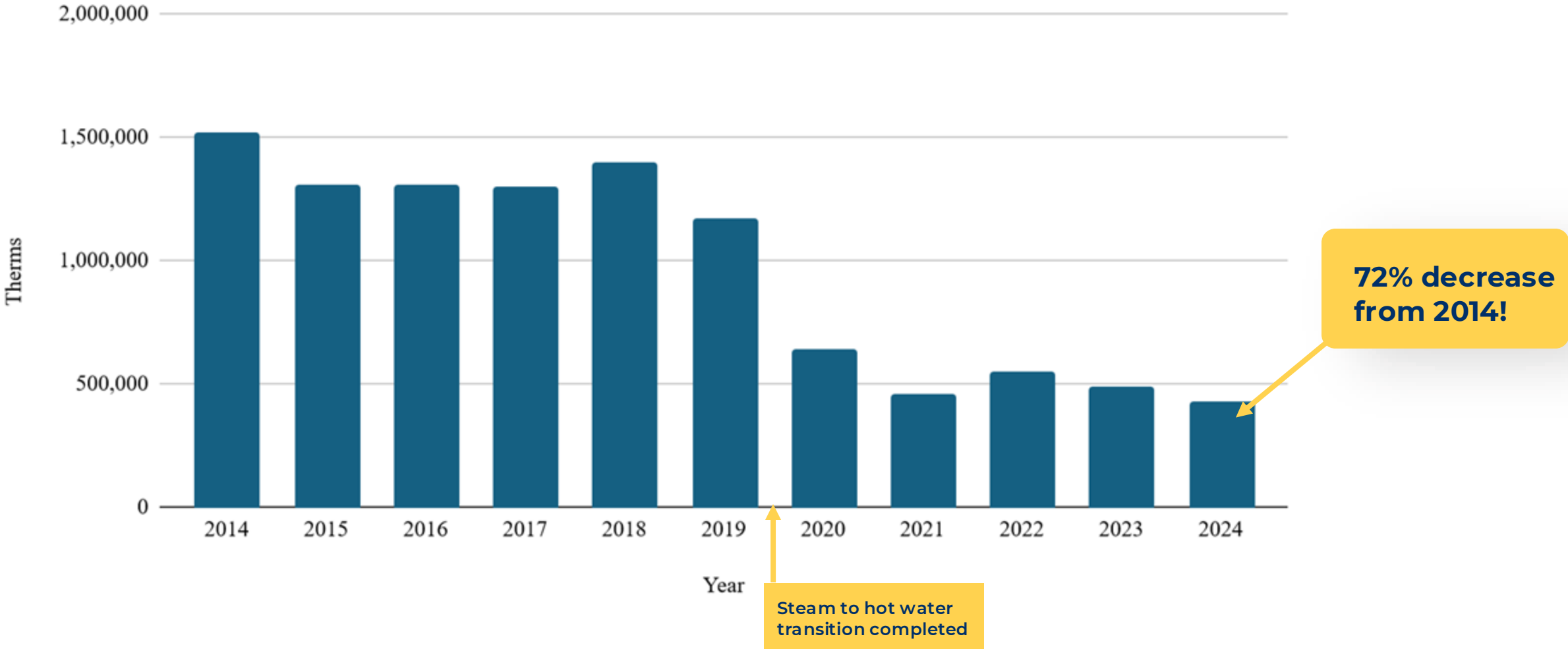


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# **Results: Energy Savings**

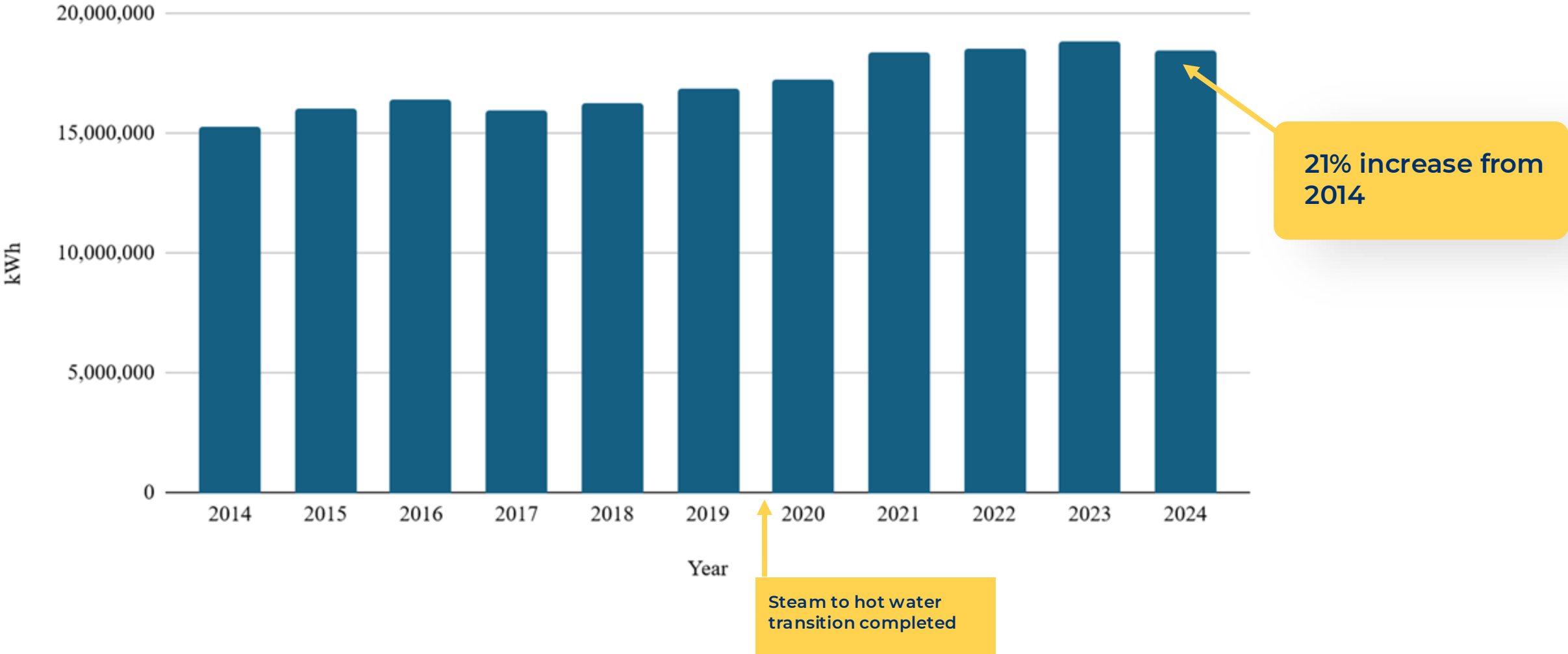
# Carleton

Annual natural gas used on main campus



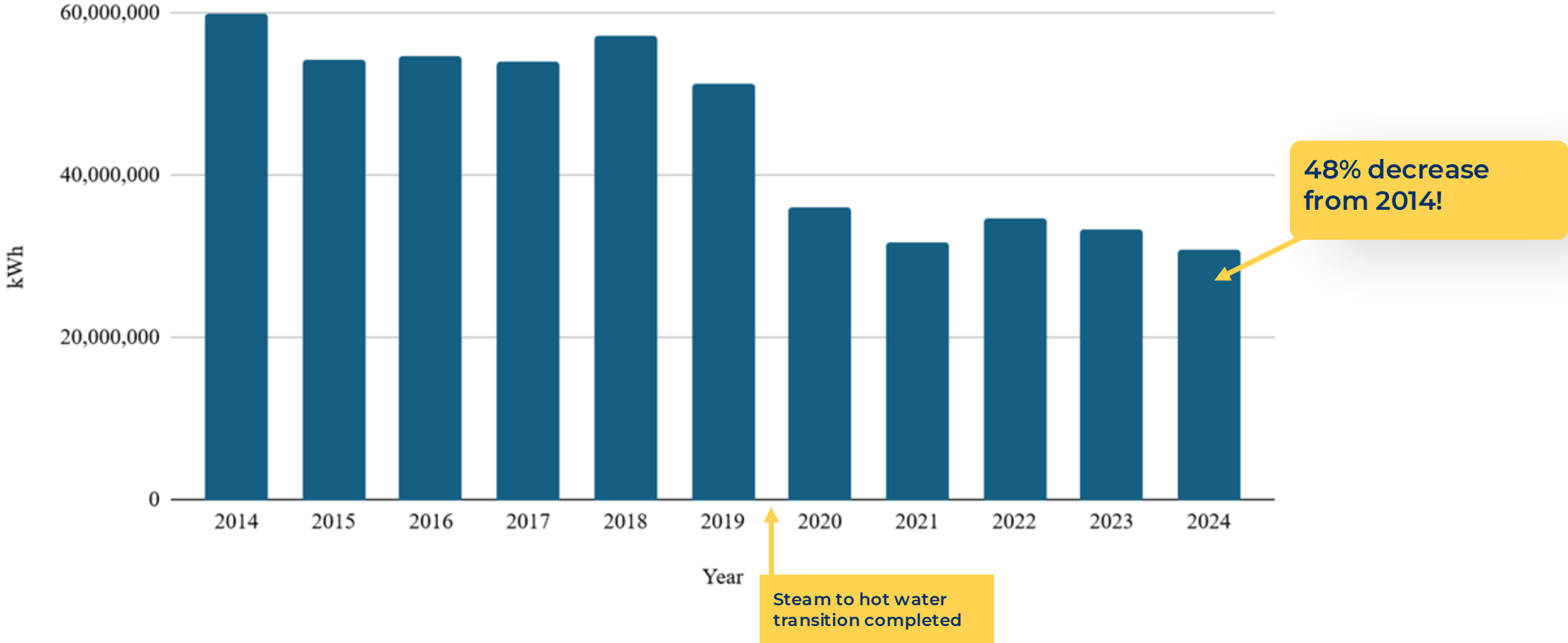
# Carleton

Annual electrical energy used on main campus



# Carleton

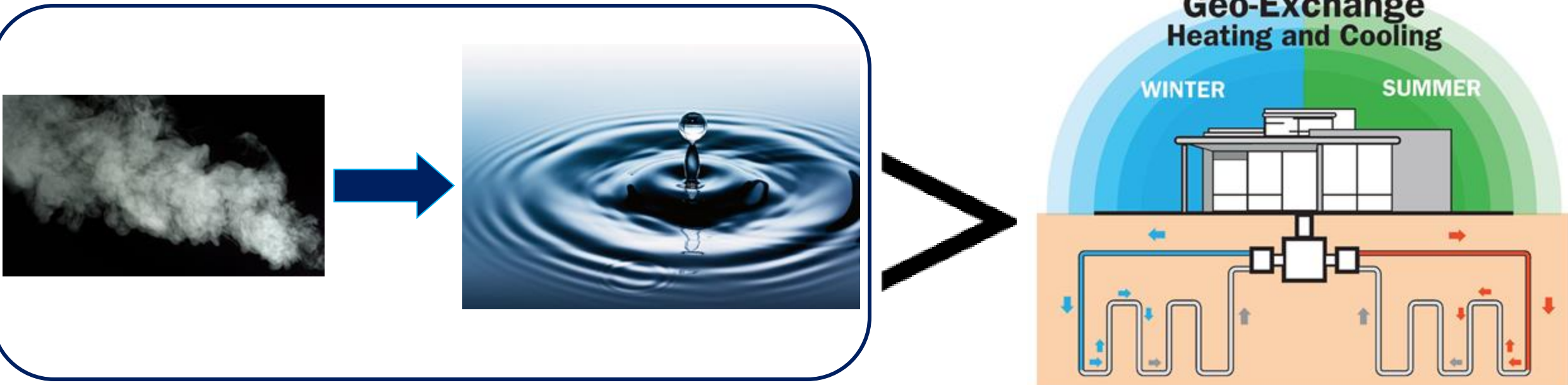
Annual energy used on main campus (electricity and natural gas)



# Key Takeaways

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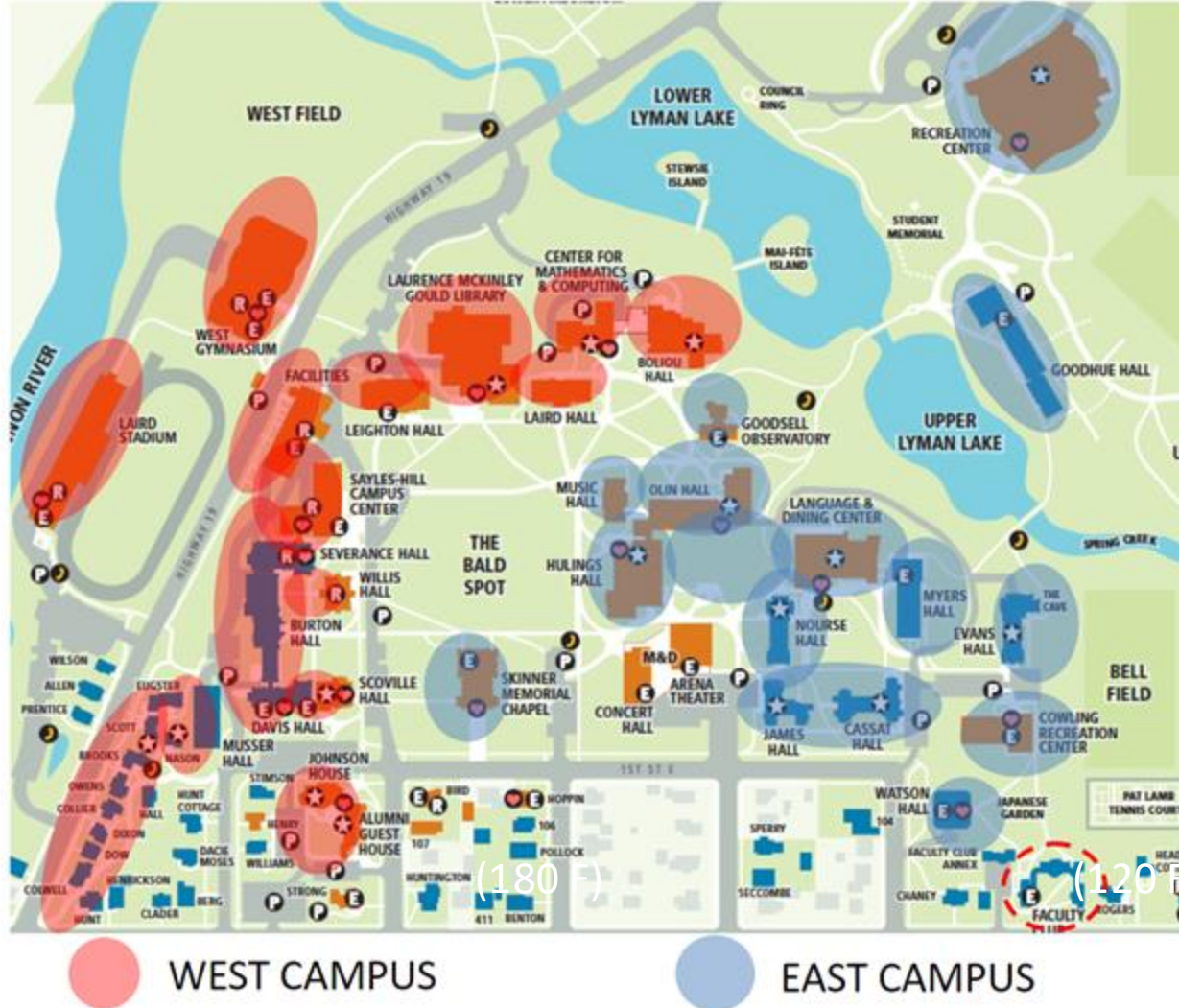
# Prioritize Steam to Hot Water Conversion



# Carleton

## Thoughtful Order for Building HVAC Updates

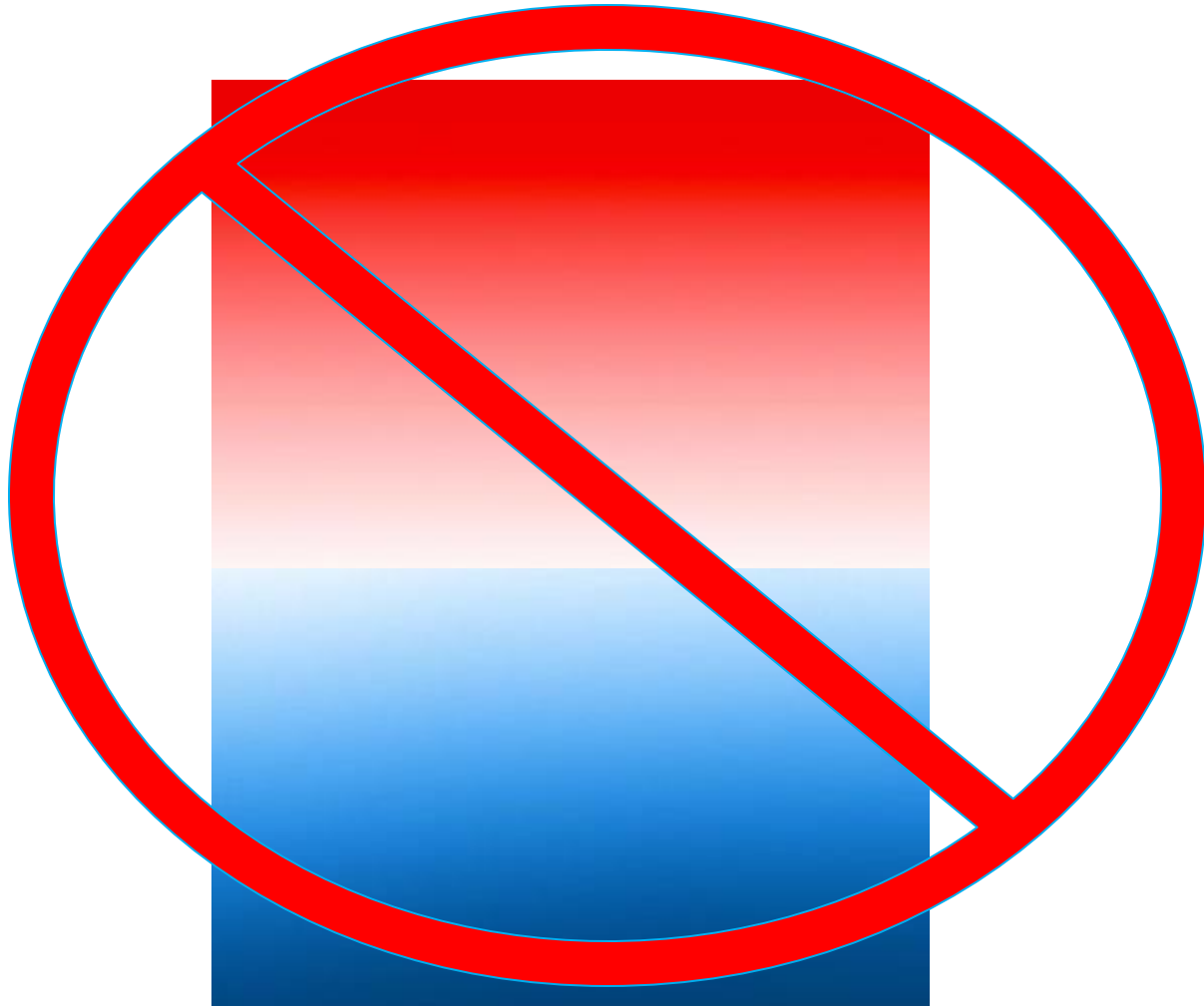
**West Campus** runs on gas boilers at 180°F for 3-4 months (winter only) and the heat pump at 120°F for the rest of the year.



**East Campus** runs on the heat pump at 120°F all year (buildings fully converted for LTHW.)

Carleton

# Thinking of Heat Differently



# Other Sources of Heat



Solar thermal



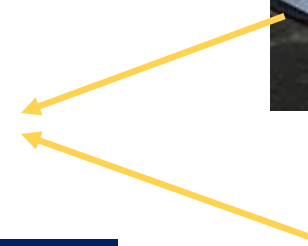
Electric boilers  
(Ideally powered by  
renewable electricity)



Wastewater  
heat recovery



Geothermal  
expansion



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U.S. DEPARTMENT OF ENERGY

Better Buildings Webinars  
**Powering Progress: Strategies for Efficient & Reliable Central Plants**

**Additional Resources**  
Learn more about the topics discussed on the webinar by visiting the resources below.

**Better Buildings Resources**


- [Central Plant Retrofit Working Group Report Out](#)


Explore more resources on the [Better Buildings Solution Center](#)

**Other Resources**


- [Massachusetts Executive Order 594](#)
  - [Executive Order 594 Guideline Documents](#)

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- Better Buildings Solution Center Resources
- Speaker-chosen content
- Accessible now

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# Q & A

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U.S. DEPARTMENT  
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# Additional Questions?

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