BUILDINGENERGY BOSTON

From Building Decarbonization to Campus Decarbonization: Lessons, Pitfalls, Results

Karl Calvo, University of Rhode Island (URI)
Tamar Warburg, Sasaki
Jacob Knowles, Romeo Michael & Tammy Ngo, BR+A

Curated by Scott Greenbaum and Yossi Bronsnick

Northeast Sustainable Energy Association (NESEA) | March 24, 2026

Introduction

Karl Calvo
URI | Associate Vice President, Facilities Group

Tamar Warburg AIA, LEED AP
Sasaki | Director of Sustainability

Jacob Knowles
BR+A | Chief Sustainability Officer

Romeo Michael PE, CEM
BR+A | Senior Associate

Tammy Ngo PE, WELL AP, CPCH
BR+A | Associate

Outline

1. Campus Overview
2. Decarbonization Study Driving Factor
3. Electrification Options
4. Implementation Plan
5. Decarbonization Costs
6. Key Takeaways
7. Q&A

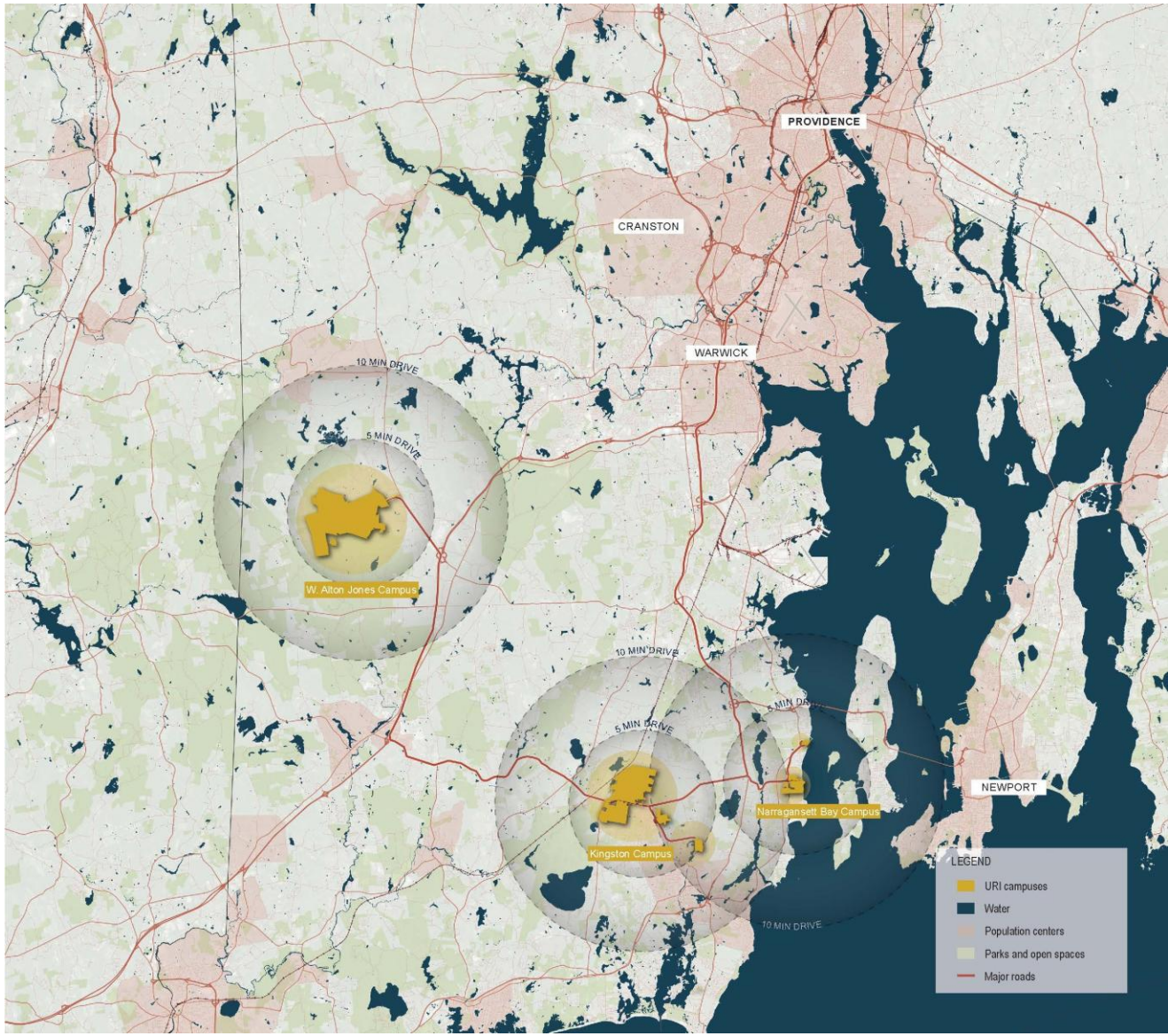
Campus Overview

Campus Statistics

- Founded in 1892
- Public Land and Sea-Grant Institution
- 17,000+ students
- Carnegie R1 research activity
- #1 Public University in New England (WSJ)
- #78 in Best Value Schools (US News)

Three Main Campuses

1. Kingston, 1,245 Acres
2. Narragansett Bay, 153 Acres
3. W. Alton Jones, Providence, 2,300 Acres



Karl

Campus Overview

Kingston (main)

- Central gas-fired steam plant → ~70 buildings
- Natural gas distribution network
- Renewable electricity supply (2024)
- 5 kV campus electric distribution
- Building condition assessments completed

Narragansett Bay

- Natural gas distribution
- Utility renewable electricity supply
- Building condition assessments completed

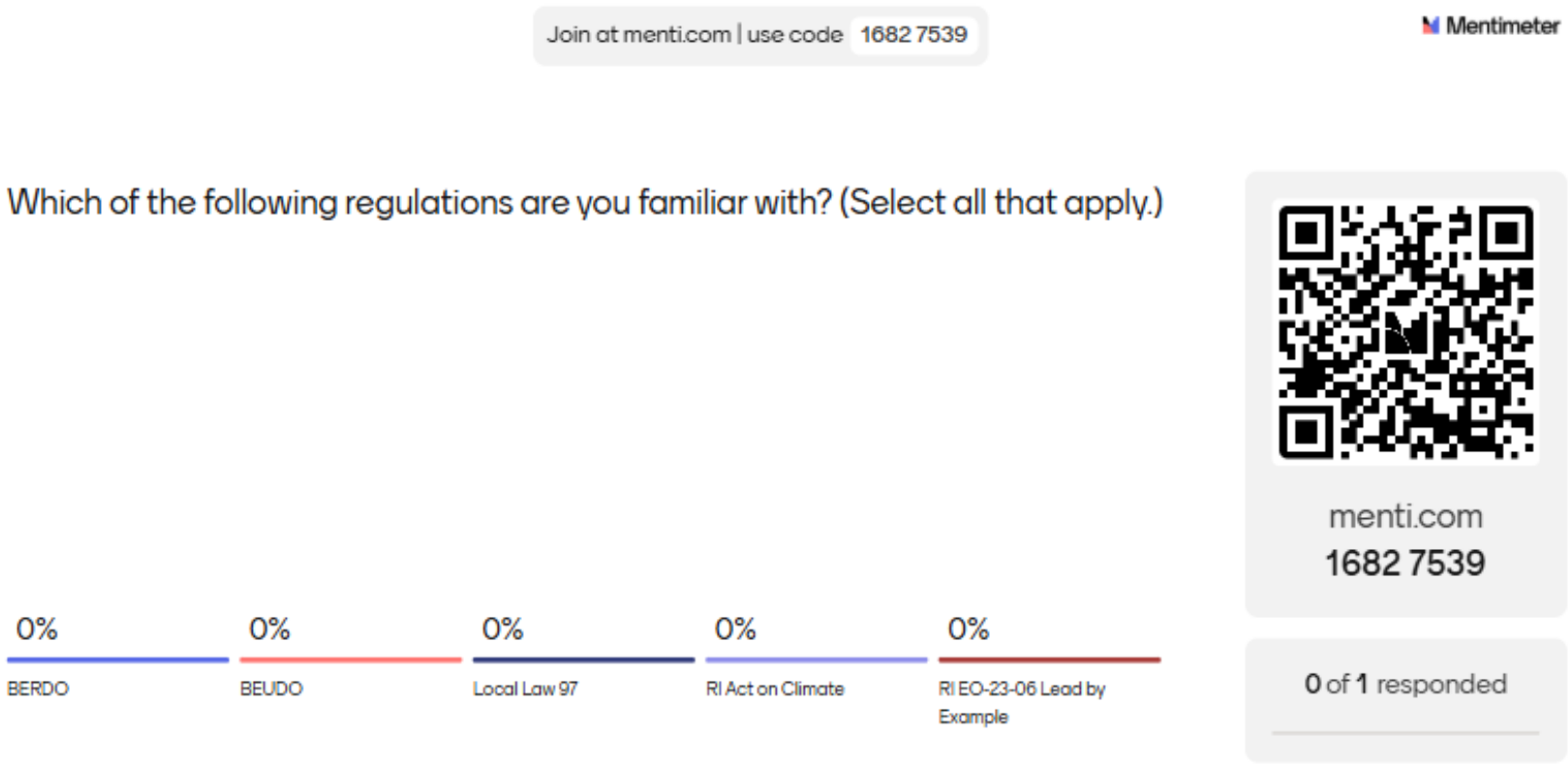
W. Alton Jones

- Not in study scope

Planning & Procurement

- Campus Comprehensive Plan (CCP) and Energy Master Plan (EMP) ran in parallel
- RFP issued; 8 firms responded → shortlist of 3
- Evaluation criteria: technical approach & depth, relevant campus decarb experience, communication/stakeholder engagement, team capacity

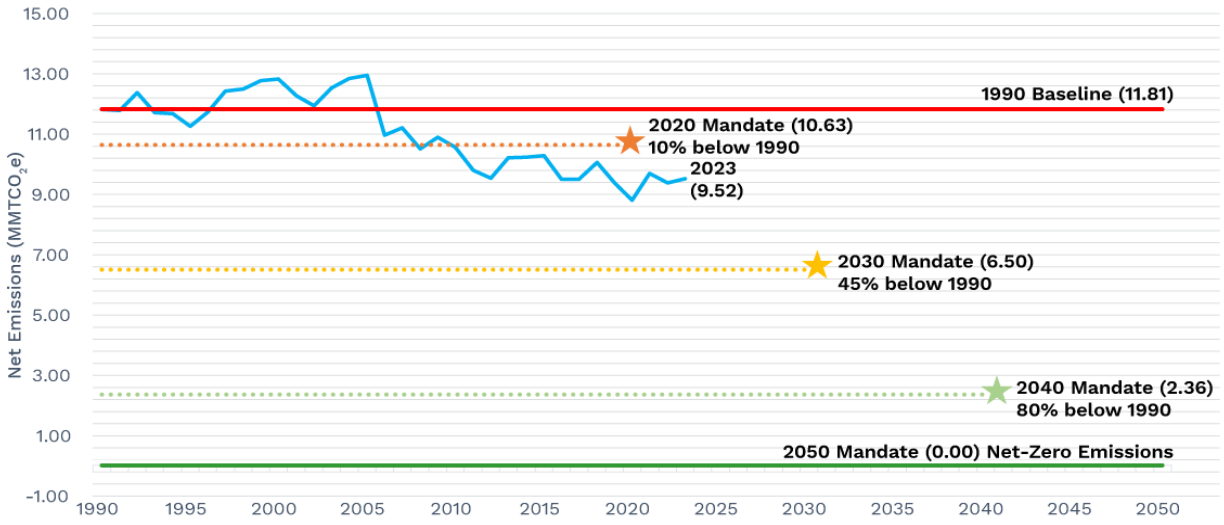
Audience Poll



Decarbonization Study Driving Factor

Rhode Island Regulations:

- 2021 Act on Climate
- The State Agency 'Lead by Example' Energy Program



Other Regulations:

BERDO, Building Emission Reduction and Disclosure Ordinance. Boston, also Newton, BEUDO in Cambridge

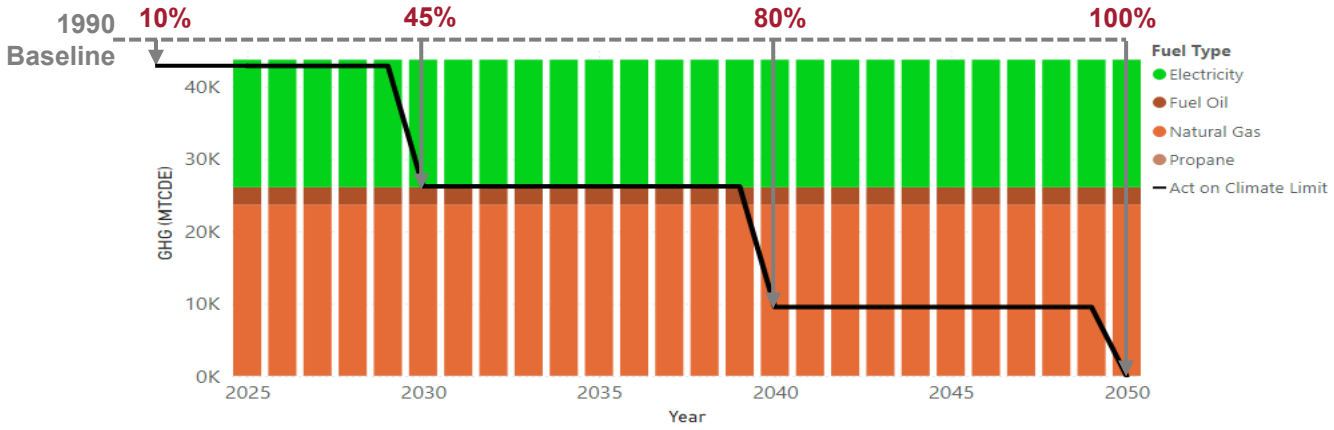
Local Law 97, New York City

PS, Washington DC

Tamar

Regulatory Landscape Findings

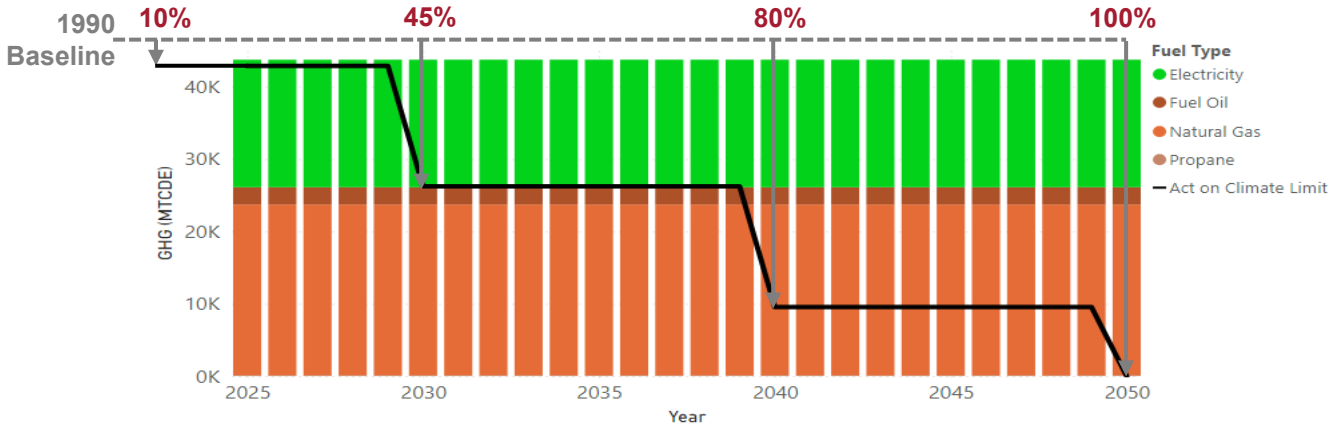
2021 Act on Climate – CO2 Emissions



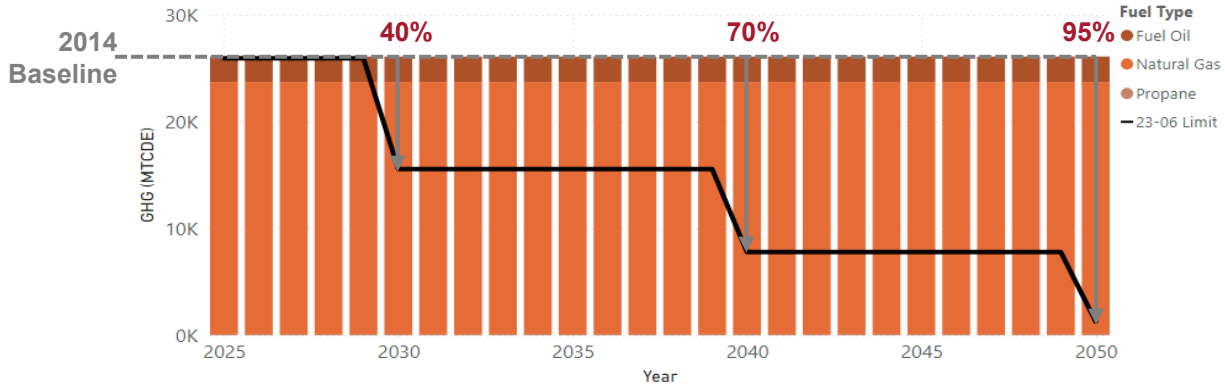
- **Post-2040 Compliance Challenge:**
  By 2040, business-as-usual operations exceed emissions thresholds under the 2021 Act on Climate.

Regulatory Landscape Findings

2021 Act on Climate – CO2 Emissions



Lead by Example for State Agencies – Fossil Fuel CO2 Emissions



- **Post-2040 Compliance Challenge:**
  By 2040, business-as-usual operations exceed emissions thresholds under the 2021 Act on Climate.

- **Post-2030 Compliance Challenge:**
  By 2030, business-as-usual operations exceed emissions thresholds under EO 23-06 (Lead by Example).

Decarbonization Study Driving Factors

Environmental

- Paris Accord
- University Public Perception
- Sustainability
- American College & University Presidents' Climate Commitment (ACUPCC)

Financial

- Utility Incentives
- State Funds
- Federal Funds

Stakeholders and Alignment

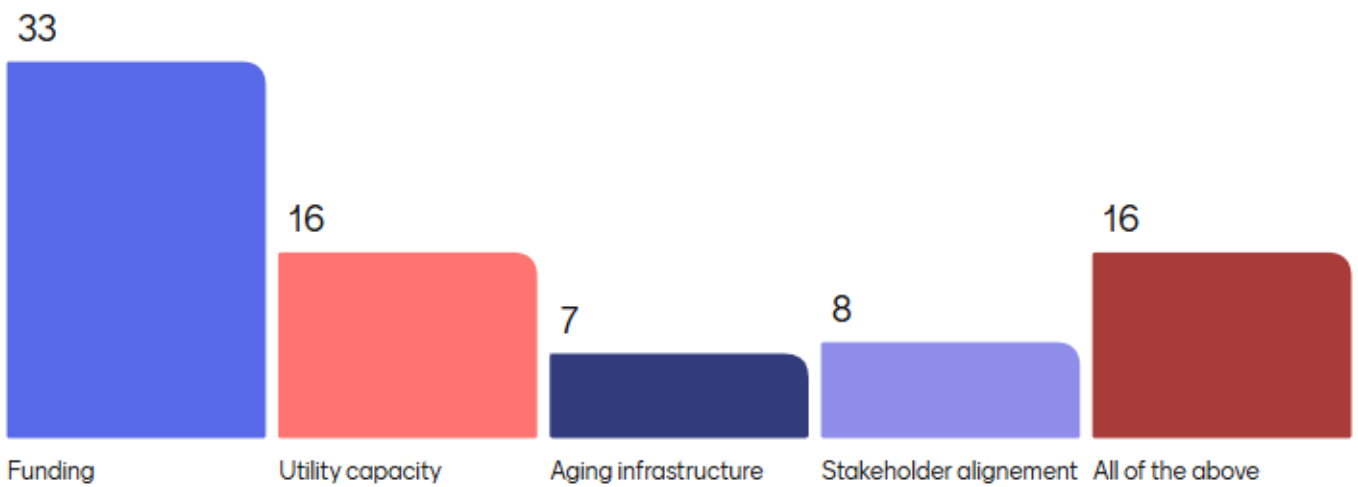
- Alignment with campus comprehensive master plan
- Staff
- Students
- Research staff

RI Regulations

- Act on Climate
  - R.I. Gen. Laws §42-6.2
- Lead by Example Executive Orders
  - EO 23-06

Jacob

Audience Poll



→ Show responses

Mentimeter

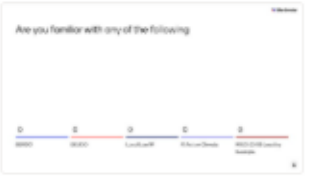
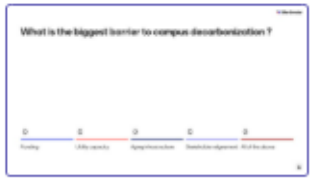
Menti
NESEA Presentation

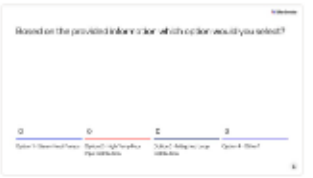
menti.com
5750 6353

56 of 86 responded

Responses are hidden

Select which slide to add

Romeo

Decarbonization Study Approach

Goal Setting
- Convene a stakeholder group: set goals, build consensus, and open lines of communication
- Climate and energy regulatory review

Existing Conditions Analysis
- Discovery Phase: Deep dive with an energy lens
- What are your urgent needs and priorities? What have you done already? Where are you going?

Baseline Scenario
- Business as Usual = summarize Facilities existing condition and emissions + expected growth and change
- Calibrated models inform energy demands, GHG, and CapEx / OpEx projections

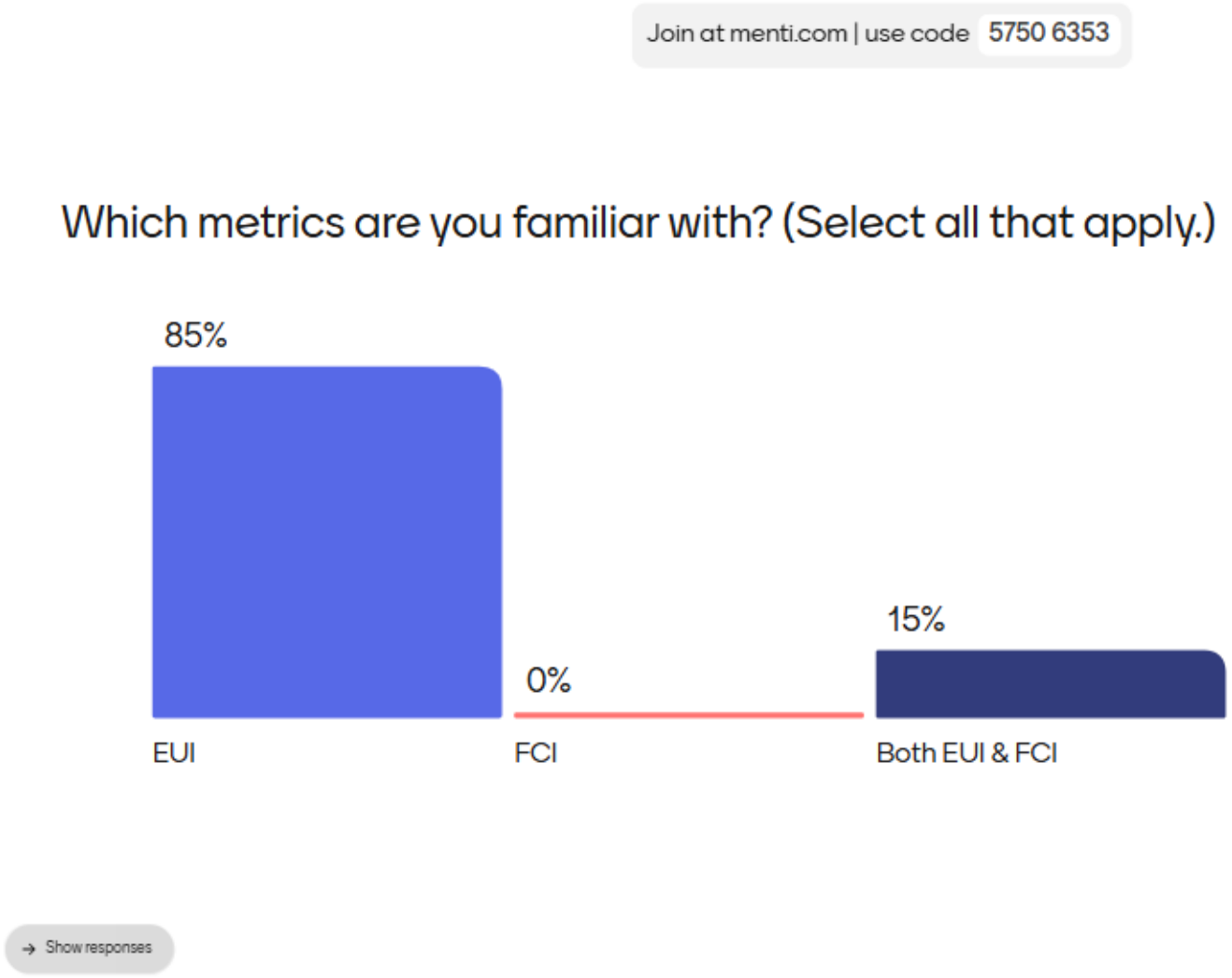
Decarbonization Analysis
- **Early Recommendations:** Pick low hanging fruit and capitalize on current plans

Opportunities and Challenges
- Align decarb with other campus needs and constraints.
- Reduce GHG emissions over 25 years

Alternative Scenarios: Holistic solutions for building efficiency and energy supply
- Focus on cost-effectiveness and fossil fuel reduction
- Visualize results and empower confident decision-making

Decarbonization and Resilience Plan: Expand to an actionable plan
- Specify physical infrastructure
- Meet campus' expansion, reliability, cost and sustainability objectives
- Communicate and educate!

Audience Poll



FCI Definition

$$FCI = \frac{\text{Backlog}}{\text{Replacement Value}}$$


10-Yr FCI
Bio & Rest. Ecology Res.
Gardener Res.
Skogley Res. Center
Central Rec.
Dining Services
Accounting
Garage
Sherman
Admin.
Housing Maint.
Brookside
Garrahy
Wiley
Heathman
Social Science Res. Center
White
Beaupre Center
Cener for Biotech & L.S.
Coastal Institute
Eldred Farm Cottages
Greenhouses
Chafee
Avedisian
Woodward
Tyler
Rodman
Rodmann
Ryan Center
Burnside
Coddington
Aldrich
Fascitelli Fitness
Merrow
Tucker
Watson
Mainfare
Carothers Library
Heating Plant
Ballentine
Taft
Lippitt
Fascitelli Adv., Eng.
Kirk Applied Eng. Lab
Fine Arts Center
Bliss
University Club
Kingston Fire
Tootell Aquatic
Door
Ellery
Gotham
Hopkins
Keaney Gym
Mackal Field House
Faverweather
Potter Health Services
Peck
Hutchinson
Roosevelt
Davis
East
HR
Carlotti Admin.
Washburn
Tucker
Multicultural Ctr.
Eddy
Browning
Butterfield
Res
Quinn
Ranger
Edwards Auditorium
Adams
URI Foundation
Alumni Center
Memorial Union
Pastore
Green
Swan
IEP
IEP II
Boss Ice Arena
Independence Square II
Adams
Bressler
Morrill
Weldin
Barlow
Hillside
Christopher
Fogarty
President's House
Welcome Center
Chabad
Int. Student Center
URI Police
Greek Life
Hart
Graduate Village Apt.
Child Dev. Center
Peckham Farm
Women's Center
Gender Studies Center
Transition Center
Newman
University Gateway Apt.
Good (0.00 - 0.05)
Fair (0.06 - 0.10)
Poor (0.11-0.30)
Critical (0.31 -050)
Divest (0.51-1.0)
Data not available

Tamar


EUI
Bio & Rest. Ecology Res.
Gardener Res.
Skogley Res. Center
Central Rec.
Dining Services
Accounting
Garage
Sherman
Admin
Housing Maint.
Brookside
Garrahy
Wiley
Heathman
White
Social Science Res. Center
Center for Biotech & L.S.
Beaupre Center
Coastal Institute
Chafee
Avedisian
Woodward
Tyler
Greenhouses
Eldred Farm Cottages
Rodman
Rodmann
Burnside
Ryan Center
Coddington
Aldrich
Fascitelli Fitness
Merrow
Tucker
Watson
Mainfare
Carothers Library
Heating Plant
Ballentine
Taft
Lippitt
Bliss
Fascitelli Adv. Eng.
Kirk Applied Eng. Lab
Fine Arts Center
University Club
Kingston Fire
Tootell Aquatic
Keaney Gym
Mackal Field House
Boss Ice Arena
Independence Square II
Beer
Ellery
Hopkins
Gotham
Fayerweather
Potter Health Services
Peck
Hutchinson
Roosevelt
HR
Carlotti Admin.
Davis
East
Washburn
Tucker
Multicultural Ctr.
Eddy
Browning
Butterfield
Res
Quinn
Ranger
Edwards Auditorium
Adams
URI Foundation
Alumni Center
Memorial Union
Pastore
Green
Swan
IEP
IEP II
Morrill
Adams
Bressler
Welcome Center
Welcin
Barlow
Hillside
Christopher
Fogarty
President's House
Chabad
Int. Student Center
URI Police
Greek Life
Hart
Graduate Village Apt.
Peckham Farm
Child Dev. Center
Women's Center
Gender Studies Center
Transition Center
Newman
University Gateway Apt.
Best: Significantly lower EUI than building type campus average
Better than building type campus average
Near building type campus average
Worse than building type campus average
Significantly worse than building type campus average
Data not available
Tamar

FCI & EUI Combined Score

Tamar

Proposed Framework

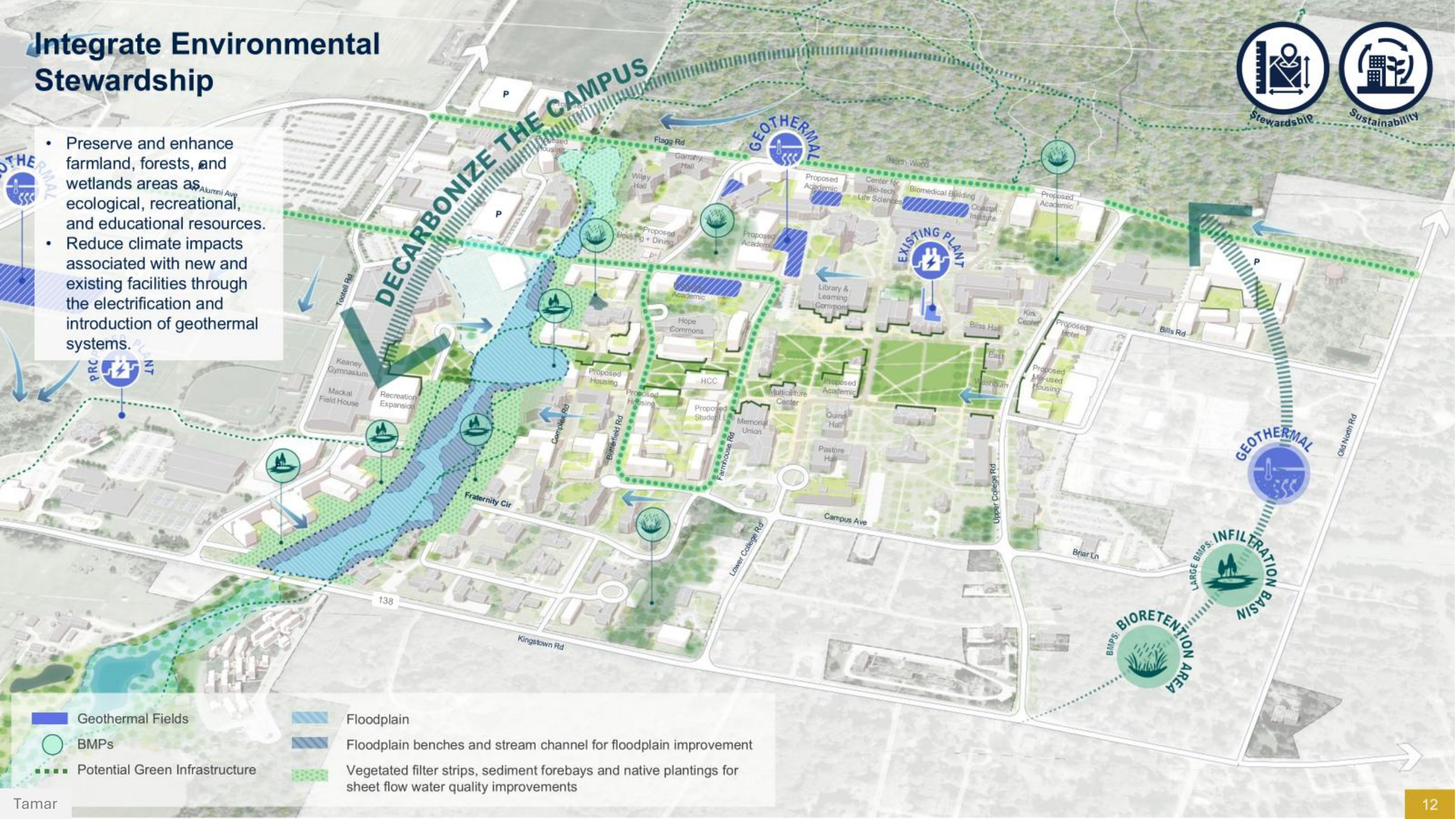
Long Term

- Proposed renovations and the development of new academic facilities ensure quality spaces for learning and opportunities for growth in response to emerging programmatic needs.
- Investments in student housing, recreation, campus life facilities, and a campus hotel contribute to a dynamic environment for students, faculty, and staff.
- A new campus greenway, expanded Ellery Pond, and the pedestrianization of many internal campus streets stitch together the campus, creating a space for community and connections to the natural landscape.

Proposed New Development
Proposed Renovations
Existing Buildings to Remain

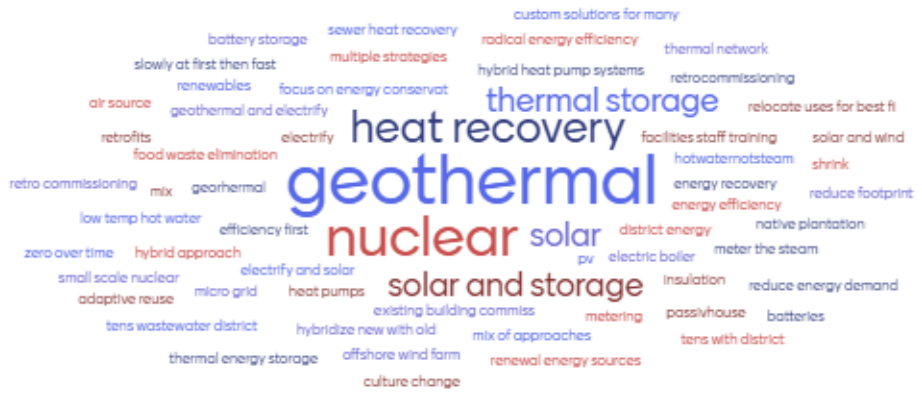
Integrate Environmental Stewardship

- Preserve and enhance farmland, forests, and wetlands areas as ecological, recreational, and educational resources.
- Reduce climate impacts associated with new and existing facilities through the electrification and introduction of geothermal systems.



Audience Poll

How would you decarbonize this campus?



→ Show responses

Mentimeter

Menti

NESEA Presentation

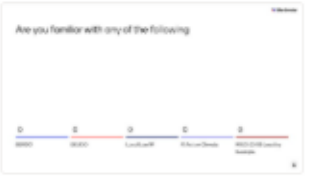
menti.com

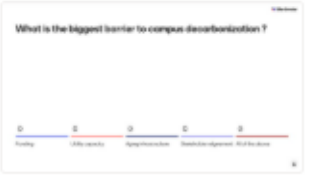
5750 6353

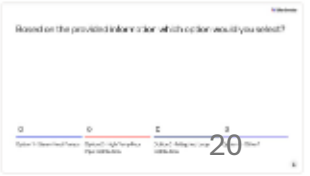
46 of 86 responded

Responses are hidden

Select which slide to add





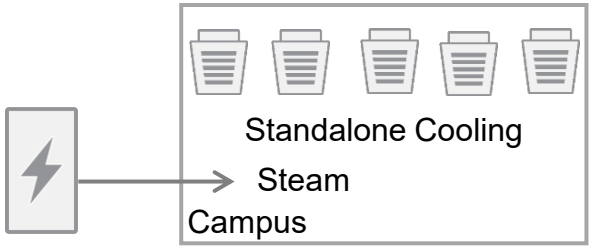


Romeo

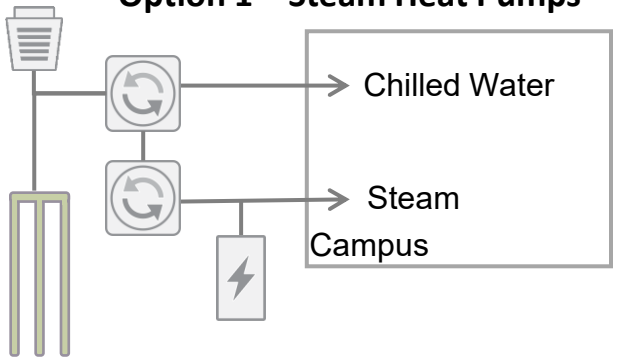
Decarbonization Analysis

Electrification Options

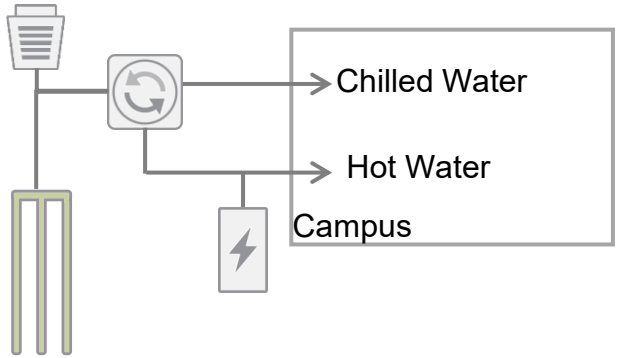
Electric Base – Central Electric Boilers



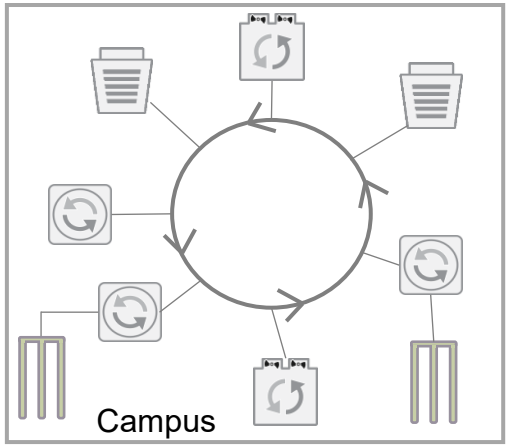
Option 1 – Steam Heat Pumps



Option 2 – Four Pipe HW and CHW Distribution

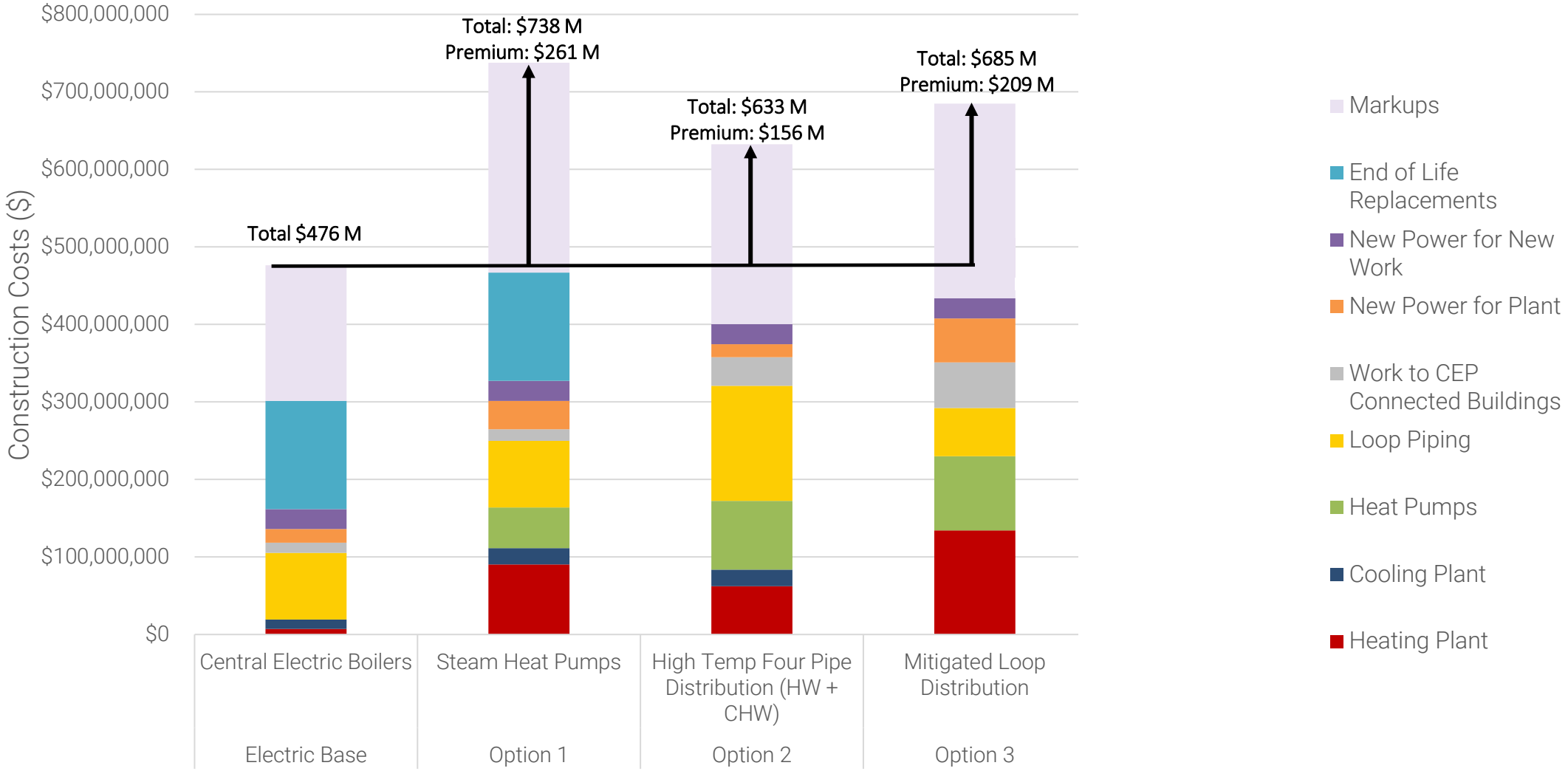


Option 3 – Mitigated Loop Distribution



Decarbonization Analysis

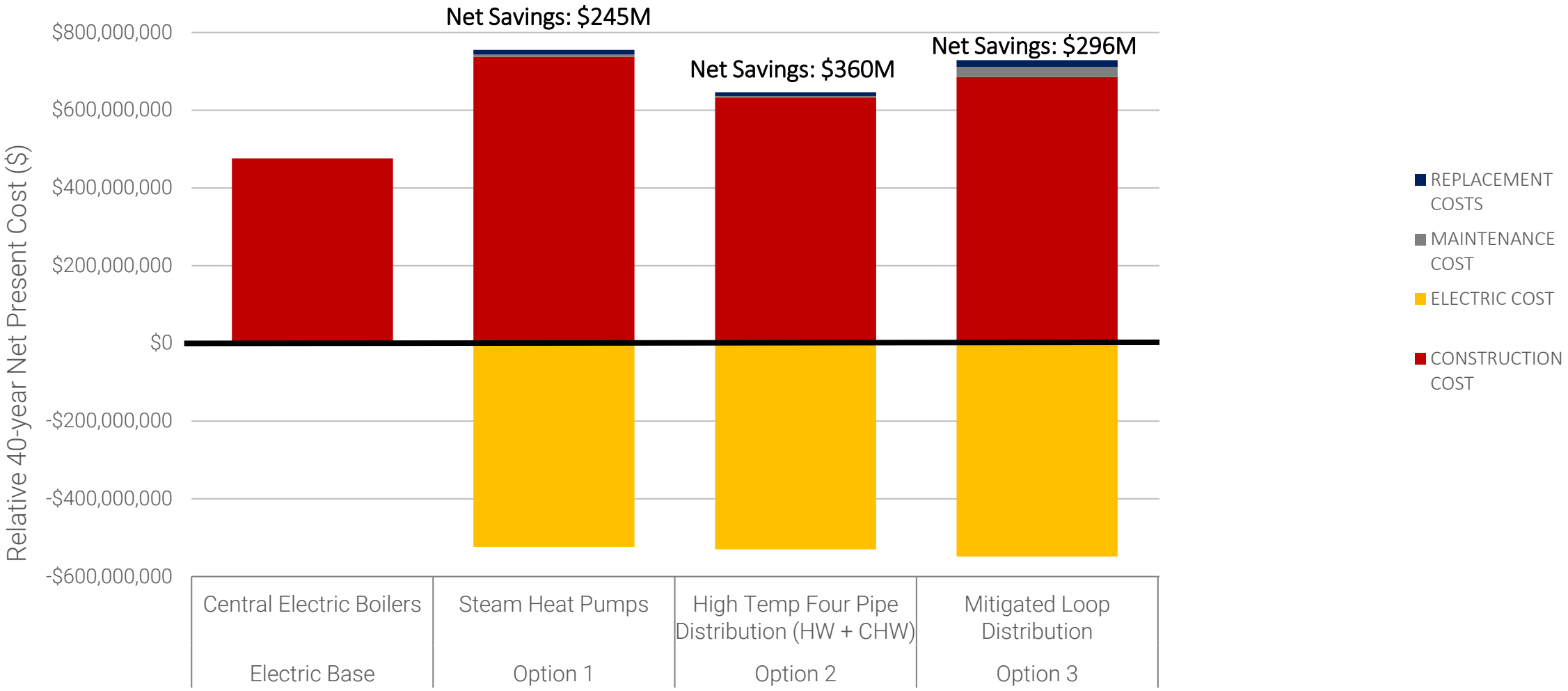
Construction Costs



** The construction cost is expressed in 2025 dollars.*

Decarbonization Analysis

Life Cycle Cost Analysis

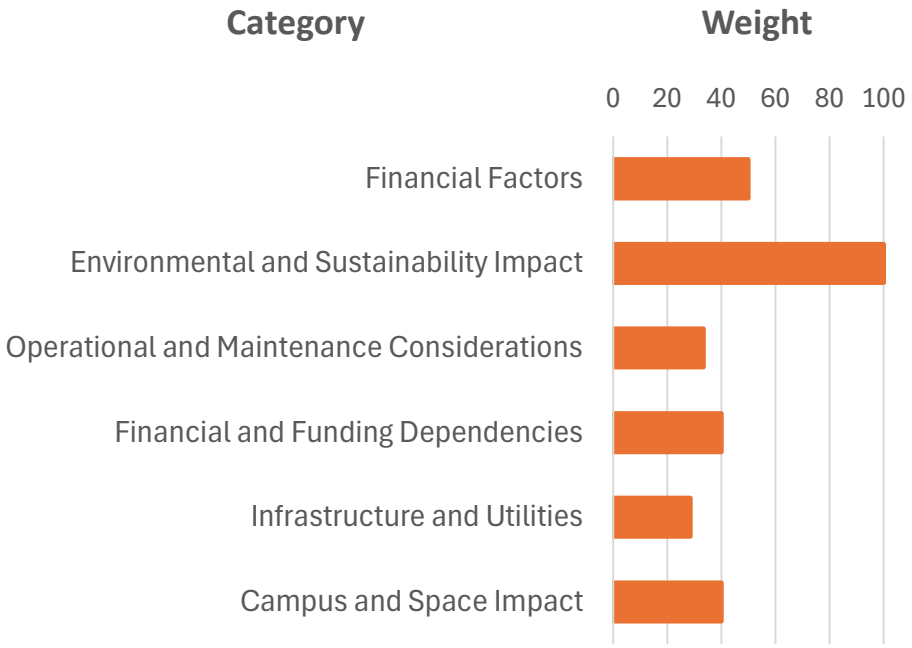


** Cost estimates reflect only the variable costs impacted by decarbonization options.*

*** 40-year net present cost, consistent with standard industry practice for lifecycle cost analysis.*

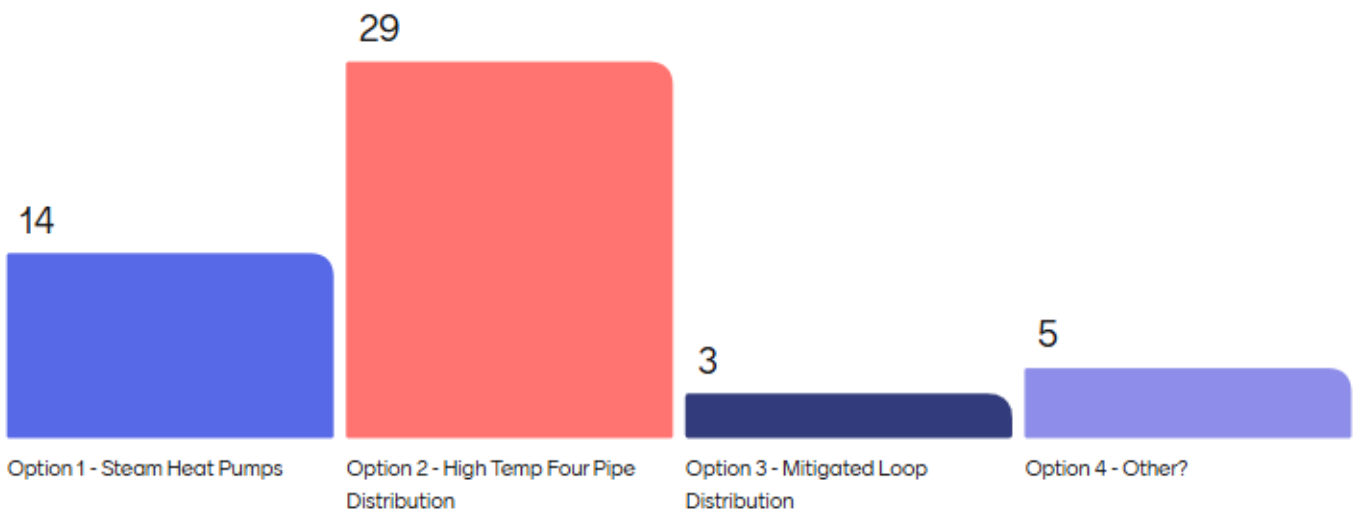
Decarbonization Analysis

Evaluation Criteria Matrix



Option / Weighed Score	Electric Base Central Electric Boilers	Option 1 Steam Heat Pumps	Option 2 Four Pipe HW and CHW Distribution	Option 3 Mitigated Loop Distribution
Financial Factors	3.5	6.2	7.5	6.7
Environmental and Sustainability Impact	10.6	12.7	13.9	15.3
Operational and Maintenance Considerations	4.7	2.9	4.2	3.2
Financial and Funding Dependencies	6.4	5.5	1.8	4.1
Infrastructure and Utilities	3.3	3.2	3.1	2.3
Campus and Space Impact	6.9	5.1	4.3	1.4
TOTAL Score	**35.36**	**35.54**	**34.79**	**32.96**

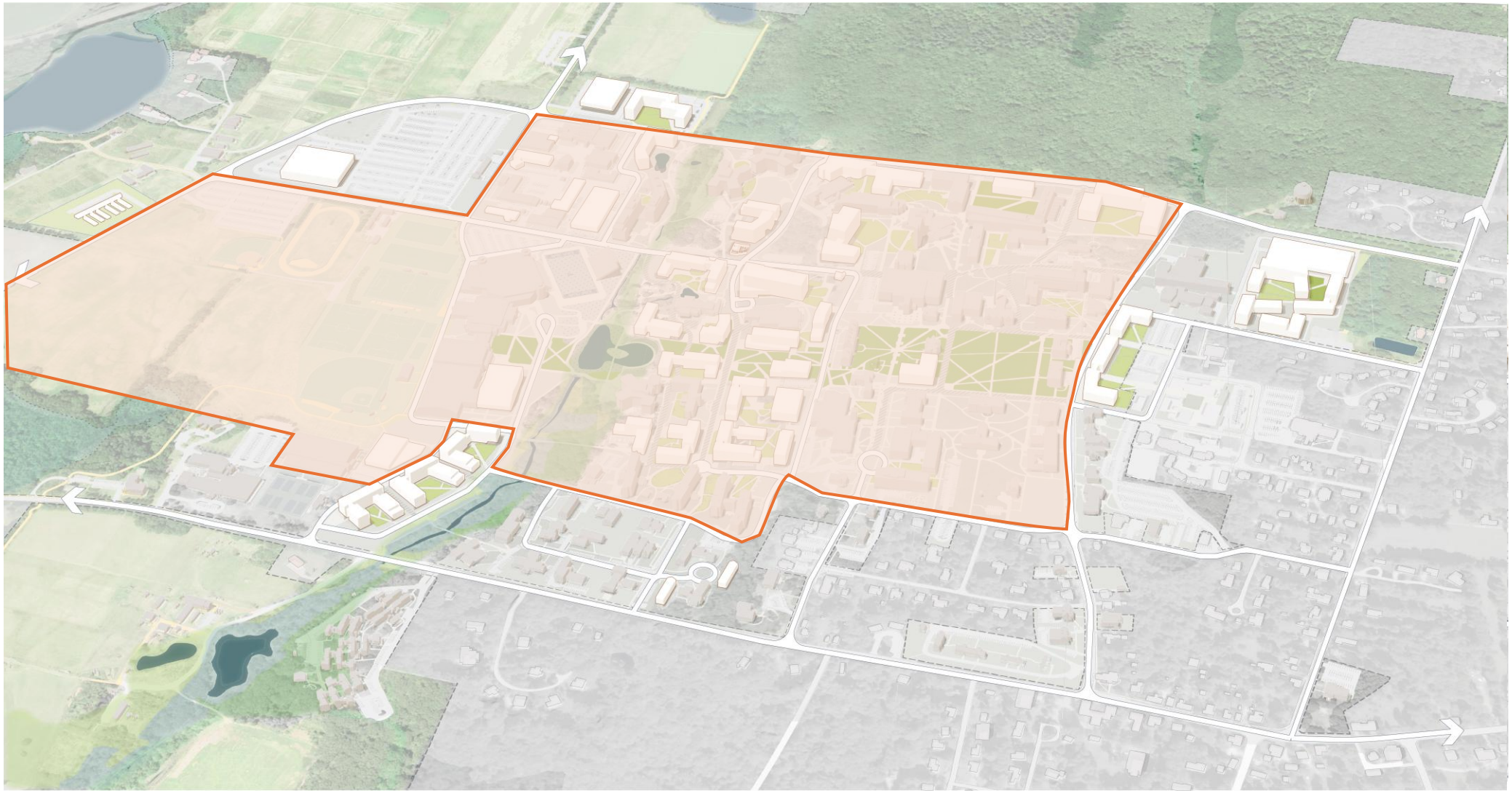
Audience Poll



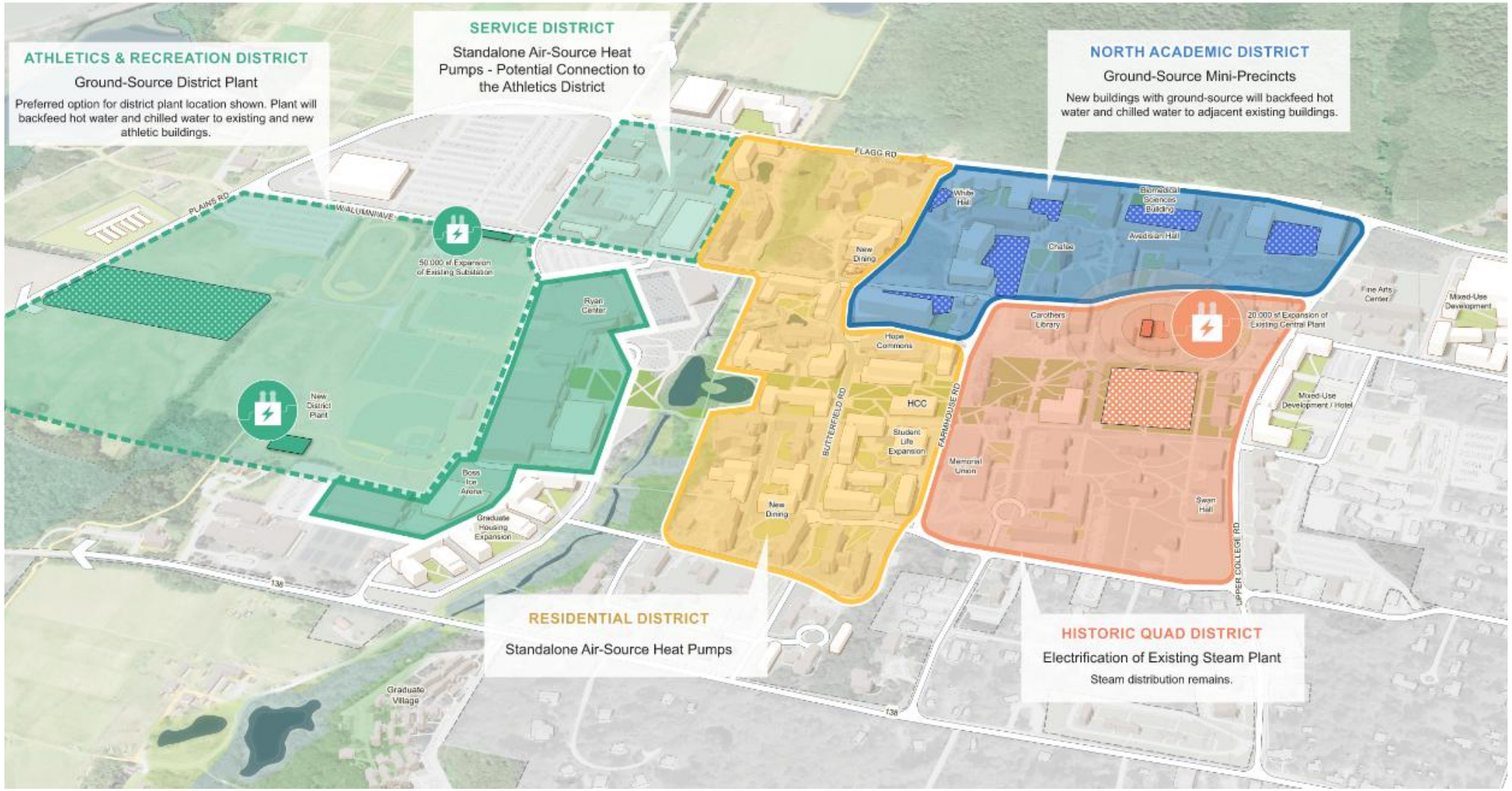
→ Show responses

Romeo

Implementation Plan: Which Option?

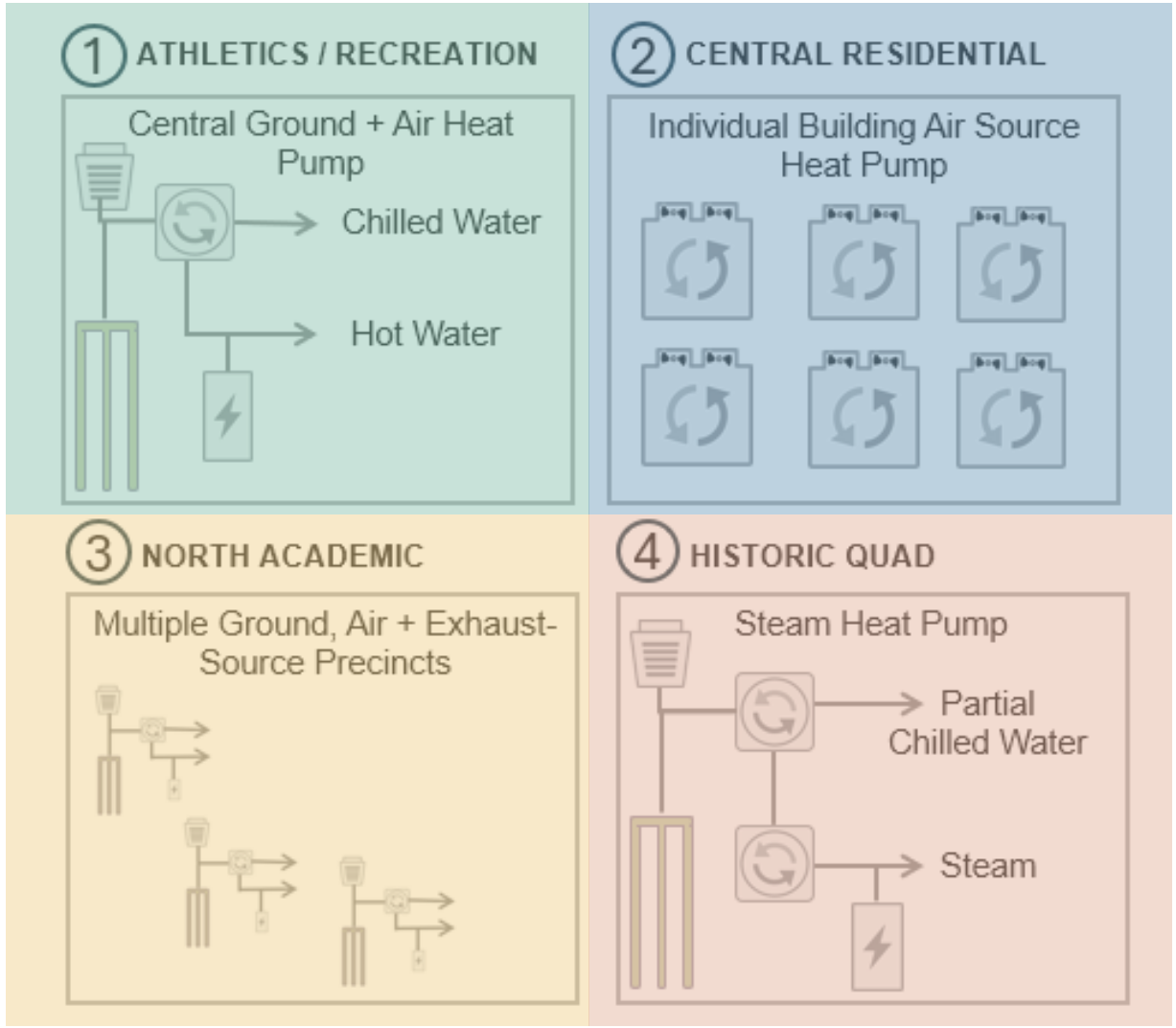


Implementation Plan: District Approach



Decarbonization Analysis

Option 4 – District Approach



Audience Poll

Why a hybrid approach made more sense?

→ Show responses

Mentimeter

Menti

NESEA Presentation

Select which slide to add

menti.com

5750 6353

45 of 86 responded

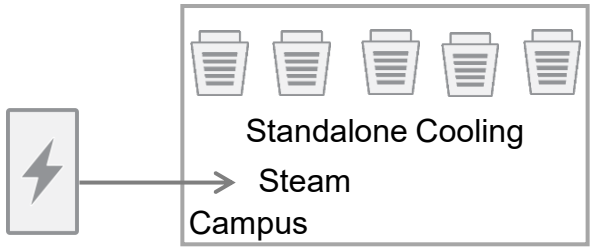
Responses are hidden

Romeo

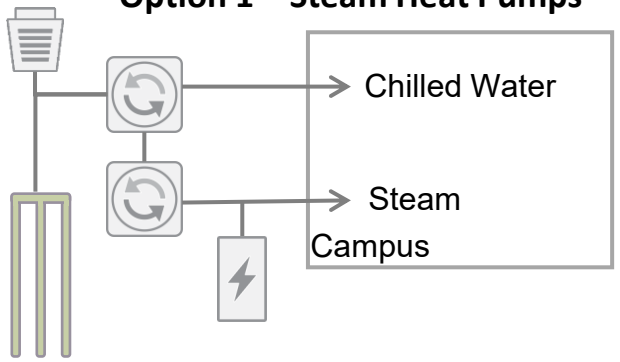
Decarbonization Analysis

Electrification Options

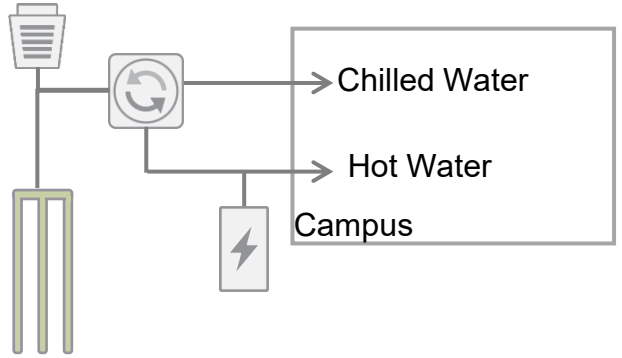
Electric Base – Central Electric Boilers



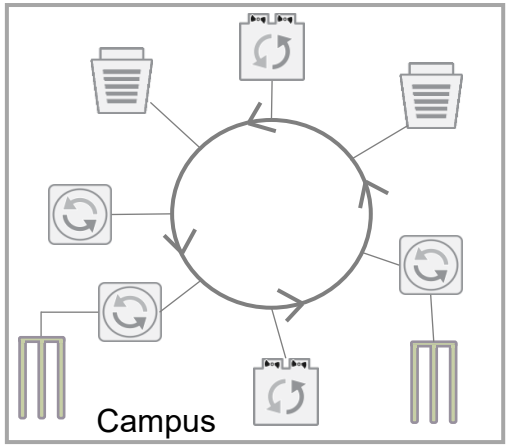
Option 1 – Steam Heat Pumps



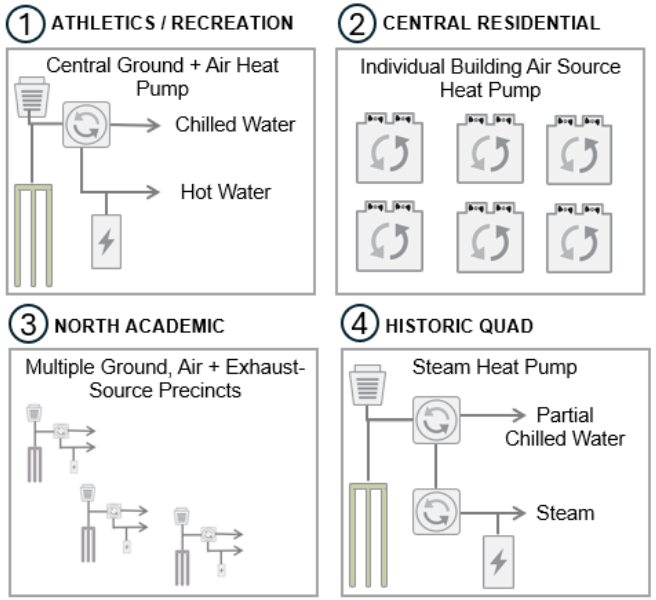
Option 2 – Four Pipe HW and CHW Distribution



Option 3 – Mitigated Loop Distribution

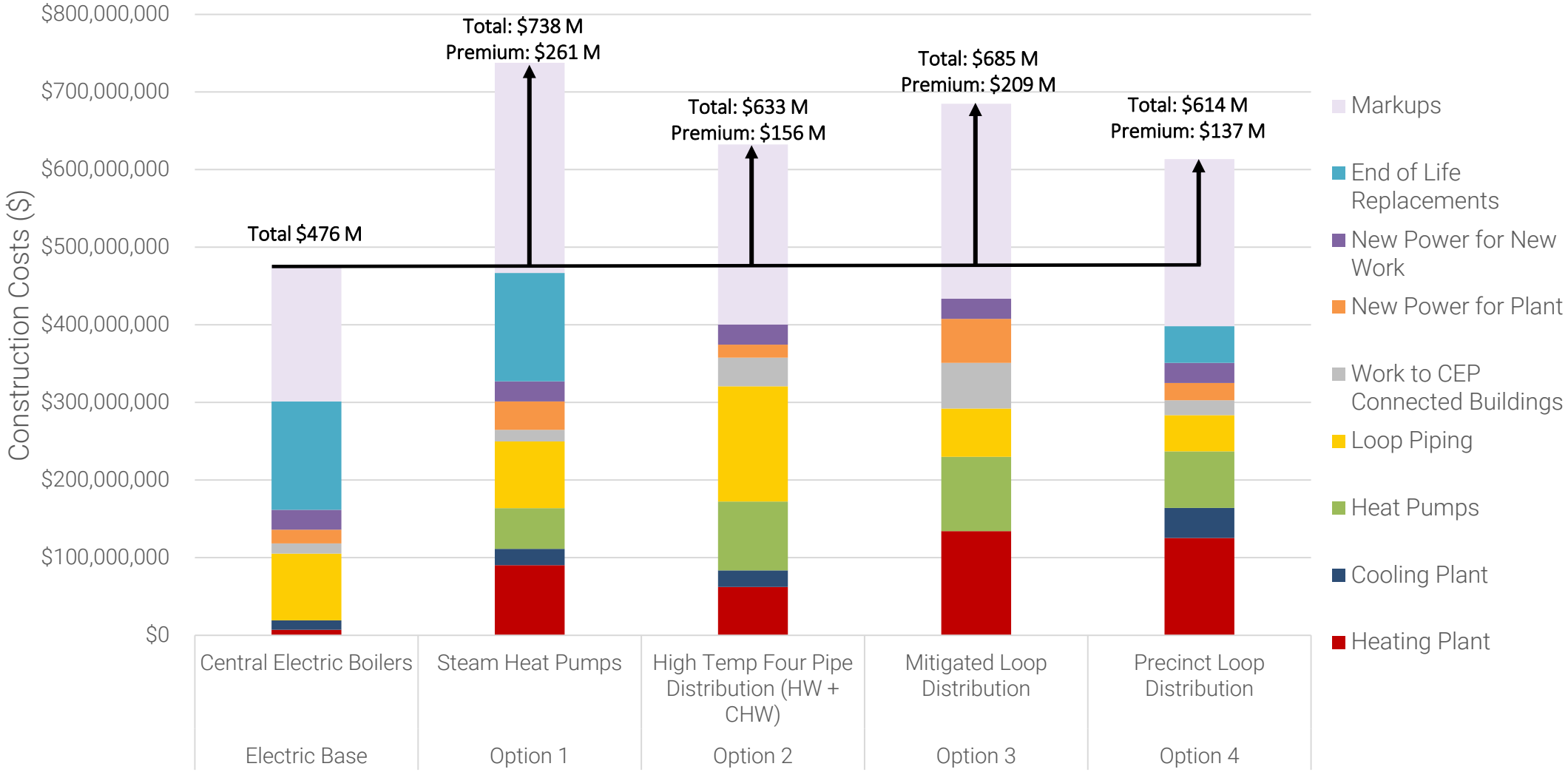


Option 4 – District Approach



Decarbonization Analysis

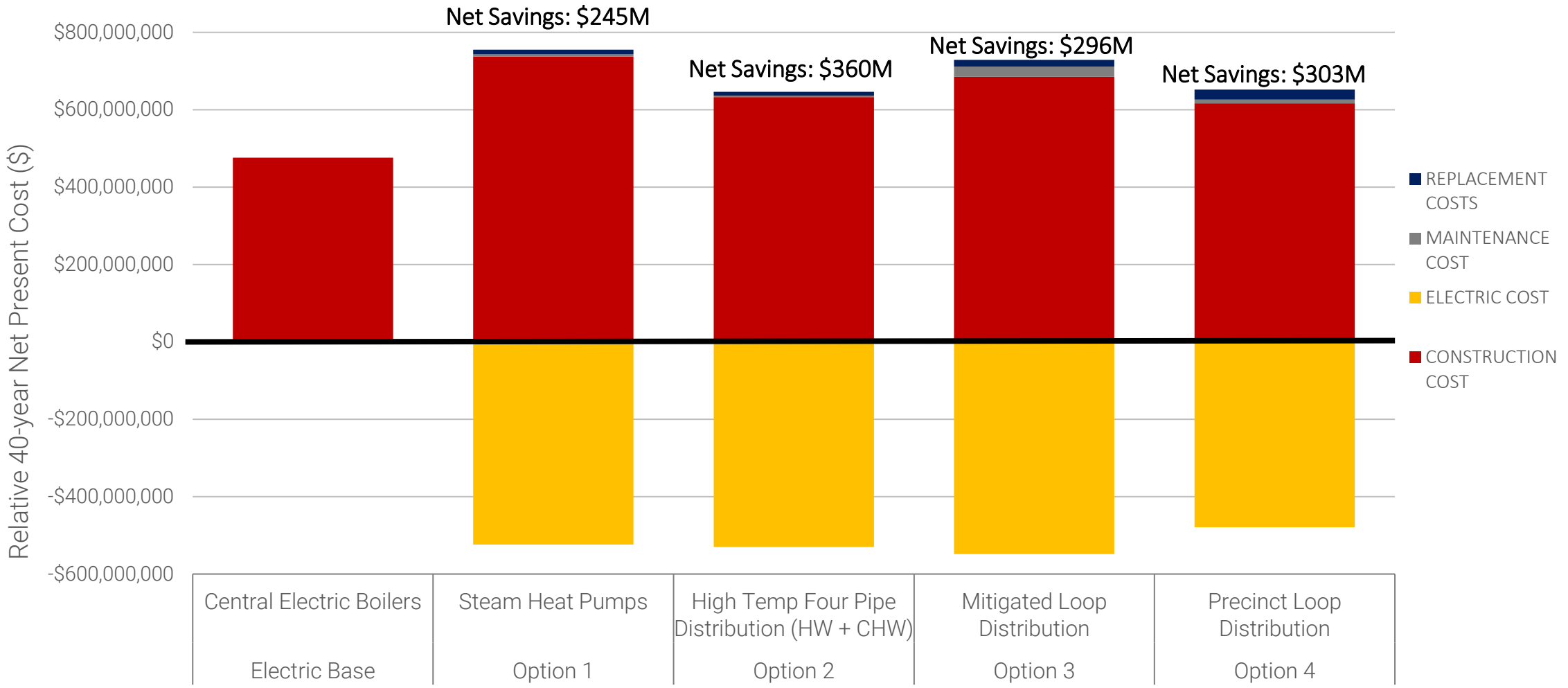
Construction Costs



* *The construction cost is expressed in 2025 dollars.*

Decarbonization Analysis

Life Cycle Cost Analysis

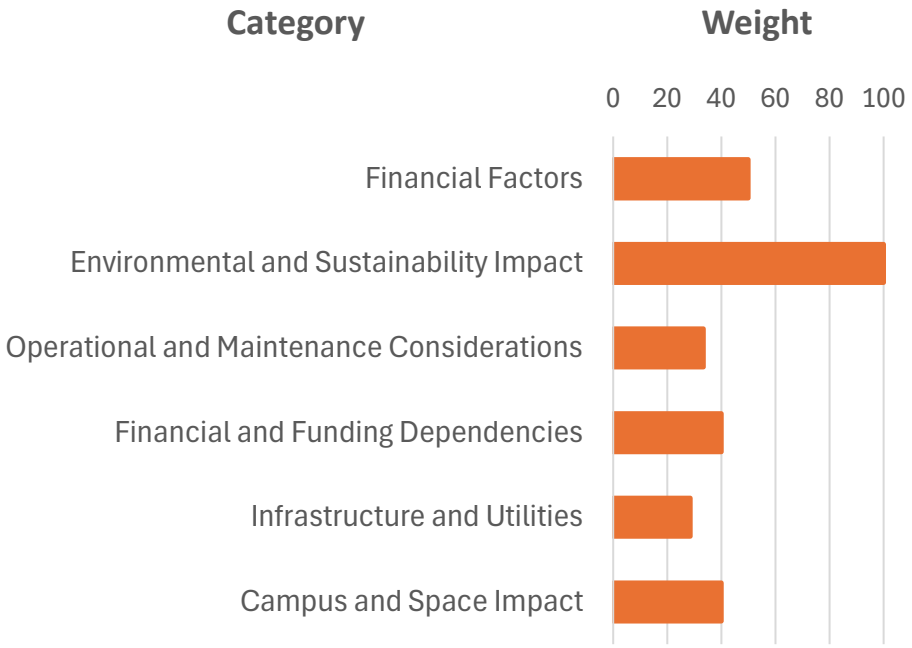


** Cost estimates reflect only the variable costs impacted by decarbonization options.*

*** 40-year net present cost, consistent with standard industry practice for lifecycle cost analysis.*

Decarbonization Analysis

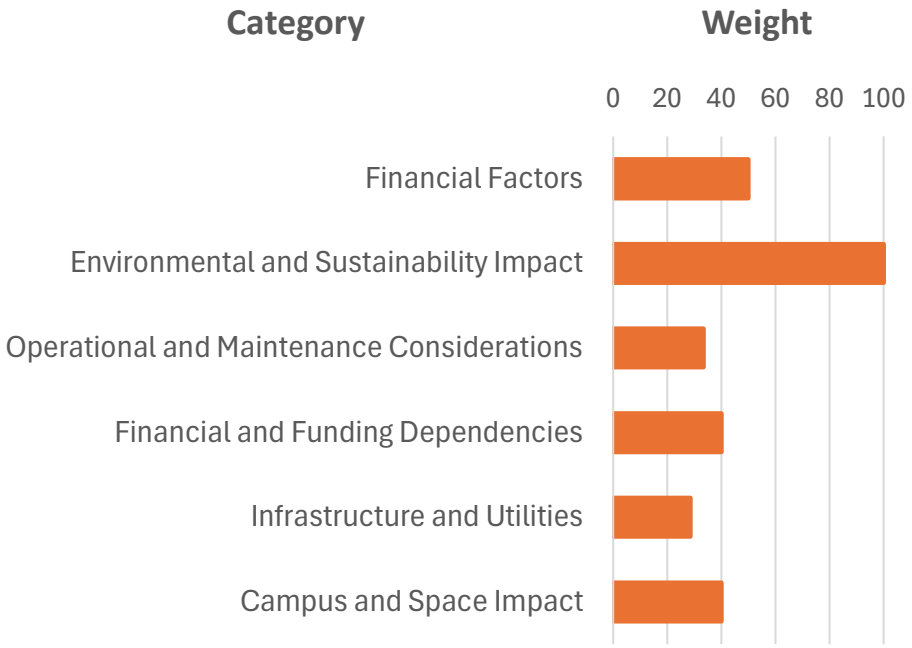
Evaluation Criteria Matrix



Option / Weighed Score	Electric Base Central Electric Boilers	Option 1 Steam Heat Pumps	Option 2 Four Pipe HW and CHW Distribution	Option 3 Mitigated Loop Distribution	Option 4 Precinct Loop Distribution
Financial Factors	3.5	6.2	7.5	6.7	7.2
Environmental and Sustainability Impact	10.6	12.7	13.9	15.3	16.7
Operational and Maintenance Considerations	4.7	2.9	4.2	3.2	4.4
Financial and Funding Dependencies	6.4	5.5	1.8	4.1	5.0
Infrastructure and Utilities	3.3	3.2	3.1	2.3	3.9
Campus and Space Impact	6.9	5.1	4.3	1.4	3.3
TOTAL Score	**35.36**	**35.54**	**34.79**	**32.96**	**40.51**

Decarbonization Analysis

Evaluation Criteria Matrix



Option / Weighed Score	Electric Base Central Electric Boilers	Option 1 Steam Heat Pumps	Option 2 Four Pipe HW and CHW Distribution	Option 3 Mitigated Loop Distribution	Option 4 Precinct Loop Distribution
Financial Factors	3.5	6.2	7.5	6.7	7.2
Environmental and Sustainability Impact	10.6	12.7	13.9	15.3	16.7
Operational and Maintenance Considerations	4.7	2.9	4.2	3.2	4.4
Financial and Funding Dependencies	6.4	5.5	1.8	4.1	5.0
Infrastructure and Utilities	3.3	3.2	3.1	2.3	3.9
Campus and Space Impact	6.9	5.1	4.3	1.4	3.3
TOTAL Score	**35.36**	**35.54**	**34.79**	**32.96**	**40.51**

Implementation Plan – Emissions

State Regulations

2021 Act on Climate

Emission reductions from 1990 baseline

- 10% reduction by 2020
- 45% reduction by 2030
- 80% reduction by 2040
- Net zero emissions by 2050

Executive Order 23-06 (2023) Lead by Example

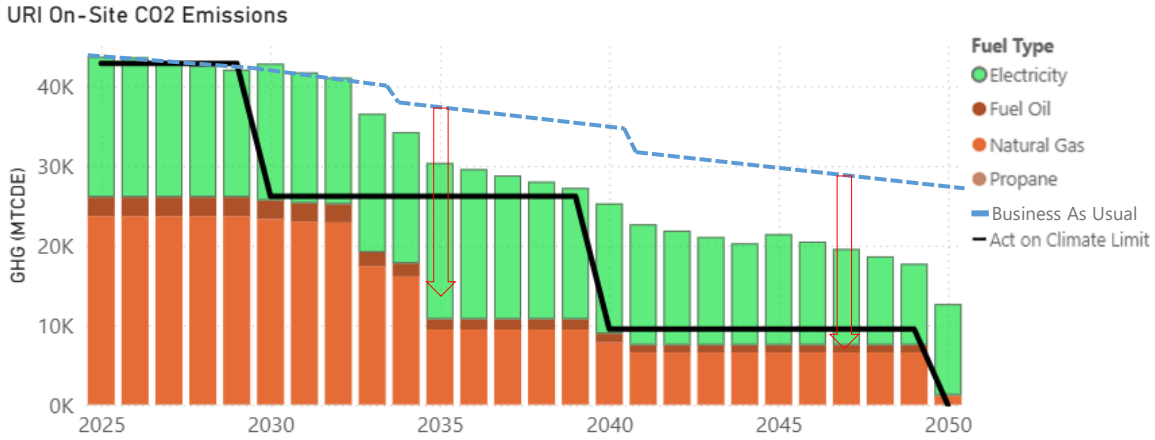
State agencies must reduce emissions from burning of onsite fossil fuels from 2014 baseline

- 40% reduction by 2030
- 70% reduction by 2040
- 95% reduction by 2050

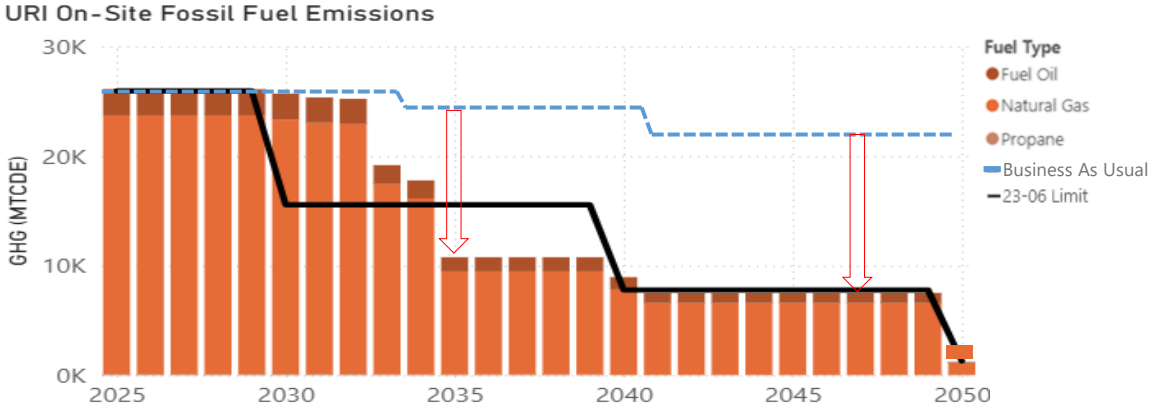
Early action in the first 10 years is required for compliance.

URI Energy Master Plan (EMP) Proposed Solution[1]

2021 Act on Climate Compliance



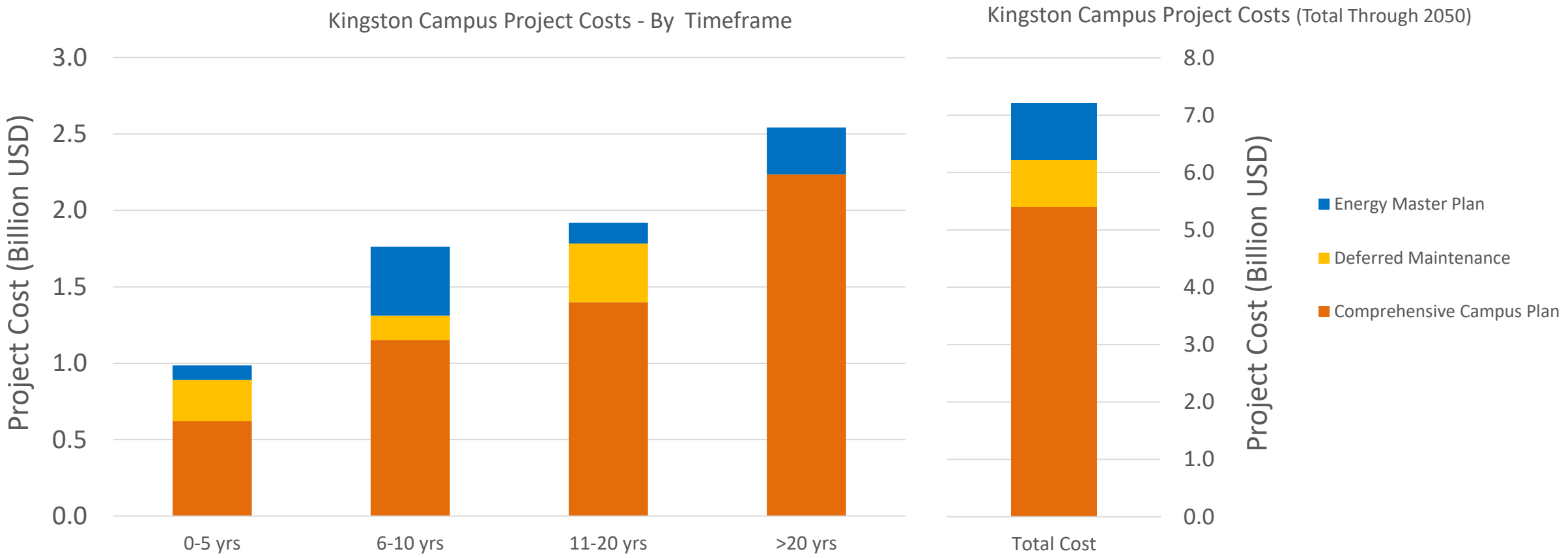
Executive Order 23-06 Compliance



[1] The Energy Master Plan focuses only on Scope 1 and 2 emissions from building operations but does not address Scope 3. For each regulation, the team developed a building energy emissions baseline. Meeting the requirements of Executive Order EO 23-06 would require URI to invest early in electrifying the steam plant by 2035, a move that represents an expensive and potentially challenging undertaking.

Decarbonization Costs and Funding Opportunities

COST DOES NOT INCLUDE ANY INFRASTRUTURE COST FROM RIE



*The Facility Condition Assessment (performed by Bureau Veritas) study captured costs only through 2044, which is why no deferred maintenance costs are shown in the > 20 yrs phase.

Audience Poll

Now that you see the scale of cost, what is the most realistic next move for URI?

→ Show responses

Mentimeter

Menti

NESEA Presentation

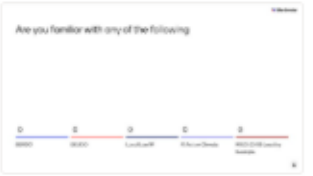
menti.com

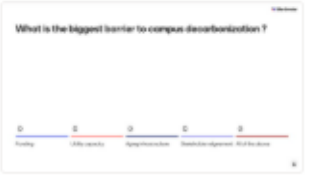
5750 6353

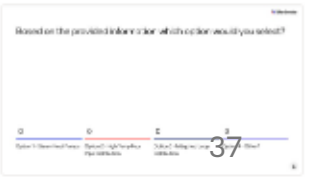
31 of 86 responded

Responses are hidden

Select which slide to add



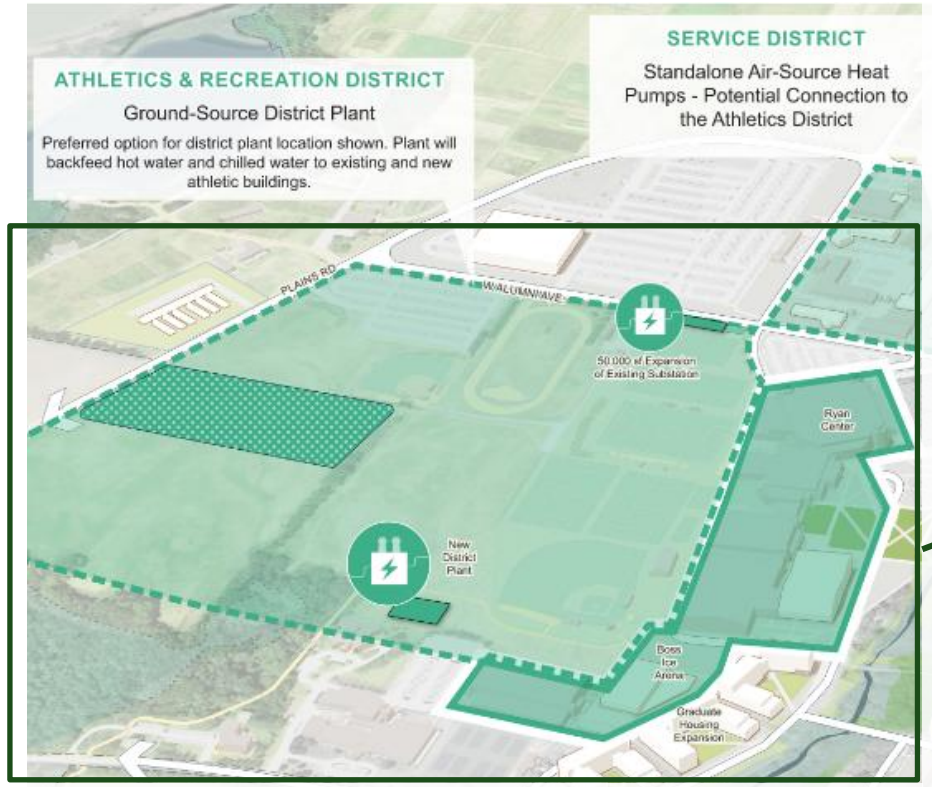


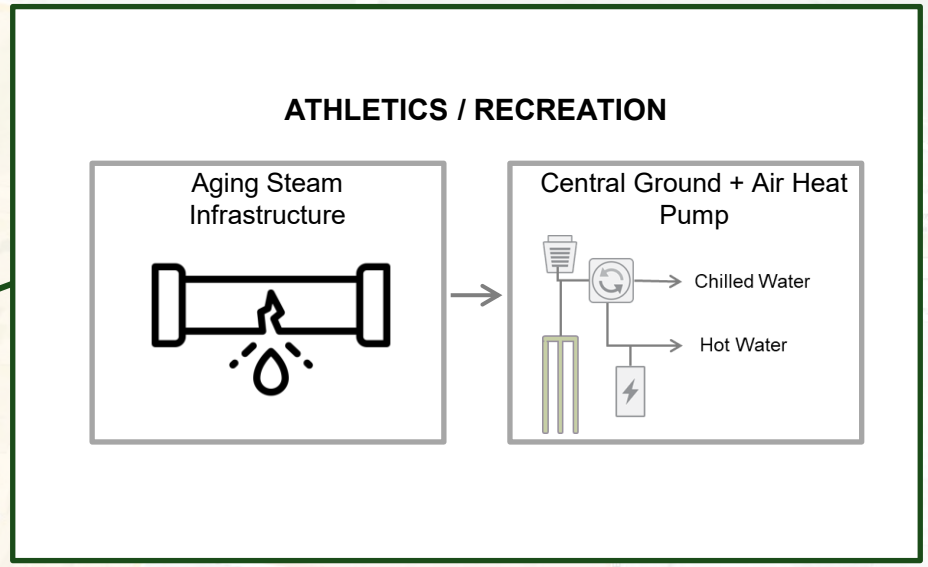


Key Takeaways

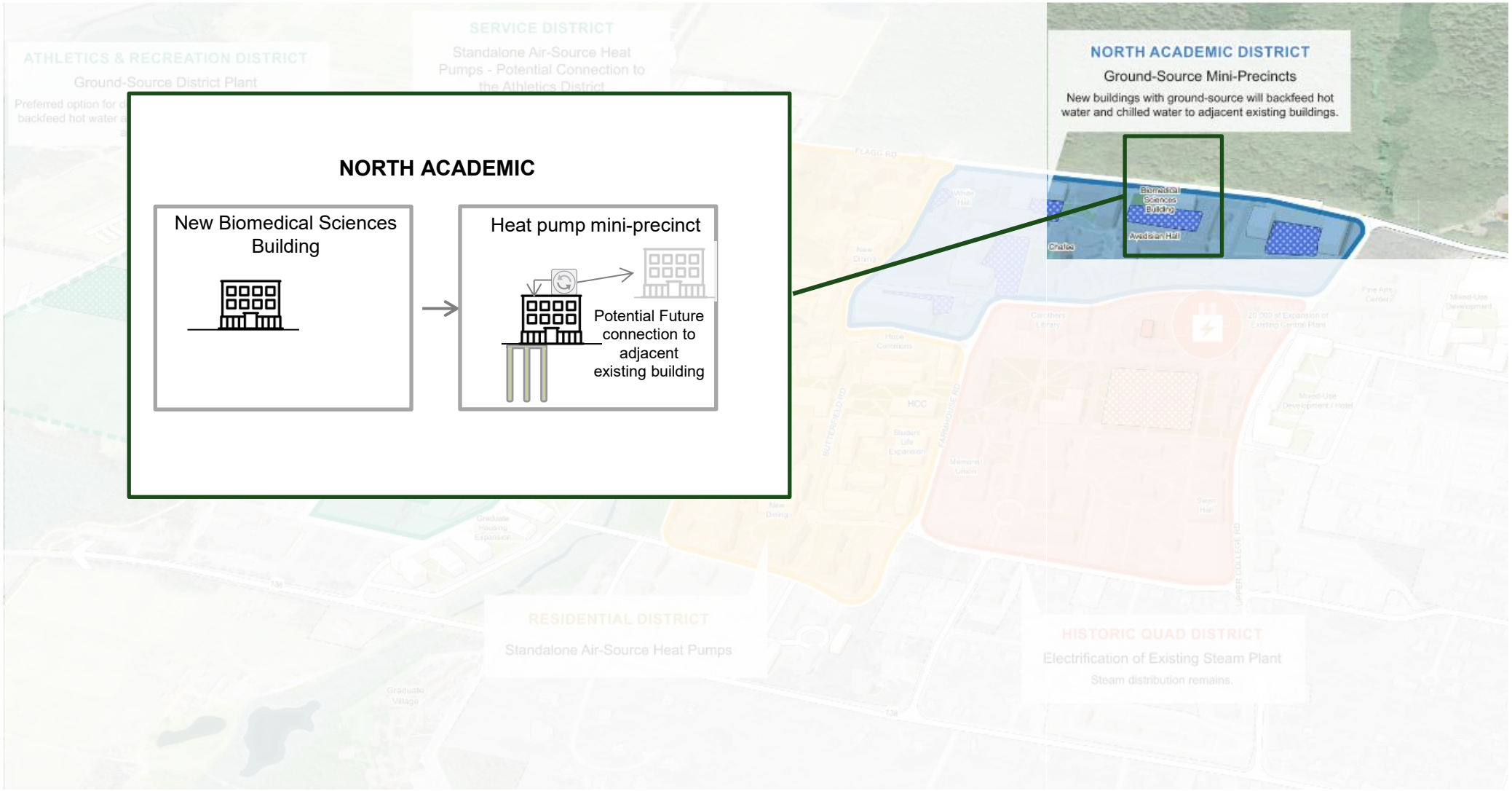
- We can meet State mandates by **replacing fossil fuels with all-electric systems** and integrating **carbon-neutral systems in design** of all **new construction and renovations**.
- **Electrification is an essential prerequisite** to achieving decarbonization goals, coupled with procuring electricity from **onsite or offsite renewable resources**.
- Increased demand will require **increased capacity from the utility company**, Rhode Island Electric (RIE).
- Through 2050, cost for all campus projects with Deferred Maintenance are estimated at **$6.2 billion**. **Infrastructure upgrades for the Energy Master Plan add $1 billion** in total project costs.
- Urgent priorities in the coming year include:
  - **Negotiating with RIE to expand electrical capacity** to support future campus development.
  - Incorporating **guidelines for carbon-neutral systems** into all capital improvement projects.

Implementation Plan: Athletic District





Implementation Plan: Biomedical Science



Questions?

Thank You!

SASAKI

BR+A

Building Performance Exchange

Learn more and subscribe for email updates by visiting ***buildingperformance.exchange***

A statewide resource for people and organizations seeking to enhance performance and reduce carbon pollution in larger existing buildings.

BUILT ENVIRONMENT PLUS

MASSACHUSETTS CLEAN ENERGY CENTER®

A program of Built Environment Plus and MassCEC

BUILDINGENERGY BOSTON

Please fill out an evaluation for this session

or: *nesea.org/eval*

Northeast Sustainable Energy Association (NESEA)

Decarbonization Costs and Funding Opportunities

Utility Incentives Program

- **Clean Heat Program Incentives:** Ranges from $32K for ASHP to $72K for GSHP, capped at 16 tons of equipment capacity.
- **New Construction and Major Renovations - Simple Energy Efficiency:** Incentives based on energy savings at $0.35/kWh and $2/therm.
- **New Construction and Major Renovations - Net Zero and Low EUI:** Offers multiple tiers, ranging from $1.50 to $3.50/SF, with post-occupancy verification required.

Inflation Reduction Act

- **Tax Credits:** Available regardless of tax liability, including for tax-exempt entities, as the IRS provides refunds. Covers 30–50% of system costs if contractors meet prevailing wage and apprenticeship requirements.
    - **Dual-Use Equipment Eligibility:** Applies to thermal distribution systems if the geothermal source meets ≥50% of annual heating and cooling loads.
- **Tax Deduction:** Requires tax liability; only taxable entities can directly benefit. For URI, the design team can claim deductions as a pass-through benefit.