

Presented for the Mass Cultural Council 11.02.2022

Cultural Facilities: Paths to Decarbonization



New Ecology works nationally to bring the benefits of sustainable development to the community level, with a concerted emphasis on underserved populations.

A mission-driven non profit, we seek to make the built environment more efficient, healthy, durable and resilient.

CORE WORK in Buildings:

- Audit & Analyze
- Monitor & Diagnose
- Implement & Solve
- Design, Certify & Verify
- Train & Share

Qualified PRF 74 Vendor



Terms

- *Net Zero* removing greenhouse gas emissions from the atmosphere in an amount equal to what we are releasing into it
- *Decarbonization* the result of actions taken to reduce or eliminate fossil fuel use by your building
- *Deep Energy Retrofit (DER)* systematic forethought and intentionality that leads to investments and decisions over time that result in highly impactful energy savings and GHG emissions reductions
- CO2_e –carbon dioxide equivalent is a standard unit of measure for emissions that includes nitrous oxide and methane (emissions from buildings kg CO2_e/sf)



Current Context for Decarbonization

- The State
 - Clean Energy and Climate Plan
 - Climate Bill H4515
 - Exec Orders 596
- "The Grid"
 - Reduce own emissions!
 - New load? Capacity?
 - Creating incentives





DRIVER: Fuel Costs

Mass Cultural Council





DRIVER: Benchmarking Ordinances

Boston - Building Emissions and Disclosure Ordinance (BERDO)

BUILDING USE	2025- 2029	2030 - 2034	2035 - 2039	2040- 2044	2045- 2049	2050 -
Assembly	7.8	4.6	3.3	2.1	1.1	0
College / University	10.2	5.3	3.8	2.5	1.2	0
Education	3.9	2.4	1.8	1.2	0.6	0
Food Sales and Service	17.4	10.9	8.0	5.4	2.7	0



BOSTON | BALTIMORE | WILMINGTON





DECARBONIZATION APPROACHES

- Reduce Load
- Electrify
- Generate on Site



Source: ©2013 2030, Inc. / Architecture 2030. All Rights Reserved. Data Source: U.S. Energy Information Administration (2012).



Reduce Load





Envelope Energy Savings

















Envelope: Insulation

Structurally Insulated Panels (SIPs)









Envelope: Insulation







Equipment: Heat Pumps

Heating Technology Mix Assumed

	20% GSHPs	- No backup heat			
2050 Heat Pumps: 50- 80% adoption across Res and Com buildings	40% ASHPs w/ Electric Backup	Backup heat in 1% of coldest hours			
	40% ASHPs w/	20% "Central" arrangement	Backup heat in 5% of coldest hours		
	Fuel Backup	20% "Minisplit" arrangement	Backup heat in 20% of coldest hours		



Heat Pumps: Air to Air

"Mini-splits"









Challenge: Refrigerant Phase-out, temperature and time





Heat Pumps: Heat pump to Water











Heat Pumps: Air-Water-Air with the Outdoor unit Inside





Geothermal: GSHP









DRIVER: Fuel Costs

Mass Cultural Council







NEWECOLOGY Community-Based Sustainable Development

Renewables: Hot Water CO₂ Heat pump Vs. Solar thermal







Energy Recovery Ventilation (ERV)





Vulnerability and Risk Assessment

Sensitivity to a hazard and the **capacity to adapt** to the hazard.



Image: Virginia Living Museum

Mass Cultural Image: Flood Panel





PROJECTS: Fine Arts Work Center

- What: Opportunity Assessment (ASHRAE Lvl 1) 2 buildings
- Scope: Identify Carbon, Energy, and Water improvements for incorporation into Capital Planning
- Includes:
 - Historic Energy, Water Use Analysis
 - Deep Physical Inspection; Measurements
 - Vulnerability and Risk Assessment
 - Recommendations with Savings Estimates











https://resilientma.mass.gov/rmat_home/designstandards/



Output from Resilient MA





Mass Cultural Council

Consider Co-Benefits!

Measure with Co-Benefits

- Insulation, Air Sealing, and Window Replacement

 Heating and Cooling Energy Savings
 Improved Passive Survivability
 Improved Wind Load Performance
 Improved Comfort
 Improved Functionality
 - Reduced Maintenance

Measure without Co-Benefits

- Backup Generator

 Increased Building Services
 - Increased Operations and Maintenance Costs



Historic Northampton

Challenges to Achieving Carbon Neutrality

Northampton















0k

Year



YEAR	DAMON*		PARSONS		SHEPHERD	
	Museum, offices, collections storage		Collections storage		Rented as office space; collections storage	
	Oil (GALLONS)	KwH	GAS (GALLONS)	KwH	Oil (GALLONS)	KwH
2020- 2021	957	11,325	730	9,594	746	11,434
2021- 2022	1,180	7,415	596	9,683	1,324	4,500
Solar pan		ıt 50% of				





Page 1 of 4



HEATING, COOLING & PLUMBING INC.

Proposal Submitted To:	Date:	Revision Date:	
Historic Northampton	11-24-2021		
Billing Address:	Phone:		
	413-588-2642 (Lau	urie Sanders)	
	Email:		
	Isanders@historic	lsanders@historicnorthampton.org	
Job Name & location:	Job Description:		
46 Bridge Street Northampton, MA	 Quote for Siductwork. Quote for Siductwork. 	team Humidifier on the current	
	Fan Pack for	r the basement.	
	Quote for U	Itra-Aire Dehumidifier	
	integrated v	with ductwork.	
Submitted By:	Payment Terms	Sales Tax Included:	

4 South Main Street, Suite K Haydenville, MA 01039 Office: 413-268-7777

MPL: 15672

westernmassheatingcooling.com

<u>Challenges for historical museums and cultural</u> <u>institutions:</u>

- Restricted by preservation mission
 - Example: mini-splits or solar on roofs would disfigure historic fabric
 - Example: Geothermal would trigger a detailed archaeology survey
- Limited by location, size and shape of property
- Achieving net neutrality is "off mission"



As non-profit:

- Not eligible for state and federal financial incentives (e.g. need to work with private LLC)
- Not eligible for MASS Save program upgrades

General:

- Need for expert team to provide technical assistance to evaluate options (geothermal, solar, heat pumps)
- Need for grant program within MCC, DOER or other





Making the move to Green Equipment New England

Mark Richardson Director of Horticulture



Former Landscape Practices

- Twice weekly mowing with 4 stroke ride on mower
- Twice weekly blowing with 2 stroke gas blower, plus as needed
- Twice weekly string trimming with 2 stroke line trimmer
- All work needed to be completed before 10am to keep from disturbing visitors, some days had to be completed earlier to accommodate for events

Spring 2019

Fall 2022

Lower level of maintenance

- Greater biodiversity
- Pollinator habitat
- Educational opportunity





Green Zone Certification program



- A pledge to the implementation of sustainable landscape equipment and the control of carbon output
- "Certification strengthens environmental leadership and sets examples for clean, quiet, and sustainable landscape maintenance practices in their region and beyond."
- First ever AGZA green zone certified botanic garden

New Landscape Practices

- Mean Green Mowers ride on 48v turf grass mower
- Husqvarna 40V Battery powered String trimmers, chainsaws, handheld blowers, forestry clearing saws,etc.
- EGO blowers
- All tools being implemented have been field test certified by the American Green Zone Alliance for reliability, and ability to keep up with workload of gas counterparts
- Changes to fall cleanup / spring cleanup. Including changes in planting design
- Mow less grass!









2022 Giant G2200E Lithium Ion articulating Ioader

2006 Bobcat S-185 Diesel Skid Steer



Future technology goals





On-site Generation

- 16kwH array
- Standing seam metal roof
- Fully integrated PV vs. traditional roof & panels
- MCCF





HUNTINGTON THEATRE BOSTON

Major renovation of historic regional theatre

- Opportunity to replace mechanical systems
- Reduce Energy by 70% over existing (58kbtu/sf/year)

• 80% Electric/20% Natural gas



STRATEGIES

- Recycle Existing Building
- Envelope Upgrades at roof and back of house
- Increased ventilation with filtration
- LED lighting
- Controls
- 80% Electric
 - Air-cooled chiller
 - Ventilation and fans
 - VRF for back of house
 - Radiant panels
- 20% Natural Gas, but convertible
 - Condensing boiler to serve AHU heating coils
 - Domestic water heating

• On-site solar considered, but eliminated due to future shadows.



MASS MoCA Phase 3

North Adams

- 3rd phase of 20-year museum renovation
- 120,000 square feet
- Opportunity to replace mechanical systems
- Reduce Energy by 79% over national average for museum (21kbtu/sf/year)
 80% Electric/20% Natural gas



STRATEGIES

- Recycle Existing Building
- Low-carbon design (618,000 kgCO2 to construct)
- Minimal envelope upgrades (roof and windows)
- "Museums within the Museum"
- DOAS with VRF (57 units)
- LED lighting
- Controls
- Electric
 - Ventilation and fans
 - VRF throughout
 - Domestic Hot water
- Fossil Fuels
 - "Small Sip" off existing boiler for ventilation heating coils and kitchen make-up air

200kw Solar array financed by state clean energy fund





Cape Rep Theatre, Brewster

"Our challenge is that we have a 2,500 square foot open space that needs an HVAC system - but we don't want to install a system fueled by natural gas in light of our global climate crisis."



Questions:

- We've been told to switch to heat pumps. Is this correct? Is there new technology we should consider?
- Can the duct work system that was designed be adapted to electric instead of gas?
- How long will it take us to make this pivot?
- Can we convert or add in solar down the road?

RESOURCES

Inflation Reduction Act

Mass Save Incentives

MA DOER Monitoring grant funds

Cultural Finance Fund





RESOURCE: Inflation Reduction Act of 2022

Investment Tax Credit (IRS)

Eligibility: Anyone; Organizations Exempt from paying Income Taxes

Purpose: Increased incentives; Allows non-profit organizations to monetize the ITC directly ("Direct Pay")

- From 2022 2032, ITC = 30% (*previously 22%*)
 - \circ +10% domestic content
 - \circ +10% Environmental Justice Location

(https://masseoeea.maps.arcgis.com/apps/webappviewer/index.html?id=1d6f63e7762a48e593 0de84ed4849212)

• E.g., Solar, Geothermal



Upcoming Webinar: Mass Save and Cultural Facilities December 6, 2:00 PM



Join the Mass Save Program Administrators as they discuss ways to implement energy efficiency for your building.
Solutions for Whole Buildings
Eligible Equipment Rebates
Equipment & Systems Performance Optimization with Controls





RESOURCE: Mass Department of Energy Resources

<u>Intent</u>: Collect & analyze real time operational data for the purpose of reducing gas consumption

<u>Best Fit</u>: Gas-fired, commercial systems - hydronic and steam boilers; Combined Heat and Power (i.e., CHP, Co-gen)

Funds can subsidize:

- 1. Systems Operational Assessment *subset of a decarbonization audit* (50%)
- 2. Monitoring System Installation, Optimization (\$3,750)

Grant Funds available until August 31, 2023



Cultural Facilities Fund

A capital grant program of the Mass Cultural Council and MassDevelopment

Three Grant Categories

Capital (Implementation)

□ Feasibility & Technical Assistance (Planning)

Systems Replacement Plan (Conditions assessment)









Grant Application Deadlines



• Framingham State Planetarium

- Grant Application: February 2, 2023 at 11:59pm
- Grant Announcements : May 2023
- Returning Grantee Deadlines:
- Grant Agreement executed: December 4, 2022
- Final invoices to MassDevelopment:
- January 3, 2023





Thank You for your Participation! Jay Paget, Program Director, Cultural Facilities Fund Jay.Paget@mass.gov 617-858-2723

Miranda Cook, Program Coordinator , Cultural Facilities Fund Miranda.Cook@mass.gov 617-858-2733

Marty Josten, Director Marty.Josten@newecology.org 617-557-1700 x7071

Jonah DeCola, Senior Energy Engineer DeCola@newecology.org 617-557-1700 x7033

