639 Warren Street

PROJECT NOTIFICATION FORM

Submitted to:
Boston Planning Department
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Boston, MA 02201

Submitted & Prepared by:
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In Association with:
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September 17, 2024

MPDC
Madison Park Development Corporation

Chapter 4

Sustainable Design and Climate Change Resilience

4.0 SUSTAINABLE DESIGN AND CLIMATE CHANGE RESILIENCE

4.1 Introduction

The 639 Warren Street project will leverage the site's transit-oriented location and efficient construction methods to achieve high sustainability standards. The focus is on minimizing energy consumption, enhancing water conservation, and reducing the building's overall environmental impact. Throughout the design phase, energy efficiency measures will be continuously evaluated and implemented.

The team will utilize the Leadership in Energy and Environmental Design (LEED) for Homes Multifamily Midrise Version 4 rating system to track the building's sustainable design approach and demonstrate compliance with Article 37 of the Boston Zoning Code. The LEED system evaluates sustainability across categories such as Location and Transportation (LT), Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (EQ), Innovation (IN), and Regional Priority (RP). This chapter outlines the preliminary LEED compliance strategy, targeting 67 points to achieve the Gold level. As the project progresses, additional LEED credits may be pursued based on feasibility. A preliminary LEED checklist is provided at the end of this section.

4.2 Green Building

This section details the approach to achieving LEED certifiability for the building. Attached to this section is a summary of the path to Passive House certification.

4.2.1 Integrative Process

An integrative process will guide the design and development team in meeting green objectives throughout the project lifecycle. The team comprises experts in architecture, civil engineering, mechanical/electrical/plumbing (MEP), energy engineering, and sustainable design. The project will involve Passive House consultants and verifiers, LEED Accredited Professionals, and LEED Green Raters to ensure a comprehensive approach to design, construction, operations, and maintenance. Regular design meetings will ensure team engagement throughout the project. During construction, on-site training, inspections, and testing will ensure compliance with sustainability standards.

4.2.2 Location and Transportation

The building will be developed on a previously developed site surrounded by parks, buildings, and infrastructure, offering easy access to retail, grocery, restaurants, cultural venues, and public transportation options. It is close to multiple bus routes (10, 14, 19, 22, 23) and within half mile walking distance to the MBTA Commuter Rail station Four Corners/Geneva serving the Fairmont line. The neighborhood also provides open space opportunities, including Elm Hill and Franklin Park within a half-mile radius.

4.2.3 Sustainable Sites

Low-impact development and green infrastructure practices will be integrated into the site design. The landscaping will include native and drought-tolerant plants, and light-colored materials will be used for sidewalks to reduce the heat island effect. The building will incorporate plantings and highly reflective roofing materials to further reduce heat absorption. An erosion and sedimentation control plan will be

implemented to meet LEED construction activity pollution prevention prerequisites. The site will meet the stormwater standards required by the City of Boston, including rainwater collection and groundwater recharge to minimize runoff.

4.2.4 Water Efficiency

Water conservation goals will be achieved by installing low-flow indoor water fixtures, including showerheads, toilets, and faucets. High-efficiency, low-water-use appliances will be installed throughout the building. The landscape design will prioritize native and adaptive plant species to reduce the need for irrigation. Any necessary irrigation will utilize smart scheduling technology to minimize water consumption.

4.2.5 Energy Efficiency

Passive House principles will guide the design process to identify key energy-efficient strategies. The building will be designed to meet MA Stretch Energy Code by demonstrating compliance with Passive House standards and Energy Star Multifamily New Construction certification. The building will feature high-performance glazing, high wall and roof R-values, and reduced infiltration to enhance energy efficiency. Mechanical systems will include efficient heating and cooling systems and reduced lighting power density. ERVs will be utilized to reduce the energy required to ventilate the building. The project team will implement a robust building envelope and airtight construction with low air change rates and high-performance windows and doors to manage energy use and minimize leakage. Fundamental Commissioning will be pursued to verify and ensure that building elements and systems are designed, installed, and calibrated to operate as intended. The building will be maximizing the available roof space and installing PV where feasible.

4.2.6 Materials and Resources

A Construction Waste Management plan will be implemented, tracking all waste materials leaving the site. Material selection will focus on environmental responsibility, including non-tropical wood to comply with LEED requirements, recycled and reclaimed products, and locally sourced materials within 100 miles of the site. Durability risks will be assessed early in the project, with appropriate design, materials, and construction practices followed. LEED interior moisture control measures and the ENERGY STAR water management checklist will be implemented and verified by a third-party verification team.

4.2.7 Indoor Environmental Quality

The project will prioritize indoor air quality for occupants by selecting systems and materials that support superior indoor environments. Mechanical ventilation will provide more fresh air than required by ASHRAE 62.1-2010, ensuring high indoor air quality in unit spaces and common areas. Continuous ventilation will exhaust air from bathrooms and kitchens, balanced by fresh air provided to each residential unit. Testing at the end of construction will ensure that ventilation rates meet design specifications. Units will be compartmentalized to contain air and odors, and the building will meet LEED air leakage requirements of 0.30 CFM50 per square foot of enclosure, verified by testing at the end of construction. All interior paints, adhesives, insulation, and composite wood materials will meet low-

emitting and low- or no-added formaldehyde requirements. Zero and low volatile organic compound (VOC) products will be prioritized for finishes, and the building will be smoke-free during construction and once operational.

4.2.8 Innovation in Design and Regional Priority

Innovation credits will be pursued for Housing Types and Affordability, with additional strategy credits for including a LEED Homes Accredited Professional and achieving Exemplary Performance Credits for Community Resources. Regional priority credits, as determined by the USGBC based on zip code, may be awarded if certain point thresholds are met. The project is eligible for points in the categories of Annual Energy Use.

4.3 Zero Carbon Approach

The project team at 639 Warren Street is committed to pursuing every feasible measure to conserve energy, including improvements to the building envelope, incorporation of renewable energy, and enhanced mechanical equipment. Although extensive analysis of the envelope and mechanical systems is ongoing, the design will aim to meet the sustainability standards established by the City of Boston Mayor's Office of Housing. The building will be designed to PHIUS 2021, Energy Star Multifamily New Construction, Department of Energy Zero Energy Ready Home, and Environmental Protection Agency Indoor Air Plus Program standards.

The building design will feature a low-energy-use model with all-electric mechanical systems and a high-performing envelope. The path to zero net carbon includes on-site renewable energy and off-site renewable procurement, which are under study. Key design features will include:

- Slab Insulation: R-10 for perimeter and R-20 under the slab
- Roof Insulation: R-60 Minimum
- Exterior Walls: R-21 cavity insulation and an additional R-12 continuous insulation
- High-Performance Windows: Minimum U-value of 0.20 and Solar Heat Gain Coefficient (SHGC) of 0.35
- Heating and Cooling: High-efficient Air Source Heat Pump
- Water Heating: Air source heat pump water heater with an Energy Factor (EF) of 3.5 for high efficiency.
- Unit Airtightness: Compartmentalization achieves an airtightness performance of ≤0.30 CFM50/ft² of enclosure.
- Building Airtightness: Passive House Standards .06 CFM50/SQ FT. Shell
- Ventilation: Energy Recovery Ventilation system that exhausts air from bathrooms, kitchens, and common areas, while supplying tempered make-up air to each unit and common occupied spaces.
- Plumbing Fixtures: Low-flow technology to reduce water consumption.
- Appliances: Specification of ENERGY STAR certified appliances to meet high energy efficiency standards.
- Lighting: Utilizes high-efficiency LED fixtures and bulbs for optimal energy conservation.

Following this section can be found a narrative regarding the Mechanical, Electrical, Plumbing, and Fire Protection (MEPFP) systems as well as preliminary HVAC and Domestic Hot Water system considerations.

The project team will explore and utilize federal, state, and utility incentives for energy efficiency and renewable energy. Specifically, the team intends to pursue MassSave Passive House incentives.

4.3.1 Rooftop Solar Photovoltaic Feasibility

639 Warren Street is planning for the installation of a rooftop solar array. The array will help to reduce the operating cost of the rental development by offsetting the electricity use of the elevator, community room, shared laundry facilities, and common area HVAC & lighting. The array will be connected 'behind' the common area, development-paid electrical meter specific to the rental portion of the development. It is anticipated that the electricity usage on the common area meter will exceed that of the electricity generated on-site by solar. Therefore, no excess electricity bill credits will be sent to other meters.

It is expected that the solar array will take advantage of two primary state and federal incentives. The federal incentive is an upfront 50% tax credit (ITC) (the base ITC for all solar projects is 30% – buildings with active LIHTC are eligible to receive a boost to 50%). The LIHTC investor for the development is expected to purchase the solar ITC alongside the LIHTC. The Massachusetts state incentive is the SMART program, which is a production-based incentive, delivering cash payments to the development on a monthly basis, based on the amount of electricity generated by the array.

A proposal for direct solar ownership for the Project can be found in Appendix F.

The Passive House approach, all-electric systems, and solar PV integration will result in an energy-efficient building that approaches net zero carbon. While energy modeling is ongoing, these commitments align with the project's goals for a zero-carbon future. The team will continue to evaluate additional measures to further enhance energy efficiency, reduce carbon emissions, and potentially achieve a net positive carbon design.

4.3.2 Building Energy Consumption

See Appendix F for Energy Model results and Climate Resiliency Checklist.

4.3.3 On-Site Renewable Energy

See Appendix F for full Solar proposal.

4.3.4 Off-Site Renewable Energy

Off-site renewable energy sources are to be determined.

4.4 Climate Change Preparedness and Resiliency

The project team will evaluate climate change impacts, including increased maximum and mean temperatures, more frequent extreme heat events, prolonged droughts, and intensified precipitation.

4.4.1 Extreme Heat Events

According to the Climate Ready Boston report, Boston could experience between 25 to 90 days above 90 degrees Fahrenheit each summer by 2070, compared to an average of 11 days currently. To address this, the design strategies will focus on mitigating the building's vulnerability to rising temperatures and extreme heat.

4.4.1.1 Reducing Solar Heat Gain

The building will feature energy-efficient windows and mechanical systems to minimize heat gain during summer and heat loss in winter. Windows will be selected based on their solar heat gain coefficient and other performance metrics to enhance heating and cooling efficiency, targeting a U-value of 0.20 and SHGC of 0.35. The roof will incorporate a reflective membrane to lower solar heat absorption and reduce cooling demands. Additional analysis will consider integrating shading devices to further minimize solar heat gain.

4.4.1.2 Providing Mechanical Cooling

The building will include high-performance, energy-efficient cooling systems to maintain comfortable indoor temperatures during extreme heat events. Energy modeling and comfort simulations will ensure compliance with Passive House Institute US (PHIUS) climate criteria.

4.4.1.3 Climate-Resilient Planting and Landscaping

Drought-tolerant and heat-resilient plant species will be selected to reduce irrigation needs while providing adequate shading. Native and adaptive plants suited to the region’s evolving climate will be prioritized.

4.4.2 Increased Precipitation

With the potential for increased precipitation leading to greater stormwater runoff, flooding, and changes in the water table, the project will incorporate advanced stormwater management strategies.

4.4.3 Resilience to Extreme Weather Events

To mitigate the impact of extreme weather events, the project will consider the following measures:

4.4.3.1 Storm-Resistant Design

The building will feature robust structural design elements to withstand severe wind and precipitation, including reinforced materials, upgraded window and door standards, and secure rooftop equipment.

4.4.3.2 Backup Power

The feasibility of an emergency backup power system will be evaluated to ensure essential services during prolonged power outages.

4.4.3.3 Communication and Coordination

The project team will coordinate with local authorities and utility providers to establish effective emergency planning and response protocols. Engaging with city officials and participating in climate resilience planning will be prioritized.

4.5 Conclusion

The 639 Warren Street project is committed to a sustainable design approach that addresses energy efficiency, water conservation, and climate resilience. By integrating Passive House principles, LEED certification goals, and a zero-carbon strategy, the project aims to exceed current environmental standards. Through ongoing evaluation, expert collaboration, and community engagement, the project will contribute positively to Boston's sustainability and climate resilience efforts.

CLEAResult®

639 Warren Street, Boston, MA

PHIUS WUFI Passive Feasibility

September 12, 2024

Prepared For:

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Passive House Feasibility Study

639 Warren Street

The PHIUS Feasibility Study evaluates a building's potential to achieve PHIUS Certification early in the design phase.

Process:

CLEAResult evaluated the feasibility of meeting Passive House standards for 639 Warren Street through the PHIUS CORE 2021 program. An initial WUFI Passive energy model was created based on the baseline project design, using available drawings and narrative documents. Where specific data was missing, default assumptions were applied. Following the completion of the baseline simulation, an upgraded case was generated with necessary adjustments to meet PHIUS 2021 standards. Passive House adheres to a performance-based standard alongside prescriptive requirements. This study focuses on ensuring the building meets these performance-based standards, validated through the WUFI Passive Software modeling tool. It is important to note that the study presents one possible combination of performance upgrades to meet PHIUS requirements. Given the performance-based nature of the standard, there are multiple alternative upgrade combinations that could also achieve compliance.

Project Details:

Building Type: Single multifamily building, 63 units
Conditioned Floor Area: 77,259 ft²
Energy Model Scope: All interior spaces within the thermal Passive House envelope, including stairwells and elevator shafts down to the foundation.

PHIUS 2021 Targets:

Using the PHIUS 2021 Space Conditioning Criteria Calculator, targets for annual heating and cooling demands, as well as peak loads, were established based on factors such as location, envelope-to-floor area ratio, and occupant density. Climate data from Boston Logan International Airport was applied to both the baseline and PHIUS-compliant models.

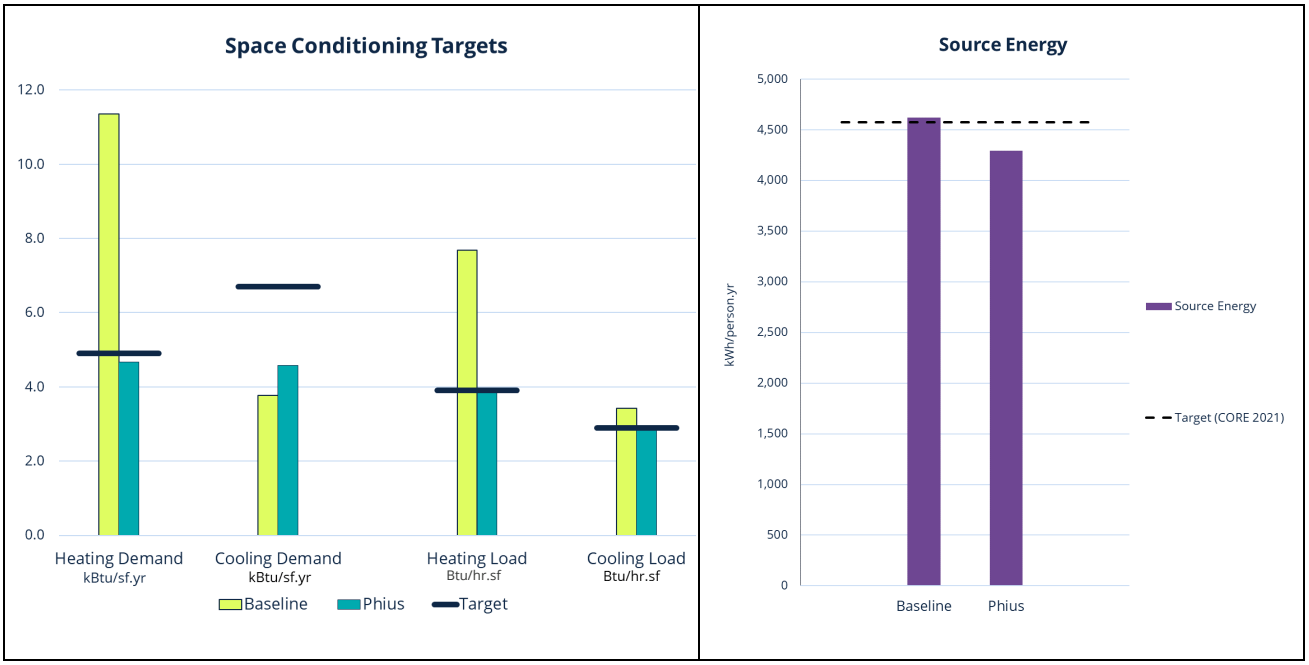
Phius 2021 Performance Criteria Calculator v3.3		
UNITS:		IMPERIAL (IP)
BUILDING FUNCTION:		RESIDENTIAL
PROJECT TYPE:		NEW CONSTRUCTION
STATE/PROVINCE		MASSACHUSETTS
CITY		BOSTON LOGAN INT ARPT MA
Envelope Area (ft^2)		91,167.6
iCFA (ft^2)		77,259.0
Dwelling Units (Count)		63
Total Bedrooms (Count)		116
Space Conditioning Criteria		
Annual Heating Demand	4.9	kBtu/ft^2/yr
Annual Cooling Demand	6.7	kBtu/ft^2/yr
Peak Heating Load	3.9	Btu/ft^2/yr
Peak Cooling Load	2.9	Btu/ft^2/yr
Source Energy Criteria		
Phius CORE	4575	kWh/person.yr
Phius ZERO	0	kWh/person.yr

WUFI Energy Model Results

Space Conditioning and Source Energy Comparison: Baseline vs. PHIUS Case:

The graph below compares the baseline energy model (yellow) with the PHIUS Case model (blue). The PHIUS targets (black lines), derived from the Space Conditioning Criteria Calculator, represent the benchmarks for compliance. To achieve PHIUS compliance, the building's performance must be below these target lines. The adjustments made to the WUFI energy model from the baseline to the PHIUS model have successfully reduced the building's performance metrics to fall below each of these PHIUS target lines.

PHIUS 2021 Space Conditioning Criteria Results



The baseline model is developed from schematic plans, incorporating assumed typical envelope assemblies and systems commonly used for this project type, along with code-compliant assumptions. However, it falls short of meeting PHIUS requirements. Key factors contributing to the baseline model exceeding PHIUS targets include airtightness, fenestration requirements, as well as the opaque assemblies. In the baseline cases, airtightness is modeled at the code minimum of 0.28 cfm/ft², whereas Passive House standards mandate a measured airtightness of 0.06 cfm/ft².

To achieve PHIUS compliance, adjustments are necessary, as detailed in the table below:

Baseline vs. PHIUS Target Performance Levels:

Building Information			Units
Building Address:	639 Warren Street, Boston, MA 02121		
Climate Data:	Boston Logan INT ARPT MA		
Exterior Envelope Area:	91,168		ft^2
Interior Conditioned Floor Area: (iCFA)	77,259		
Window-to-Wall Ratio:	0.13		WWR
Number of Stories Above Grade:	6		
Number of Dwelling Units:	63		
Number of Bedrooms:	116		
Modeling Information			**Units**
Fuel Type:	Electricity		
Site-to-Source Energy Factor:	1.8*		
Exterior Envelope	**Baseline Case**	**Phius Case**	**Units**
Roof:	32.3	37.0	R-value
Exterior Walls:	20.8	31.3	R (effective)
Slab:	1.3	6.3	R-value
Foundation Perimeter:	Horizontal / 10 / 4	Horizontal / 10 / 4	Position / R-value / Depth (ft)
Residential Windows:	0.421/0.37	0.273/0.35	U-window / SHGC
Storefront Windows / Glazed Doors:	0.656/0.30	0.586/0.30	
Opaque Doors:	5	5	R-value
Airtightness	**Baseline Case**	**Phius Case**	**Units**
Envelope Airtightness:	**0.28**	**0.06**	$cfm50/ft^2$ (envelope)
Lighting	**Baseline Case**	**Phius Case**	**Units**
Total:	92,083	90,280	kWh/yr
Appliances	**Baseline Case**	**Phius Case**	**Units**
Refrigerators (typ):	28,035	28,035	kWh/yr
Dishwasher:	6,532	6,532	
Clothes Washer:	2,072	2,072	kWh/yr / MEF
Electric Exhaust Clothes Dryer:	19,768.10	19,768.10	kWh/yr
Miscellaneous Electric Loads	**Baseline Case**	**Phius Case**	**Units**
Total:	70,887	70,887	kWh/yr
Outdoor Ventilation	**Baseline Case**	**Phius Case**	**Units**
Continuous Ventilation (total):	4,680	4,680	Supply cfm / Exhaust cfm
Mechanical Systems	**Baseline Case**	**Phius Case**	**Units**
Continuous Ventilation System:	70%	70%	Sensible Recovery Efficiency
	70%	70%	Latent Recovery Efficiency
	1.40	1.40	W/cfm
Heat Pump (Cooling):	21.4	21.4	SEER
Air Source Heat Pump:	3.7	2.7	COP @ 47F
	2.12	2.12	COP @ 17F
HPWH	1.05	1.05	Performance Ratio of Heat Generator (1 / % efficiency)
	1.8	1.8	Source energy factor (Btu/Btu)
WUFI Passive Results	**Baseline Case**	**Phius Case**	**Units**
Site Energy Use Intensity (EUI)	20.3	18.8	kBtu/sqft.yr
Savings over Baseline EUI	-	**7%**	
Source Energy	4,617	4,290	kWh/person.yr
Savings over Baseline Source Energy	-	**7%**	

In transitioning from the baseline case to the PHIUS case, several key upgrades will be implemented to significantly enhance the building's energy performance and align it with Passive House standards.

The exterior envelope will be notably improved with enhanced insulation in the roof, walls, and slab. These upgrades will contribute to better thermal resistance and reduced heat loss, thereby boosting the building's energy efficiency. Additionally, the

windows will be upgraded to offer improved thermal performance, helping to minimize heat loss and control solar heat gain.

Airtightness will require significant improvement to meet the Passive House minimum rate. The current baseline level of air leakage will need substantial reduction to minimize drafts and heat loss, ensuring more stable indoor temperatures and lower energy consumption for heating and cooling.

Lighting efficiency is expected to see a slight reduction in energy use, likely due to increased efficiency or adjusted lighting levels, contributing to overall energy savings.

Mechanical systems will also need adjustments. The efficiency rating of the cooling system will be reviewed to ensure it meets performance expectations, while the heat pump water heater's performance will remain consistent.

Overall, these upgrades are anticipated to lead to a substantial reduction in site energy use and source energy consumption, demonstrating the enhanced energy efficiency of the PHIUS case compared to the baseline.

Conclusion:

The project exhibits strong potential as a high-performance building and is on track to meet Passive House standards with the planned adjustments. Achieving compliance will rely on improved window performance, enhanced thermal performance of assemblies, and meticulous air sealing. Additionally, mechanical systems will require optimization to ensure efficiency. While onsite renewables are not required under the current PHIUS model, the project must include provisions for solar and EV readiness. As the design progresses, updating the WUFI model will be essential to ensure ongoing adherence to these standards.

LEED BD+C: Multifamily Midrise v4 - LEED v4

639 Warren Street Scorecard

Location: **639 Warren Street, Boston, MA 02121**

Note: The information on this tab is READ-ONLY. To edit this information, see the Credit Category tabs.

Integrative Process		**Preliminary**	Y	0 of 2	M	*0*	**Verified**	0
IPc	**Integrative Process**			0 of 2		*0*		
Location and Transportation		**Preliminary**	Y	15 of 15	M	*0*	**Verified**	0
LTp	Floodplain Avoidance			Required				Not Verified
Performance Path								
LTc	LEED for Neighborhood Development			0 of 15		*0*		
Prescriptive Path								
LTc	Site Selection			8 of 8		*0*		
LTc	Compact Development			3 of 3		*0*		
LTc	Community Resources			2 of 2		*0*		
LTc	Access to Transit			2 of 2		*0*		
Sustainable Sites		**Preliminary**	Y	3.5 of 7	M	*0*	**Verified**	0
SSp	Construction Activity Pollution Prevention			Required				Not Verified
SSp	No Invasive Plants			Required				Not Verified
SSc	Heat Island Reduction			0 of 2		*0*		
SSc	Rainwater Management			2 of 3		*0*		
SSc	Nontoxic Pest Control			1.5 of 2		*0*		
Water Efficiency		**Preliminary**	Y	4 of 12	M	*3*	**Verified**	0
WEp	Water Metering			Required				Not Verified
Performance Path								
WEc	Total Water Use			0 of 12		*0*		
Prescriptive Path								
WEc	Indoor Water Use			4 of 6		*0*		
WEc	Outdoor Water Use			0 of 4		*3*		
Energy and Atmosphere		**Preliminary**	Y	31 of 37	M	*0*	**Verified**	29
EAp	Minimum Energy Performance			Required				Not Verified
EAp	Energy Metering			Required				Not Verified
EAp	Education of the Homeowner, Tenant or Building Manager			Required				Not Verified
EAc	Annual Energy Use			29 of 30		*0*		29
EAc	Efficient Hot Water Distribution System			2 of 5		*0*		
EAc	Advanced Utility Tracking			0 of 2		*0*		

Materials and Resources		Preliminary	Y	1.5 of 9	M	0	Verified	0
MRp	Certified Tropical Wood			Required				Not Verified
MRp	Durability Management			Required				Not Verified
MRc	Durability Management Verification			1 of 1		0		
MRc	Environmentally Preferable Products			0.5 of 5		0		
MRc	Construction Waste Management			0 of 3		0		

Indoor Environmental Quality		Preliminary	Y	8 of 18	M	0	Verified	0
EQp	Ventilation			Required				Not Verified
EQp	Combustion Venting			Required				Not Verified
EQp	Garage Pollutant Protection			Required				Not Verified
EQp	Radon-Resistant Construction			Required				Not Verified
EQp	Air Filtering			Required				Not Verified
EQp	Environmental Tobacco Smoke			Required				Not Verified
EQp	Compartmentalization			Required				Not Verified
EQc	Enhanced Ventilation			3 of 3		0		
EQc	Contaminant Control			0 of 2		0		
EQc	Balancing of Heating and Cooling Distribution Systems			1 of 3		0		
EQc	Enhanced Compartmentalization			0 of 3		0		
EQc	Combustion Venting			2 of 2		0		
EQc	Enhanced Garage Pollutant Protection			1 of 1		0		
EQc	Low-Emitting Products			0 of 3		0		
EQc	No Environmental Tobacco Smoke			1 of 1		0		

Innovation		Preliminary	Y	3 of 6	M	0	Verified	0
INp	Preliminary Rating			Required				Not Verified
INc	Innovation			2 of 5		0		
INc	LEED Accredited Professional			1 of 1		0		

Regional Priority		Preliminary	Y	1 of 4	M	0	Verified	0
RPc	Regional Priority			1 of 4		0		

Point Floors	
The project earned at least 8 points total in Location and Transportation and Energy and Atmosphere	Yes
The project earned at least 3 points in Water Efficiency	No
The project earned at least 3 points in Indoor Environmental Quality	No

Total	Preliminary	Y	67 of 110	M	3	Verified	29

Certification Thresholds Certified: 40-49, Silver: 50-59, Gold: 60-79, Platinum: 80-110

Petersen Engineering

MEPFP SD Narrative

Job Name: 639 Warren Ave, Boston, MA
Job #: 24016
Date: August 23rd, 2024
To: Sophie Nahrmann (Studio Luz)
Prepared By: Jonah Israelit, Ryan Moy, Tim Gaston - Petersen Engineering Inc (PEI)
Cc: Hansy Better Barraza (Studio Luz)
Subject: MEPFP Schematic Design Narrative

The project includes the construction of a new 3-story midrise home ownership unit building and a new 6-story midrise apartment building at the 639 Warren Street location in Boston, MA. The 3-story home ownership building will have qty-9 units, and the apartment rental building will have qty-56 units and qty-2 ground floor commercial spaces that will be designed as core and shell. Retail Spaces A & B will be approximately 1200sf and 720sf, respectively. The project includes qty-65 total dwelling units and 82,000 total square feet.

The following is a description of the proposed MEPFP systems and includes an outline of preliminary HVAC and Domestic Hot Water system options.

Heating and Cooling

Ownership Dwelling Units - Individual Air Source Heat Pumps (ASHP)

- Heating and cooling provided by dedicated split-system air-source heat pump systems (one per unit)
  - Each dwelling unit shall have a dedicated indoor unit and a dedicated outdoor unit on the roof
  - 1-Bed – 1 ton vertical ducted fan coil.
    - Mitsubishi PVA-A12AA7 & PUZ-A12NKA7-BS
  - 2-Bed – 1 ton vertical ducted fan coil.
    - Mitsubishi PVA-A12AA7 & PUZ-A12NKA7-BS
  - 3-Bed – 1.5 ton vertical ducted fan coil.
    - Mitsubishi PVA-A18AA7 & PIZ-A18NKA7-BS
  - Roof equipment shall be mounted on 24" high stands and positively attached to structure.
  - Each dwelling unit shall have a hard-wired digital thermostat
  - Equipment specified above is what is currently available based on R-410a refrigerant. Due to ongoing R410a phase-out we expect the model numbers above to change and the system to employ A2L type refrigerant, required after Jan 1, 2025.
- Ducted fan coils shall be located between living room and bedroom to minimize duct distribution.
  - Two bedroom units shall require a soffit for ductwork.
  - Alternatively ductwork distributed in the ceiling cavity of the rated floor/ceiling assembly
    - Ceiling radiation dampers shall be required for any penetration of the rated ceiling.
  - FCU return grille/access panel size: 58" H x 20" W in the front (short side) of the unit
- Individual refrigerant line set from each unit's indoor unit to the dedicated rooftop heat pump.
  - Refrigerant distributed vertically through the building inside walls and stacking pipe chases.
  - Refrigerant pipe routing shall be based on ASHRAE 15-2022 Refrigerant Safety Standard.
- Metering: Heating and cooling energy use will be on each tenant electric utility meter (i.e. 100% of the heating and cooling energy use will be on tenant owned electric meters).

Rental Dwelling Units – Option #1 Variable Refrigerant Flow (VRF)

- Heating and cooling will be provided by central VRF air-source heat pump system with low ambient heating down to -13° F.
- System shall be "simultaneous type" allowing for heating and cooling in any dwelling unit year round.
- Please note, R410a refrigerant is currently undergoing a federally mandated phase-out. New equipment is expected to be available soon, the following models and installation details are subject to change.
- Basis of Design VRF System: Mitsubishi R2-Series High Efficiency or equal
  - Outdoor Units (total of 72 tons): (6) Mitsubishi PURY-EP144
  - Indoor Units (1 unit per apartment):
    - 1 Bed units: Mitsubishi PVFY-P12
    - 2 Bed units: Mitsubishi PVFY-P12
    - 3 Bed units: Mitsubishi PVFY-P18
- (1) Indoor VRF unit will be located in each dwelling unit and will be concealed, vertical type with supply ductwork minimized to the extent practical to serve all rooms within dwelling unit.
    - Condensate piping risers installed in stacking heat pump closets to collect and dispose of condensate from the heat pumps to the storm water system.
- Each outdoor VRF unit will be located on 24" high stand on the roof, with positive attachment to structure.
- Refrigerant piping routed to branch boxes and indoor VRF units throughout the building.
- Branch boxes Located in utility closets – 2 per floor.
  - Utility room shall include 24x48" fire rated shaft to the roof
  - Each utility room provided with dedicated exhaust fan, supply fan, and refrigerant detector
  - Refrigerant piping shall be routed in a ventilated shaft up to the rooftop equipment.
- Metering:
    - Electricity usage for VRF system will be on landlord electric utility meter (with the exception of the electricity usage of the fan within indoor VRF unit).
    - Electricity usage for Community Space VRF system will be on a separate electric utility meter.

Rental Dwelling Units – Option #2 All Electric Water Source Heat Pump (WSHP) System

- Individual WSHP units located in each apartment shall have individual zone control and can operate in heating or cooling throughout the year.
    - Indoor Units (1 unit per apartment): ClimateMaster SM-12, or SM-18
      - (1) Heat pump will be located in each dwelling unit and will be concealed, vertical type with supply ductwork minimized to the extent practical to serve all rooms within dwelling unit.
      - Condensate piping risers installed in stacking heat pump closets to collect and dispose of condensate from the heat pumps to the storm water system.
- A central condenser water loop (condenser water) shall run throughout the building to interconnect the WHSP terminal units and the central plant equipment.
    - Includes central pumps, variable speed controls and glycol anti-freeze solution.
- A cooling tower shall provide central evaporative cooling to the condenser water loop.
    - Shall be located on grade or on roof.
    - Based on Qty-1 Evapco Model LRWB 8-4L9-Z (80 tons nominal cooling total)
- A cold-climate Air-to-Water (A2W) packaged heat pump shall provide central heating to the condenser water loop.
    - Shall be located on grade or on roof, adjacent to cooling tower.
    - Based on Qty-1 Aermec Model NYG 1000 (40 tons nominal heating)
- Metering: Heating and cooling energy use shall be on landlord's electric utility meter (cooling tower fan, heating energy and central pumps). Electrical energy use from WSHP compressor and fan may be metered on an individual apartment basis.

Retail A & Retail B – Future Air Source Heat Pumps

- Heat pumps shall be installed in the future based on the specific needs of the tenant. The following accommodations should be made by the base building.
- Provide electric unit heaters for minimum heating/tempering of white box tenant space.
- Provide a dedicated 24"x24" shaft from the roof to the tenant space for installation of future refrigerant piping and other utilities.
    - Provide natural ventilation for shaft, including 4" duct at the bottom of the shaft connected to the outdoors.
- Provide roof space for installation of future air source heat pumps
    - Based on (2) 4-ton single-phase VRF systems, Mitsubishi MXZ-SM48 "Smart Multi"
- Metering: Heating and cooling energy use will be on tenant's electric utility meter.

Utility Spaces - Individual Air Source Heat pumps

- Outdoor unit located on roof with 24" stands.
- Indoor unit shall be wall mounted and gravity drain.
- Basis of Design: Mitsubishi P Series.
    - Elevator Machine Room: Qty-1 Mitsubishi PKA-A24 & PUZ-HA24
    - Main Electrical Room: Qty-1 Mitsubishi PKA-A24 & PUZ-HA24
- Metering: Heating and cooling energy use will be on landlord's electric utility meter.

Miscellaneous Heat for Freeze Protection

- Electric resistance heat for code compliance and protection of wet sprinkler system.
- Wall mounted heater with built-in tamper-proof control.
- Located at exterior doors, exterior stairs, entry vestibule.
- Metering: Heating and cooling energy use will be on landlord's electric utility meter.

Ventilation

Enclosed Parking Garage Ventilation

- Louvers shall be installed on opposite ends of the garage, approximately 12 SF each and 50 % free area (min.)
    - Louvers shall be connected to the outdoors by dedicated shafts or areaway.
- Two exhaust fans will serve the parking garage
    - (1) continuous exhaust (0.05 CFM/sq.ft.)
    - (1) intermittent exhaust (0.75 CFM/sq.ft.).
- Intermittent exhaust shall be initiated by gas detection system (CO and NO2).
- Intermittent exhaust shall be interlocked with motorized dampers.

Rental Dwelling Units - Central Energy Recovery Ventilation Units (ERVs)

- Central Energy Recovery Ventilation Units (ERVs) provide tempered ventilation air to all apartments, residential corridors and other spaces that may be occupied 24/7.
- ERV will be roof-mounted and located above corridors where possible. A spring vibration isolation curb may be needed based on final location.
    - Capacity is approximately 4000 CFM, Basis of Design ERV: AnnexAir ERP-E-05
- ERV shall include post-conditioning for heating and dehumidification of supply air.
    - ERV shall be connected to Air Source Heat Pump (ASHP).
    - Basis of Design VRF Outdoor Unit: Mitsubishi PUHY-EP120

- Outdoor air will be ducted to living room and bedrooms in each apartment.
- Exhaust air will be ducted from grilles in each bathroom and kitchen area back to central system.
    - Kitchen ranges will be served by recirculating hoods.
- Each supply and exhaust grille shall include a Constant Air Regulator (CAR) damper for balancing.
- Ventilation ductwork will be routed through the building vertically in fire-rated central duct shafts and horizontally in ceiling.
    - Ductwork to be tightly sealed with Aeroseal process.
    - Fire/Smoke control dampers will be required where ductwork penetrates fire-rated shafts.
    - Ceiling radiation dampers will be required where ductwork penetrates fire-rated ceilings.
- Metering:
    - Electricity usage for Central ERVs will be on landlord electric utility meter.

Rental Dwelling Units – Common Laundry Rooms

- Clothes dryers in common floor-by-floor laundry room shall be vented to the roof.
    - Provide a dedicated sheet metal duct riser to the roof, enclosed in fire-rated shaft.
    - Provide a rooftop fan for constant airflow in riser – Enervex BEF 315x
    - Fan shall be on generator power and run continuously
    - Each clothes dryer shall be connected to duct riser via a 22" sub-duct (no dampers)
- Provide a gravity intake on the roof and a duct riser serving each laundry room. Each laundry room shall have a dedicated supply fan to deliver un-heated makeup air to the "dryer plenum."
- Clothes dryers on each level shall be installed recessed in an outdoor air plenum constructed of framed walls and building insulation materials.

Ownership Dwelling Units - Central Energy Recovery Ventilation Units (ERVs)

- Central Energy Recovery Ventilation Units (ERVs) provide tempered ventilation air to all apartments, residential corridors and other spaces that may be occupied 24/7.
- ERV will be roof-mounted and located above corridors where possible.
    - Capacity is approximately 500 CFM, Basis of Design ERV: Ventacity VS 1000 RT
- ERV shall not include post-conditioning for heating and dehumidification of supply air.
- Outdoor air will be ducted to living room and bedrooms in each apartment.
- Exhaust air will be ducted from grilles in each bathroom and kitchen area back to central system.
    - Kitchen ranges will be served by recirculating hoods.
    - In-unit clothes dryers shall be ventless type.
- Each supply and exhaust grille shall include a Constant Air Regulator (CAR) damper for balancing.
- Ventilation ductwork will be routed through the building vertically in fire-rated central duct shafts and horizontally in ceiling.
    - Ductwork to be tightly sealed with Aeroseal process.
    - Fire/Smoke control dampers will be required where ductwork penetrates fire-rated shafts.
    - Ceiling radiation dampers will be required where ductwork penetrates fire-rated ceilings.
- Metering:
    - Electricity usage for Central ERVs will be on landlord electric utility meter.

Retail A & Retail B – Outdoor Air Louvers

- Provide outdoor air louvers at the tenant's floor level for installation of future individual ERVs.
- Provide (4) 2.5 square foot louvers located at least 10 feet from one another (two for each tenant)
- Louvers shall be blanked off and insulated for future connection by tenant.

Domestic Hot Water Systems:

Rental Units – Central Air Source Heat Pump Water Heaters with Recirculation

- Domestic Hot Water (DHW) shall be generated by central heat pump water heaters
    - Basis of Design: (2) Mitsubishi QAHV Heat Pump Water Heaters
    - (3) 285 Gal Storage Tanks
    - (1) 150 Gal Swing Tank, with 18kW electrical resistance element
    - (2) plate heat exchangers, hot water circulator pumps, buffer tanks
    - (1) system expansion tank
    - (1) Hot water mixing valve
- Mechanical room be located on the ground level, and the outdoor heat pumps located on the roof. Provide a dedicated piping shaft between the two locations.
- A pumping system will circulate water to the outdoor heat pump and be isolated from the main piping distribution via a plate/frame heat exchanger. Piping between heat exchanger and outdoor heat pump will be protected with glycol anti-freeze solution. Valved outlets shall be provided for the tie-in of temporary/rental water heater during heat pump service/outage.
- DHW recirculation system will be provided to maintain the DHW loop temperature.
- DHW shall be distributed horizontally on the top floor to a DHW vertical riser at each stack of apartments. DHW shall run down the building within interior chase and DHW recirculation piping shall run at lowest level and connect to each DHW riser.
- Metering
    - Domestic hot water energy use shall be on landlord's electric utility meter.

Ownership Units Option #1 - Individual Electric-Resistance Water Heaters with drain water heat recovery

- DHW will be generated by 30-gallon tank-style electric resistance heaters located within mechanical closet of each apartment
    - Basis of Design: A.O. Smith ENT-30 or equal
- Mechanical closet located centrally within apartment to avoid domestic hot water recirculation.
- Provide (1) R4-72 "Powerpipe" per apartment with 4" Diameter, 72" Length and ¾"CW connection,
- Pipe cold water supply from Powerpipe through unit water meter and to all fixtures including water heater.
- Mechanical closet containing water heater will include a floor drain.
- Metering:
    - Domestic hot water energy use shall be on tenant's electric utility meter.

Ownership Units Option #2 - Individual Electric-Resistance Water Heaters (no heat recovery)

- DHW will be generated by 50-gallon tank-style electric resistance heaters located within mechanical closet of each apartment
    - Basis of Design: A.O. Smith ENT-50 or equal
- Mechanical closet located centrally within apartment to avoid domestic hot water recirculation.
- Mechanical closet containing water heater will include a floor drain.
- Metering:
    - Domestic hot water energy use shall be on tenant's electric utility meter.

Core & Shell Spaces (Retail A & Retail B)

- No water heating to be provided for core & shell space. Tenant to provide future electric resistance or heat pump water heating.

Plumbing

- Domestic cold water entrance for the rental building will be located in the ground level water service room. One utility water meter will be provided at water entrance. Domestic cold water entrance for the ownership building will be located in the water service room – location TBD. One utility water meter will be provided at water entrance.
- Metering: A domestic water sub-meter will be installed on the independent cold water supplies to the residential and retail occupancies for the rental building. Provide a cold water sub-meter on the entrance to the water heater to track hot water usage. Sub-meter will have capacity for both manual and digital collection. Data collection or analysis equipment will be by owner. A domestic water sub-meter will be installed on the independent cold water supply to the home ownership building. Provide a cold water sub-meter on the supply to each apartment. Sub-meters will have capacity for both manual and digital collection. Data collection or analysis equipment will be by owner.
- Provide new sanitary drainage, storm drainage, domestic water distribution and natural gas systems for rental and ownership buildings – the following materials are acceptable:
    - Domestic water piping: Copper Type L (within all non-residential spaces including mechanical rooms, retail spaces, laundry rooms), CPVC (within residential units including risers & branches to fixtures)
    - Sanitary waste and vent piping: Cast Iron (within all non-residential spaces including mechanical rooms, retail spaces, laundry rooms) or PVC Schedule 40 (within residential units including risers & branches to fixtures)
    - Storm drain piping: Cast Iron or PVC Schedule 40
    - Gas piping: Steel
- Provide new plumbing fixtures and equipment throughout the ownership and rental buildings. Target plumbing fixtures flow rates are the following:
    - Water Closets: 1.28 gpf
    - Lavatory: 0.5 gpm
    - Showerhead: 1.5 gpm
    - Kitchen Sink: 1.5 gpm

Core & Shell Spaces (Retail A & Retail B)

- Provide capped and valved 2” domestic water pipe within retail spaces for future connection.
- Provide 20’ of 4” sanitary main strategically located under the retail spaces for future connection of retail sanitary stacks or fixtures.
- Provide qty 2 – 3” plugged sanitary vent connections on the ground level.

Proposed Fire Protection System:

- Fire water service to include a 6” fire main with double check detector assembly for backflow prevention.
- Provide a complete NFPA 13 automatic wet pipe sprinkler system with full building coverage.
- Provide complete NFPA 14 manual standpipe system.
- Stairway vertical risers to include combination sprinkler/standpipe risers.
- Pressure & flow data from hydrant test will be used to determine fire pump requirement.

Core & Shell Spaces (Retail A & Retail B)

- Provide dedicated floor control valve assemblies to serve Retail A and Retail B.
- Provide a complete NFPA 13 automatic wet pipe sprinkler system with full coverage of Retail A and Retail B.

- Tenant to update sprinkler layout upon reallocation of interior spaces in accordance with NFPA requirements.

Proposed Electrical Service & Distribution:

Electrical Service & Distribution

- The electrical service shall be provided from a Utility pad mounted transformer. Two 5" underground conduits shall be provided in a concrete encased duct bank from the point of utility connection to the pad mounted transformer for the primary service conductors. A primary switch may be required by the Utility to feed the pad mount transformer.
- The building shall be provided with a 120/208 volt, 3-phase, 3800 amp service fed from the Eversource owned pad mounted transformer.
- Provide (8) sets of 4#750 kcmil (CU) in 4"C concrete encased ductbank from the pad mounted transformer to the main switchboard "MSB".
- The building's main switchboard shall have a rating of 4000 amp, 120/208V, 3-phase, 4-wire, 100k AIC and shall have Arc Energy Reduction system for compliance with NEC Article 240.87.
- The main switchboard "MSB" shall have a split buss incoming pull section, (3) service main disconnect sections, a house main CT section, and (2) house distribution sections.

  The switchboard shall have the following:

  - Section #1 – 4000 Amp Incoming Pull Section.
    - Provide split bus incoming section with horizontal buss bars to serve Section #1, Section #2, Section #3, Section #4, and Section #4.
  - Section #2 – Unmetered Apartment (Rental) Unit Distribution
    - Apartment - 1200A-3P trip, 100% rated insulated case type circuit breaker electronic trip.
    - Surge protection device
  - Section #3 – Unmetered Apartment (Ownership) Unit Distribution
    - Apartment - 800A-3P trip, 100% rated insulated case type circuit breaker electronic trip.
    - Surge protection device
  - Section #4 – Unmetered Tenant (Retail) Distribution
    - Tenant - 600A-3P trip, 100% rated insulated case type circuit breaker electronic trip.
    - Surge protection device
  - Section #5 – House Meter and CT Section
    - 2500 amp CT cabinet
    - Customer Meter
  - Section #6 – House Distribution Section:
    - 2500A-3P trip MCB, 100% rated insulated case type circuit breaker with electronic trip LSI capabilities.
    - Arc Energy Reduction
    - Surge protection device
    - 3000 amp bussing and feeder breakers as noted below (oversized for future P/V)

- All feeder circuit breakers shall be molded case type. The house distribution section shall contain the following circuit breakers:

  - 100A-3P circuit breaker and feeder to serve the Emergency Power ATS Switch "ATS-EM".

- 200A-3P circuit breaker and feeder to serve the Legally Required Standby Power Automatic Transfer Switch "ATS-LR".
- 200A-3P circuit breaker and feeder to serve the Optional Standby Power Automatic Transfer switch "ATS-OS".
- 150A-3P circuit breaker and feeder to serve the house panel "HPGA" on the garage floor for lighting, power, mechanical equipment and other equipment.
- 200A-3P circuit breaker and feeder to serve panel "HP1A" on the first floor for lighting and power.
- 200A-3P circuit breaker and feeder to serve panel "HPLA" located in the common laundry room for the rental apartment use.
- 225A-3P circuit breaker and feeder to serve panels "HP2A" and "HP5A" located on the second and fifth floors for lighting and power.
- 600A-3P circuit breaker and feeder to serve panel "EVCP". This feeder shall feed a 600 amp, 3-phase, 4-wire, 54 pole, 100KAIC panelboard "EVCP" located on the garage floor for powering the EV car chargers located in the garage. Panelboard "EVCP" shall be provided with (22) 50A-2P circuit breakers to serve outdoor EV Car chargers. Quantities will be verified and EVCP rating will be adjusted as necessary.
- 200A-3P reverse feed circuit breaker for future solar PV array. This breaker must be at the end of the bussing opposite the MCB.
- Spare circuit breakers including (1) 400A-3P, (1) 225A-3P and (1) 100A-3P

Residential Distribution Panels and Apartment/Tenant Load Centers

- All apartment units will be served from meterbanks located on each floor. Each meter and included circuit breaker will be rated 125A. This will be adjusted as necessary based on actual unit load calculations. For example, the studio units may be 100A. None will be less than 100A.
- Apartment units will be provided with 100 amp or 125 amp, 208/120V, 1-phase loadcenters. Loadcenter feeders shall be aluminum type MC feeder cable rated for 100 amps.
- Apartment loadcenter shall be rated MLO type, 100 amps, 30-poles, 65k AIC with aluminum bussing. Each loadcenter shall contain AFCI and GFCI/AFCI combination circuit breakers as required by code to serve loads within the apartments. As a minimum, each apartment shall have the following circuits:
    - (2) 20 amp circuits for kitchen counter receptacles (AFCI Circuit breakers)
    - (2) 20 amp circuits for living room and common area receptacles (AFCI Circuit Breakers)
    - (1) 20 amp circuit for lights, smoke alarms, and CO/smoke alarms (AFCI circuit breakers)
    - (1) 20 amp circuit refrigerator. (AFCI/GFCI circuit breaker)
    - (1) 20 amp circuit for dishwasher (AFCI/GFCI circuit breaker)
    - (1) 20 amp circuit for kitchen hood exhaust/microwave. (AFCI/GFCI circuit breaker)
    - (1) 20 amp circuit for garbage disposal. (AFCI/GFCI circuit breaker)
    - (1) 20 amp circuit for bathroom receptacle. (AFCI circuit breaker)
    - (1) 20 amp circuit for each bedroom (AFCI circuit breakers)
    - (1) 20 amp circuit for the laundry/washer circuit (AFCI/GFCI circuit breaker)
    - (1) 30A-2P circuit for the electric dryer circuit (GFCI circuit breaker)
    - (1) 50A-2P circuit for electric range (GFCI Circuit breaker)
    - (1) 15A-2P circuit for indoor hvac unit
    - (1) 30A-2P circuit for outdoor hvac unit (on roof)
- Apartment loadcenters for Group 2 accessible units shall include the following additional circuit breakers:
    - (1) 30A-2P circuit for electrical cooktop
    - (1) 20A-2P circuit for electrical walloven

Tenant Site Preparation

- The electrical subcontractor shall install (2) 2" and (2) 1" EMT conduits to the roof from the proposed location of the tenant main electrical room for future roof top VRF equipment.

Solar Photovoltaic System Turnkey Solution

- The General Contractor shall own in their bid the cost to coordinate the installation of a Solar PV system with the owner's PV consultant.
- The electrical sub-contractor shall install (2) 3" EMT conduits for the DC wire run from the designated array location to the designated inverter location (cap and label both ends).
- The electrical sub-contractor shall install (2) 3" EMT conduits from the designated inverter location to designated location of the exterior Solar PV disconnect switch. (Cap and label both ends)
- The electrical sub-contractor shall install (2) underground 3" EMT conduits from the electrical switchboard to the designated location of the exterior Solar PV disconnect switch. (cap and label both ends).
- The electrical sub-contractor shall install and label a 4' x 4' plywood panel area for mounting an inverter and balance of system components.

Emergency Generator

- A 125kW/150kVA diesel fueled generator shall be located on grade within a weatherproof Level 2 sound attenuated enclosure. The generator shall serve Emergency (EM), Legally Required Standby (LR) and Optional Standby (OS) loads via automatic transfer switches (ATS). The location of the generator will require further coordination given the limited site space.
- The generator shall have a main lugs feeding a wireway in the emergency electric room with a 600 amp feeder. The 600 amp feeder shall be MI cable or installed in a 2-hour rated enclosure within the building.
- The (3) circuit breakers serving the ATS switches shall be:
    - 400 amp frame, 100 amp trip, 3-pole molded case circuit breaker with electronic trip capability to serve ATS-EM via a 100 amp MI cable feeder.
    - 400 amp frame, 250 amp trip, 3-pole molded case circuit breaker with electronic trip capability to serve ATS-LR via a 250 amp feeder.
    - 400 amp frame, 200 amp trip, 3-pole molded case circuit breaker with electronic trip capability to serve ATS-OS via a 200 amp feeder.
- A manual transfer switch shall be provided outdoors at the generator concrete pad as required per NEC 700.3 and serve the emergency system automatic transfer switch "ATS"-EM".
- A 100 Amp, 208/120V, 3-phase, 4-wire emergency panel "EMP1A" with sub-feed lugs shall be located in the main emergency electric room on the first level and be fed from "ATS-EM".
- A 200 Amp, 208/120V, 3-phase, 4-wire optional standby panel "OSP1A" with sub-feed lugs shall be located in the main emergency electric room on the penthouse level and be fed from "ATS-OS".
    - A 200 amp feeder shall be provided from the sub-feed lugs to serve a 225 amp, MLO, 30-pole panel "OSP5B" on level 5.
- A 250 Amp, 208/120V, 3-phase, 4-wire panel "LRP1A" shall be located in the main emergency electric room and be fed from "ATS-LR". This panel shall feed each elevator with a 125A-3P feed. The general contractor shall coordinate with the elevator manufacturer to provide a selector switch allowing only one elevator in the building to operate when on standby power.

Wiring Methods

- Electrical service conductors shall be copper type XHHW-2 conductors. Aluminum conductors and type THHN shall not be permitted.
- Feeder conductors serving house panels shall be copper type XHHW. All feeders shall be installed in EMT.
- Loadcenter feeders which shall be type MC Cable aluminum and be custom ordered with oversize equipment grounding conductor to accommodate voltage drop.
- 2-hour rated cable shall be MI cable type.
- All branch conductors shall be copper conductors.
- Where concealed, conductors shall be permitted to run in metal clad cable. All exposed branch circuits and feeder shall be run in EMT conduit.
- Wiring within dwelling unit shall be permitted to consist of non-metallic-sheathed cable where the building construction type and MEC allows.

Common Area Lighting & Power

- 20 amp, 120V commercial grade duplex receptacles shall be located throughout common areas per the program needs and the minimum requirements of code. No more than six (6) 20 amp, 120V duplex receptacles shall be connected to a 20A-1P circuit.
- Receptacles shall be located within 10'-0" from ends of corridors and be spaced no more than 40'-0" apart.
- Each floor shall be provided with a minimum of (2) 20A-1P emergency lighting branch circuits and (2) 20A-1P normal power branch circuit to serve lighting.
- Each stairwell will be provided with (1) 20A-1P emergency branch circuit and (1) 20A-1P optional standby circuit.
- Provide a complete interior lighting system. Light fixtures shall be as selected by architect and interior designer. Scope shall include all fixtures, lamps, mounting hardware, switching, wiring, raceways, and all other components necessary to form a complete lighting system. The lighting system shall comply with the State of Massachusetts Energy Code and 780 CMR Appendix Stretch Energy Code and shall utilize Energy Star or DLC rated LED fixtures throughout.
- Light fixtures in corridors and lobbies shall be controlled by occupancy sensors for step dimming.
- Light fixtures in amenity areas and other common spaces shall be controlled by a room controllers with raise/lower dimming that meets the energy code.
- Provide a complete emergency egress and exit sign lighting system. Emergency lighting shall consist of selected light fixtures connected to the emergency generator. Provide UL924 shunt and bypass relays to bypass emergency lighting controls.
- Provide a complete exterior site lighting system to adequately walkways and building egress paths per the civil engineer and landscape architect design. Provide an exterior wall LED over each egress door. Provide a lighting control panel system for the exterior lighting controls.
- Provide at least one wall switch for each enclosed room or area. Provide a convenience receptacle for each corridor level, and each storage or janitors room. Provide a general-purpose receptacle on each wall in mechanical rooms or spaces. Provide receptacles and circuitry for all owner furnished common area equipment and appliances including washers and dryers, compactors, security head-end equipment, voice and data equipment, etc.

- Provide power wiring circuits, safety disconnect switches, and magnetic motor starters as required for all electrically operated mechanical equipment furnished and installed by HVAC, plumbing and fire protection contractors.
- Provide electrical work as necessary for the Group 2 Accessible units. Electrical systems in accessible units shall comply with Americans with Disabilities Act Guidelines (ADAG) and Massachusetts Architectural Access Barrier Board Requirements. Group 2 unit's appliances will be similar to non-accessible units with the exception of the installation of a separate wall oven and cooktop. Provide a visual doorbell system in Group 2 units.
- Dwelling units shall be provided with rocker switches for control of lights.

Fire Alarm System

- The fire alarm system shall be an addressable system with Class A wiring for NAC and SLC circuits. The fire alarm panel shall be located within the main electric room. An annunciator shall be provided at the building entrance and a flashing beacon shall be provided at fire department entrance. A single Master Box shall be provided, and the building's main fire alarm control panel shall be tied to the Boston Fire Department by a digital communicator monitored by a U.L. listed licensed central station facility. Provide a graphic plaque and as-built cabinet adjacent to the fire alarm control panel.
- All common areas and corridors shall be provided with manual pull stations, smoke detection and audio/signaling devices per NFPA 72.
- All electrical and telephone rooms shall be provided with smoke detectors with remote alarm indicator units.
- All mechanical rooms shall be provided with heat detectors with remote alarm indicator units.
- Duct mounted smoke detectors shall be located in the supply and return of all HVAC units with a capacity greater than 2000 cfm. The detector shall be provided with a remote test station.
- Duct mounted smoke detectors shall be provided in rated shafts to control a local smoke damper. The detector shall be provided with a remote test station
- The fire alarm system shall activate elevator recall.
- The fire alarm systems shall monitor the buildings sprinkler system flow, tamper and pressure switches.
- Each standard apartment unit shall be provided with a local 120-volt smoke alarm inside each bedroom and a combination smoke/CO alarms outside of each bedroom within 10' of the bedroom door. Alarms shall be tandem wired within each apartment.
- A low-frequency 520hz horn shall be provided in each bedroom and living room of each standard apartment unit.
- Each hearing-impaired apartment unit shall be provided with system type smoke detectors inside of each bedroom and combination smoke/CO detectors outside of each bedroom within 10' of the bedroom door. Detectors shall be provided with sounder bases to sound upon both local and general alarm.
- Each hearing-impaired apartment unit shall be provided with 177cd strobe only devices in the bedroom(s) and bathroom(s). Devices shall be labelled as "Alert" and shall activate upon local smoke, local CO and building general fire alarm.

Emergency Responder Radio Coverage System

- An emergency responder radio coverage system (Bi-Directional Amplifier system) shall be provided in compliance with MA 780 CMR requirements and Chelsea FD requirements and shall be installed per NFPA 72 and 1221. The antenna shall be located on the roof and the amplifier and filter cabinet shall be located on the top floor. The riser cable from the lowest floor to the top floor shall be installed in either a 2-hour rated shaft with 2-hour rated access panels or be located in stacked 2-hour rated closets.

Two-Way Elevator Lobby Communication System

- A Two-Way Elevator Lobby Communications system shall be provided on all upper level elevator landings to meet the requirements of the MA State building code. The system shall include a base station located next to the fire alarm annunciator, flush mounted call box stations located at each elevator landing and signage. The Two-Way Elevator Lobby Communications systems shall be provided with telecommunications wiring for dial-out to the owner's central station via a dedicated telephone service. All cabling shall be 2-hour rated MI cable.

Entry Apartment Intercom Video System

- An audio and video intercom and door release system shall be provided for access. Apartment video intercom system shall be provided in each apartment. Provide a hearing-impaired notification system in the designated hearing-impaired units. The hearing-impaired system shall consist of a labelled pushbutton at the unit entry door, an audio/visual device in each living space and bedroom, a system transformer and all necessary power and wiring.

Security and Access Control System

- The security and access control system for the building will consist of back-boxes and raceways for selected door card access readers, closed circuit television cameras (CCTV) and motion sensors. A 2-gang backbox and 1" empty conduit shall be provided for each device location. The 1" conduit shall be run to the building's security and access control panels located in the telecommunication closets.
- Provide 120 volt for headend equipment and for security and access control devices where required throughout the building.

Telecommunication System

- The telecommunications service to the building shall consist of a (2) 4" conduit concrete encased duct bank routed from the telecommunication service provider manholes to the main telecommunications room.
- Main telecommunication room shall be provided with fire-resistant plywood backboard, ground bus, and (4) quad receptacles. The telecommunication rooms shall be combined with the electrical rooms on each floor. The telecommunications rooms from the 2nd to 5th floors should be stacked and contain plywood backboard, ground bus and (2) quad receptacles. (2) 4" conduit sleeves shall be provided from the main telecommunication room to the 2nd floor telecommunication closets. (3) 4" conduit sleeves shall be provided between each of the stacked 2nd through 5th floor closets.
- A media panel, structured cabling and devices shall be provided in each apartment unit. Provide (1) RG-6 coax cable, (1) microfiber duct, and (1) CAT 6 cable from the floor telecommunication room to the media panel in each apartment unit. Provide all cabling, backboxes, outlets and faceplates in each apartment.
- Each residential unit shall be provided with a minimum of cable drops as follows: TV/data drop (RG-6 and CAT6) in each bedroom and living room and kitchen. Phone/Data drop in each bedroom and living room ((2) CAT6).
- All tele/data outlets in non-apartment areas shall be provided with backbox, conduit and CAT6 cabling back to the house server rack located in the first floor MDF room. Include data ports and cover plates.

Appendix E

Climate Resiliency Checklist

Response Summary

Assigned To	Josh McLinden
Target Record	CHA-000097
Status	Completed
Progress	97.47%
Response Language	English
Response Channel	

Response Detail

Information

Question	Response	Comment
Building Name 639 Warren Street		
Related Project 639 Warren Street		
Building Street Number	639	
Building Street Name	Warren	
Building Street Suffix	Street	
Select the type of filing	Initial/NPC	
Filing Contact Name Josh McLinden		
Filing Contact Email jmclinden@madison-park.org		

Team

Enter the names of the companies/organizations on the project team.

Question	Response	Comment
Owner/Developer Madison Park Development Corporation		
Architect	Studio Luz Architects	
Landscape Architect	Design Under Sky	
Mechanical Engineer	Petersen Engineering	
Sustainability / LEED	CLEAResult	
Performance Modeler	Petersen Engineering	
Civil Engineer	Nitsch Engineering	
Permitting	McDermott, Quilty, Miller & Hanley LLP	
Construction Management	TBD	
Transportation Consultant	Howard Stein Hudson	
Consultant for Advanced Energy Feasbility Assessment	TBD	

Building Description and Design Conditions

Question	Response	Comment
Date COBUCS Report was submitted	9/20/2024	
Site Area (SF)	32702	
Length of sidewalk to be reconstructed (LF)	367.00	
What are the building's First Floor Building Uses?	Office, Residential - High Occupant Density, Retail & Services	
Please specify the building's below grade uses.	N/A or None	
Building Gross Square Feet 81000		
Project Gross Square Feet		

Question	Response	Comment
81000		
Building Gross Floor Area 81000		
Building Height (Ft)		
Building Height (Stories)		

Description and Design Conditions - Building Envelope

When reporting U values, report total assembly U value including supports and structural elements.

Note: for any data (number) requests that are not applicable to this project, please enter a value of 0.

Question	Response	Comment
Roof Area (SF)	18090	
Roof U Value	0.027	
Foundation Wall Area (SF)	0	
Foundation Wall U Value	0.000	
Exposed Floor Area (SF)	6153	
Exposed Floor U Value	0.032	
Slab on Grade Area (SF)	9772	
Slab on Grade U Value	0.159	

Description and Design Conditions - Vertical Above-Grade Assemblies

When reporting U value, report total assembly U value including supports and structural elements.

For any data (number) requests that are not applicable, please enter a value of 0.

Question	Response	Comment
Building Infiltration Rate (AHC @ 50 Pa)	0.06	
Window to Wall Ratio (%)	14%	
Opaque Curtain Wall / Spandrel Area (SF)	792	
Opaque Curtain Wall / Spandrel U Value	0.219	
Opaque Framed Wall Area (SF)	45607	

Question	Response	Comment
Opaque Framed Wall U Value	0.032	
Vision Glazing/Window Type 1 Area (SF)	4523	
Vision Glazing/Window Type 2 Area (SF)	1631	
Vision Glazing/Window Type 1 U Value	0.270	
Vision Glazing/Window Type 2 U Value	0.280	
Vision Glazing/Window Type 1 SHGC	0.35	
Vision Glazing/Window Type 2 SHGC	0.35	
Doors - Area (SF)	155	
Doors - U Value	0.590	
Total Wall Area (SF)	52708	
Vertical U Average	0.064	
Whole Building U Average	0.065	

Article 37 Green Building

Question	Response	Comment
LEED Certified	Registered	
LEED Version	v4	
LEED Rating System	Homes Multifamily - Midrise	
Proposed LEED Rating	Gold	
Proposed LEED point score	67.0	
LEED Zero Certification	LEED Zero Carbon	

Building 2035 Predictive Carbon Emissions Intensity (pCEI) Targets and Performance

Using predictive modeling and 2035 Emission Factors, report the modeled performance for Primary, Secondary, and Tertiary Building Uses and the Whole Building including Energy Source Amount(s) and pCEI(s). If multiple uses share common systems or are not individually modeled, use a common pCEI. Otherwise provide use specific performance data.

Note: For any data (number) requests that are not applicable, please enter a value of 0.

Question	Response	Comment
2035 Emissions Factor Electric (kg CO2e/MBtu) 52.1		
2035 Emissions Factor Gas (kg CO2e/MBtu) 53.11		

Building 2035 pCEI Targets and Performance - Primary Use

In the next sections, we ask for information about up to three building uses. Using predictive modeling and 2035 Emission Factors, report the modeled performance for Primary Building Uses including Energy Source Amount(s) and pCEI(s). If multiple uses share common systems or are not individually modeled, use a common pCEI. Otherwise provide use specific performance data.

Note: For any data (number) requests that are not applicable, please enter a value of 0.

Question	Response	Comment
Please indicate the building's primary use type	Residential - High Occupant Density	
Square footage of the building's primary use floor area including related uses	77259	
Primary Use Annual Electric (MBtu/yr)	2620	
Primary Use Annual Electric pCEI (kg CO2e/sf/yr)	1.80	
Primary Use Annual Gas/Other (MBtu/yr)	0	
Primary Use Annual Gas/Other pCEI (kg CO2e/sf-yr)	0.00	
Primary Use Energy Amount Totals (MBtu/yr)	2620	
Primary Use pCEI totals (kg CO2e/sf-yr)	1.80	
Does the building have a secondary use that you would like to record pCEI performance for?	No	

Building 2035 pCEI Targets and Performance - Whole Building

Using predictive modeling and 2035 Emission Factors, report the modeled performance for Whole Building Uses including Energy Source Amount(s) and pCEI(s). If multiple uses share common systems or are not individually modeled, use a common pCEI. Otherwise provide use specific performance data.

Note: for any data / number requests that are not applicable, please enter a value of 0.

Question	Response	Comment
Whole Building pCEI (kg CO2e/sf-yr)		
Total Annual Energy (Mbtu/yr)		
Energy Use Intensity (kBtu/sf-yr)	34	
Annual Heating (kBtu/sf-yr)	360705	
Peak Heating Load (Btu/hr-sf)	4	
Annual Cooling (kBtu/sf-yr)	409599	
Peak Cooling Load (Btu/hr-sf)	3	
Energy Code Compliance Path	Passive House	
Energy Use Below Code (%)	0%	

Building Performance Assistance (Utility, State and Federal)

Question	Response	Comment
Has the project team met with utility representative for project assistance?	No	
Have the local utilities reviewed the predictive performance model?	No	
Will the project receive assistance?	Yes	
How much funding assistance?	29000000	Funding TBD

Carbon Emission Mitigation - On-site Renewable Energy Generation

Question	Response	Comment
System 1 - select the type	Solar PV	
System 1 Ownership	Direct Ownership	

Question	Response	Comment
System 1 - indicate it's size in kW	96	
System 1 Annual Output (kWh)	106878	
System 2 - select the type	No	
Total Systems (kW)		
Total Annual Output (kWh)		

Carbon Emission Mitigation - On-site Renewable Energy Storage

Question	Response	Comment
Select the Energy Storage System Type	No	
Describe the ownership	TBD – OWNER WILL EVALUATE FEASIBILITY AS THE DESIGN PROGRESSES.	
Storage System Size (kW)	0	
Storage System Capacity (MBtu)	0	

Building Carbon Emission Mitigation – Off-site measures - Procurement Renewable Electricity

Question	Response	Comment
Describe the type of Renewable Electricity procurement	TBD – OWNER WILL EVALUATE FEASIBILITY AS THE DESIGN PROGRESSES.	
Describe the source of renewable electricity	TBD – OWNER WILL EVALUATE FEASIBILITY AS THE DESIGN PROGRESSES.	
Annual Quantity of renewable electricity *(kWh)*	0	
Renewable electricity procurement - % of total Annual Electricity Usage	0%	

Building Carbon Emission Mitigation – Off-site measures - Procurement RECs, Power Purchase Agreements, and other Mechanism

Question	Response	Comment
Describe the type of RECs, Power Purchase Agreements, and other Mechanism	TBD – OWNER WILL EVALUATE FEASIBILITY AS THE DESIGN PROGRESSES.	
Source of RECs, Power Purchase Agreements, and other Mechanism	TBD – OWNER WILL EVALUATE FEASIBILITY AS THE DESIGN PROGRESSES.	
Annual Quantity of RECs, Power Purchase Agreements, and other Mechanism (tons of CO2e)	0	
Percent of total Annual Carbon Emissions - RECs, Power Purchase Agreements, and other Mechanism	0%	

Payments for Non-electricity Carbon Emissions

Question	Response	Comment
Describe the type of non-electricity carbon emissions	All electric systems	
Source of non-electricity carbon emissions	None	
Annual Quantity (tons of CO2e)	0	
Non-electricity carbon emissions - % of annual carbon emissions	0%	

Extreme Heat Mitigation - Site (Existing and Proposed)

Annual average temperature in Boston increased by about 2F in the past hundred years and will continue to rise due to climate change. By the end of the century, the average annual temperature could be 56° (compared to 46° now) and the number of days above 90° (currently about 10 a year) could rise to 90.

Note: please enter a value of 0 for any data/number requests that do not apply to your project.

Question	Response	Comment
Existing Hardscape - Percent of Site	0%	

Question	Response	Comment
Proposed Hardscape - Percent of Site	85%	
Existing Softscape - Percent of Site	99%	
Proposed Softscape - Percent of Site	15%	

Extreme Heat Mitigation - Urban Heat Island Reduction – Proposed Site and Building

Question	Response	Comment
Non-roof Landscape Area (SF)	4869	
Non-roof Landscape Percent of Site (%)	15%	
Non-roof Landscape - Area Meeting LEED Criteria (SF)	0	
Non-roof Landscape - SRI Value	0	
Non-roof Hardscape - Area (SF)	9418	
Non-roof Hardscape Percent of Site (%)	29%	
Non-roof Hardscape - Area Meeting LEED Criteria (SF)	29	
Non-roof Hardscape - SRI Value	0	
Roof Surface Area (SF)	18391	
Roof Surface Percent of Site (%)	56%	
Roof Surface Area Meeting LEED Criteria (SF)	0	
Roof Surface SRI Value	0	
Roof Vegetated Area (SF)	0	
Roof Vegetated Percent of Site (%)	0%	
Roof Vegetated Area Meeting LEED Criteria (SF)	0	
Roof Vegetated SRI Value	0	
Total Area (SF)	32678	

Question	Response	Comment
TOTAL Area Meeting LEED Criteria (SF)	29	
Total SRI Value (weighted average)	0	
Vertical Cool Wall Area (SF)	0	
Vertical Cool Wall Area Meeting LEED Criteria (SF)	0	
Vertical Cool Wall - Percent Meeting LEED Criteria	0%	

Extreme Precipitation Mitigation - Storm Water Management - Site and Building

From 1958 to 2010, there was a 70 percent increase in the amount of precipitation that fell on the days with the heaviest precipitation. Currently, the 10-Year, 24-Hour Design Storm precipitation level is 5.25”. There is a significant probability that this will increase to at least 6” by the end of the century. Additionally, fewer, larger storms are likely to be accompanied by more frequent droughts.

Question	Response	Comment
Are any parcels across the entire project located in a Groundwater Conservation Overlay District (GCOD)?	No	
Permeable Site Surfaces - Area (SF)	4869	
Permeable Site Surfaces - % of Site	15%	
Impermeable Site Surfaces - Area (SF)	27809	
Impermeable Site Surfaces % of Site (SF)	85%	
Imp. Surfaces Water fr 1" of Rain (CF)	2317	
Imp. Surfaces Water fr 1.25" Rain (CF)	0	
Roofs - Area (SF)	18391	
Roofs - Percent of Site (SF)	56%	
Roofs - Water from 1" of Rain (CF)	1533	
Roofs - Water from 1.25" of Rain (CF)	0	
Total Area Precipitation Mitigation (SF)	51069	
TOTAL - Water from 1'' of Rain (CF)	3850	

Question	Response	Comment
TOTAL - Water from 1.25'' of Rain (CF)	0	
Rain Water Reuse - Type	n/a	
Rain Water Reuse - Amount (CF)	0	
Storm Water Reuse - Type	n/a	
Storm Water Reuse - Amount (CF)	0	
Green Infrastructure - Type	n/a	
Green Infrastructure - Amount (CF)	0	
Storm Water Retention - Type	Below grade storage and recharge	
Storm Water Retention - Amount (CF)	2317	
TOTAL Retention - Amount (CF)	2317	

Sea Level Rise and Storms

Under any plausible greenhouse gas emissions scenario, sea levels in Boston will continue to rise throughout the century. This will increase the number of buildings in Boston susceptible to coastal flooding and the likely frequency of flooding for those already in the floodplain.

Question	Response	Comment
Is any portion of the site in a FEMA SFHA zone?	No	
Is any portion of the site in the BPDA Coastal Flood Resilience Overlay District? Use the online BPDA Zoning Viewer (http://maps.bostonredevelopmentauthority.org/zoningviewer/) to assess the susceptibility of the project site.	No	

Appendix F

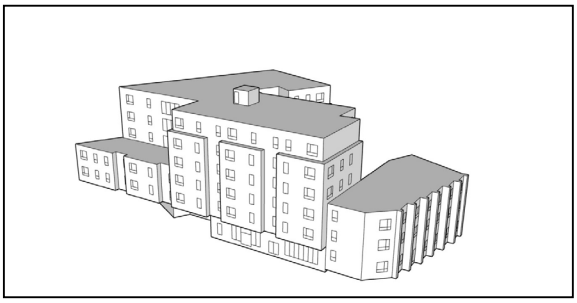
Carbon Neutral Building Assessment

Appendix F.1

Energy Model

BUILDING INFORMATION

Category:	**Residential**
Status:	**In planning**
Building type:	**New construction**
Year of construction:	
Units:	**63**
Number of occupants:	**179 (Design)**
Occupant density:	**431.6** ft²/Person



Boundary conditions

Climate:	**BOSTON LOGAN INT ARPT MA**
Internal heat gains:	**1.1** Btu/hr ft²
Interior temperature:	**68** °F
Overheat temperature:	**77** °F

Building geometry

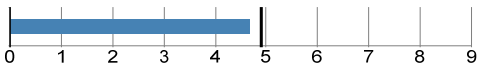
Enclosed volume:	**1,043,555.6** ft³
Net-volume:	**1,000,866.9** ft³
Total area envelope:	**87,089.2** ft²
Area/Volume Ratio:	**0.1** 1/ft
Floor area:	**77,259** ft²
Envelope area/iCFA:	**1.127**

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: PHIUS CORE 2021

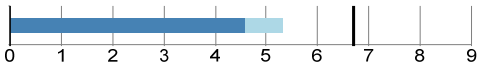
Heating demand

specific:	**4.67** kBtu/ft²yr
target:	**4.9** kBtu/ft²yr
total:	360,705.26 kBtu/yr



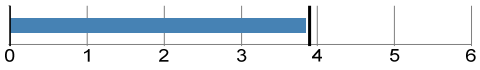
Cooling demand

sensible:	**4.58** kBtu/ft²yr
latent:	**0.72** kBtu/ft²yr
specific:	**5.3** kBtu/ft²yr
target:	**6.7** kBtu/ft²yr
total:	409,599.35 kBtu/yr



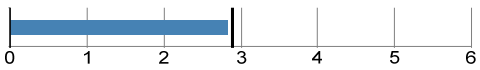
Heating load

specific:	**3.84** Btu/hr ft²
target:	**3.9** Btu/hr ft²
total:	296,399.75 Btu/hr



Cooling load

specific:	**2.84** Btu/hr ft²
target:	**2.9** Btu/hr ft²
total:	219,032.4 Btu/hr

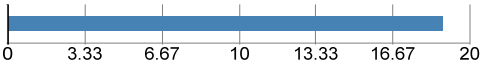


Source energy

total:	**767,848.52**	kWh/yr
specific:	**4,290**	kWh/Person yr
target:	**4,575**	kWh/Person yr
total:	**2,619,749.3**	kBtu/yr
specific:	33.91	kBtu/ft²yr

Site energy

total:	1,455,416.28	kBtu/yr
specific:	18.84	kBtu/ft²yr
total:	426,582.51	kWh/yr
specific:	5.52	kWh/ft²

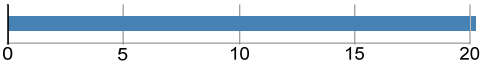


Air tightness

ACH50:	**0.44**	1/hr
CFM50 per envelope area:	**0.08**	cfm/ft²
target:	**0.44**	1/hr
target CFM50:	**0.08**	cfm/ft²

PASSIVEHOUSE RECOMMENDATIONS

Sensible recovery efficiency:	**72.9**	%
Frequency of overheating: Cooling system is required	**46.1**	%



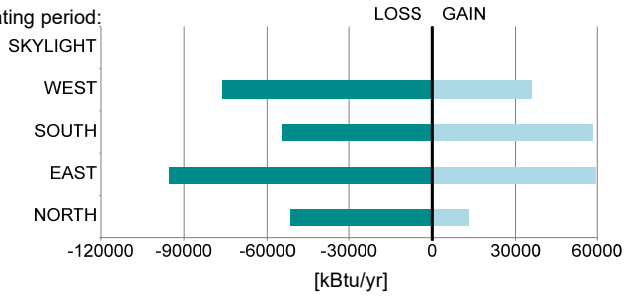
Frequency of overheating only applies if there is not a [properly sized] cooling system installed.

BUILDING ELEMENTS

Windows

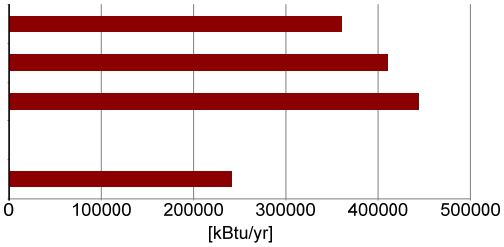
Average SHGC:	**0.35**	
Average solar reduction factor heating:	**0.57**	
Average solar reduction factor cooling:	**0.53**	
Average U-value:	**0.273**	Btu/hr ft² °F
Total glazing area:	**7,094.5**	ft²
Total window area:	**7,101.3**	ft²

Heat gain/loss heating period:



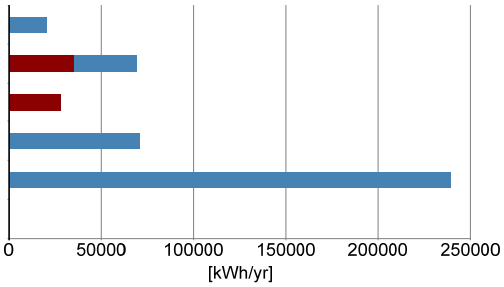
HVAC

Total heating demand:	**360,705**	kBtu/yr
Total cooling demand:	**409,599**	kBtu/yr
Total DHW energy demand:	**444,717**	kBtu/yr
Solar DHW contribution:	**0**	kBtu/yr
Auxiliary electricity:	**240,238**	kBtu/yr



Electricity

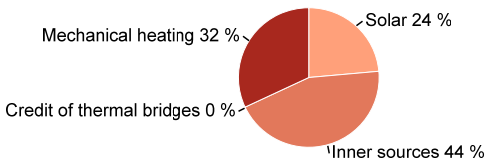
Direct heating / DHW:	**20,580**	kWh/yr
Heatpump heating:	**68,704**	kWh/yr
Cooling:	**27,817**	kWh/yr
HVAC auxiliary energy:	**70,414**	kWh/yr
Appliances:	**239,067**	kWh/yr
Renewable generation, coincident production and use:	**0**	kWh/yr
Total electricity demand:	**426,583**	kWh/yr



HEAT FLOW - HEATING PERIOD

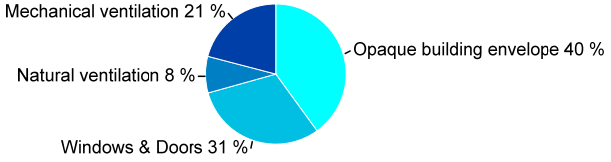
Heat gains

Solar:	**232,634**	kBtu/yr
Inner sources:	**438,718**	kBtu/yr
Credit of thermal bridges:	**0**	kBtu/yr
Mechanical heating:	**360,705**	kBtu/yr



Heat losses

Opaque building envelope:	**413,121**	kBtu/yr
Windows & Doors:	**316,237**	kBtu/yr
Natural ventilation:	**86,783**	kBtu/yr
Mechanical ventilation:	**215,915**	kBtu/yr

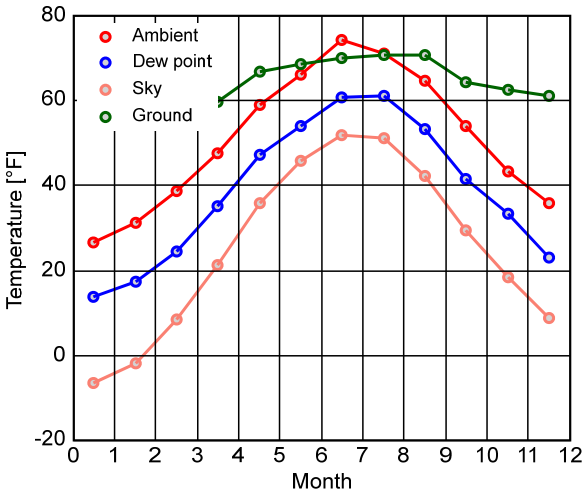


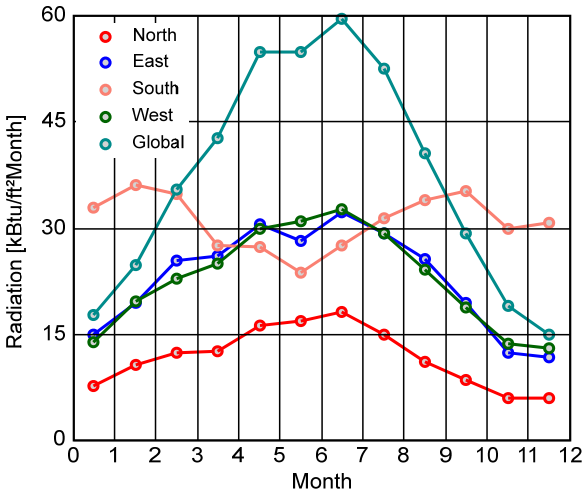
CLIMATE

Latitude:	**42.4**	°
Longitude:	**-71**	°
Elevation of weather station:	**19.7**	ft
Elevation of building site:	**106**	ft
Heat capacity air:	**0.018**	Btu/ft³F
Daily temperature swing summer:	**14.8**	°F
Average wind speed:	**13.1**	ft/s

Ground

Average ground surface temperature:	**52.5**	°F
Amplitude ground surface temperature:	**55.8**	°F
Ground thermal conductivity:	**1.2**	Btu/hr ft °F
Ground heat capacity:	**29.8**	Btu/ft³F
Depth below grade of groundwater:	**9.8**	ft
Flow rate groundwater:	**0.2**	ft/d





Calculation parameters

Length of heating period	**243**	days/yr
Heating degree hours	**143**	kFh/a
Phase shift months	**1.1**	mths
Time constant heating demand	**111.6**	hr
Time constant cooling demand	**0**	hr
Time constant cooling demand with night ventilation	**0**	hr

Climate for	Heating load 1	Heating load 2	Cooling
Temperature [°F]	16.9	31.6	83.5
Solar radiation North [Btu/hr ft²]	12	7.9	27.6
Solar radiation East [Btu/hr ft²]	22.8	13.3	61.5
Solar radiation South [Btu/hr ft²]	49.5	27.3	41.8
Solar radiation West [Btu/hr ft²]	22.2	11.4	53.3
Solar radiation Global [Btu/hr ft²]	26.9	16.5	101.4

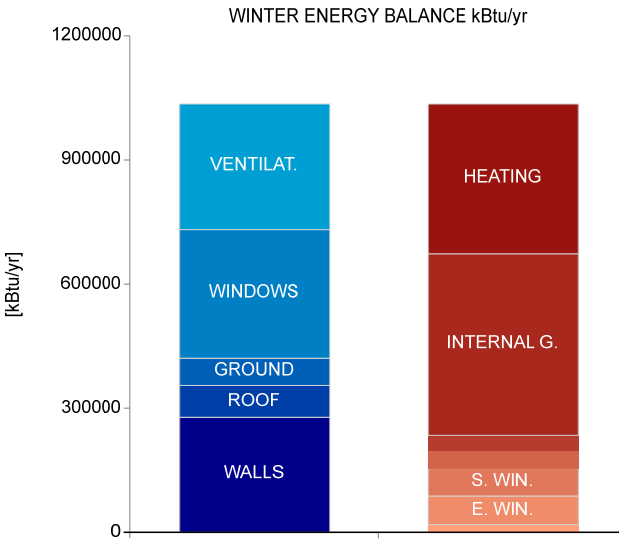
Relevant boundary conditions for heating load calculation: Heating load 1

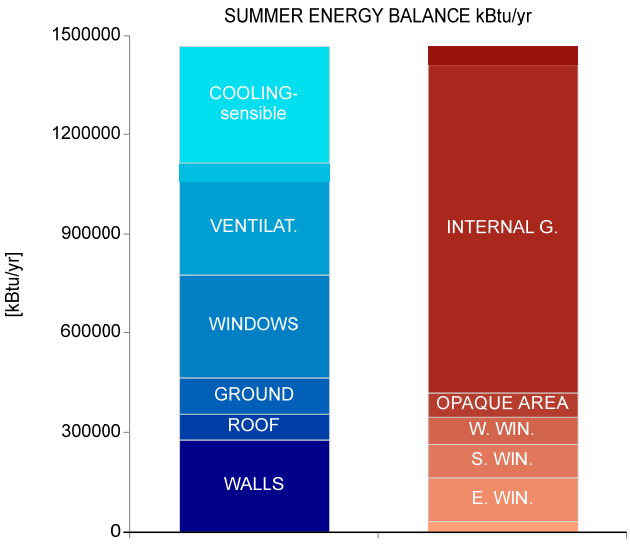
ANNUAL HEAT DEMAND

Transmission losses :	**729,359**	kBtu/yr
Ventilation losses:	**302,699**	kBtu/yr
Total heat losses:	**1,032,057**	kBtu/yr
Solar heat gains:	**265,674**	kBtu/yr
Internal heat gains:	**501,027**	kBtu/yr
Total heat gains:	**766,701**	kBtu/yr
Utilization factor:	**87.6**	%
Useful heat gains:	**671,352**	kBtu/yr
Annual heat demand:	**360,705**	kBtu/yr
Specific annual heat demand:	**4,669.2**	Btu/ft²yr

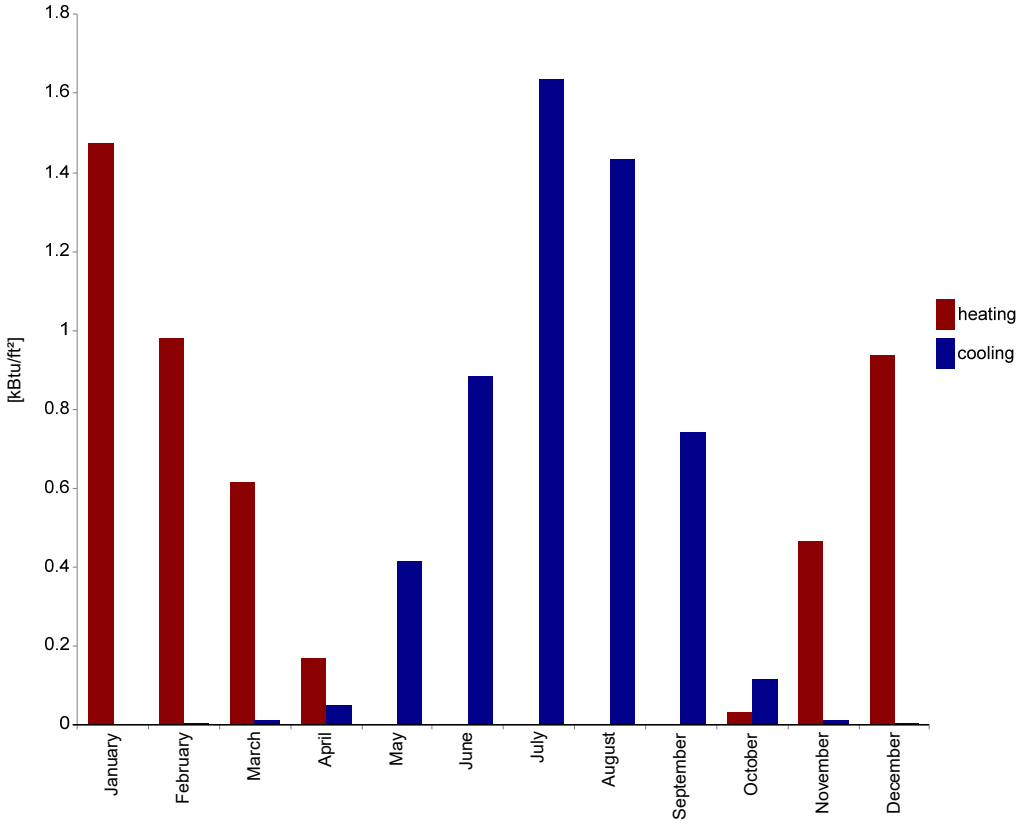
ANNUAL COOLING DEMAND

Solar heat gains:	**418,696**	kBtu/yr
Internal heat gains:	**993,370**	kBtu/yr
Total heat gains:	**1,412,065**	kBtu/yr
Transmission losses :	**1,187,958**	kBtu/yr
Ventilation losses:	**433,672**	kBtu/yr
Total heat losses:	**1,621,629**	kBtu/yr
Utilization factor:	**65.3**	%
Useful heat losses:	**1,058,181**	kBtu/yr
Cooling demand - sensible:	**353,885**	kBtu/yr
Cooling demand - latent:	**55,715**	kBtu/yr
Annual cooling demand:	**409,599**	kBtu/yr
Specific annual cooling demand:	**5.3**	kBtu/ft²yr





SPECIFIC HEAT/COOLING DEMAND MONTHLY



Month	Heating [kBtu/ft²]	Cooling [kBtu/ft²]
January	1.5	0
February	1	0
March	0.6	0
April	0.2	0
May	0	0.4
June	0	0.9
July	0	1.6
August	0	1.4
September	0	0.7
October	0	0.1
November	0.5	0
December	0.9	0

HEATING LOAD

	First climate	Second climate
Transmission heat losses:	**230,862.7** Btu/hr	**169,778.7** Btu/hr
Ventilation heat losses:	**139,028.5** Btu/hr	**99,108.4** Btu/hr
Total heat loss:	**369,891.3** Btu/hr	**268,887.1** Btu/hr
Solar heat gain:	**34,306** Btu/hr	**19,320** Btu/hr
Internal heat gain:	**39,185.5** Btu/hr	**39,185.5** Btu/hr
Total heat gains heating:	**73,491.5** Btu/hr	**58,505.5** Btu/hr
Heating load:	**296,399.7** Btu/hr	**210,381.6** Btu/hr

Relevant heating load: **296,399.7** Btu/hr

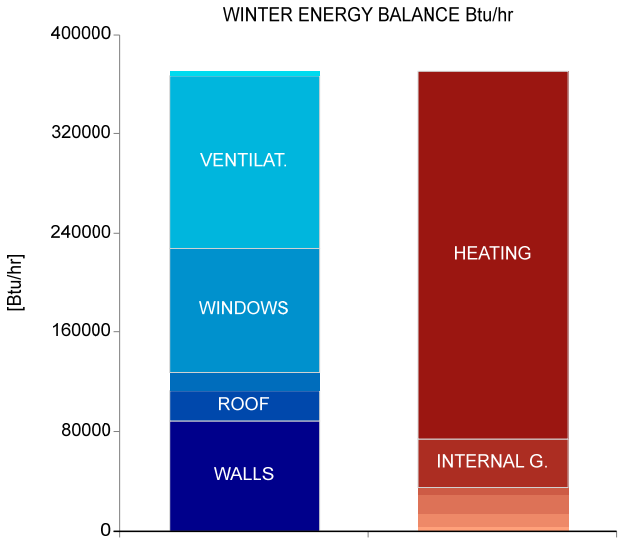
Specific heating load: **3.8** Btu/hr ft²

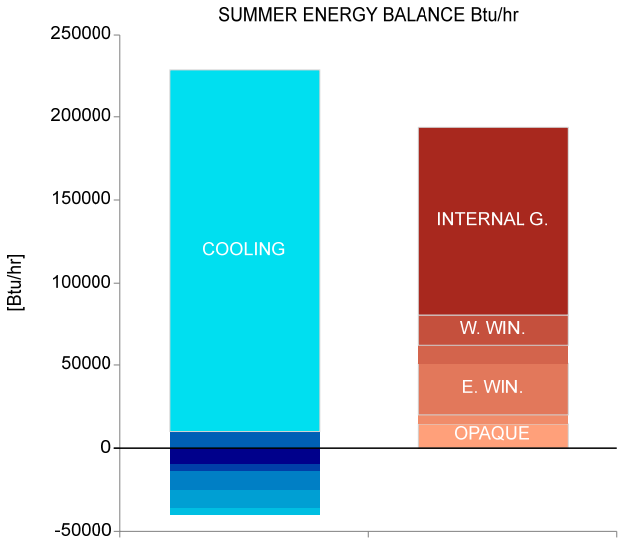
COOLING LOAD

Solar heat gain:	**80,702.4** Btu/hr
Internal heat gain:	**113,409.5** Btu/hr
Total heat gains cooling:	**194,111.9** Btu/hr
Transmission heat losses:	**-13,202.4** Btu/hr
Ventilation heat losses:	**-11,718.1** Btu/hr
Total heat loss:	**-24,920.5** Btu/hr
Cooling load - sensible:	**219,032.4** Btu/hr
Cooling load - latent:	**0** Btu/hr

Relevant cooling load: **219,032.4** Btu/hr

Specific maximum cooling load: **2.8** Btu/hr ft²





Summary building envelope

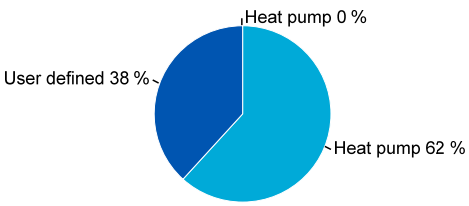
	Total area / length	Average U-value / Psi value	Transmission losses
Exterior wall ambient:	**51,759.8** ft²	**0.032** Btu/hr ft² °F	**267,815** kBtu/yr
Exterior wall ground:	**247.5** ft²	**0.165** Btu/hr ft² °F	**1,715.3** kBtu/yr
Basement:	**9,772.2** ft²	**0.159** Btu/hr ft² °F	**65,279.7** kBtu/yr
Roof:	**18,090.5** ft²	**0.027** Btu/hr ft² °F	**78,311.1** kBtu/yr
Windows:	**7,101.3** ft²	**0.273** Btu/hr ft² °F	**310,781.9** kBtu/yr
Doors:	**117.9** ft²	**0.289** Btu/hr ft² °F	**5,455.4** kBtu/yr
Thermal bridge ambient:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr
Thermal bridge perimeter:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr
Thermal bridge floor slab:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr

Shading

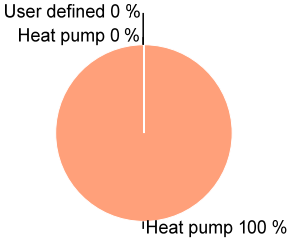
	Heating	Cooling
Reduction factor North:	**60.4** %	**48.3** %
Reduction factor East:	**74.7** %	**68.1** %
Reduction factor South:	**77.4** %	**63.4** %
Reduction factor West:	**68.9** %	**63.9** %
Reduction factor Horizontal:	**100** %	**100** %

System	DHW			Heating			Total		
	Covered DHW demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Covered heating demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Performance ratio	CO2 equivalent emissions [lb/yr]	Source energy demand [kBtu/yr]
Heat pump, Heat pump	0	0	0	100	0	121,002.8	0	53,168.5	217,805.1
Heat pump, Heat pump	85	0	113,402.9	0	0	0	0.3	49,829.1	204,125.2
User defined, Owned Units BOD: A.O. Smith ENT-30 (EF = 0.95)	15	0	70,216.4	0	0	0	1.1	60,382.3	126,389.5
Σ	100	0	183,619.3	100	0	121,002.8		163,379.9	548,319.7

DHW - final energy



Heating - final energy



COOLING UNITS

	sensible	latent
Air cooling:	**0** kBtu/ft²yr	**0** kBtu/ft²yr
Recirculation cooling:	**4.6** kBtu/ft²yr	**0** kBtu/ft²yr
Additional dehumidification:		**0.7** kBtu/ft²yr
Panel cooling:	**0** kBtu/ft²yr	
Sum:	**4.6** kBtu/ft²yr	**0.7** kBtu/ft²yr

VENTILATION

Energy transportable by supply air

Heating energy

transportable: **1.35** W/ft²
load: **1.12** W/ft²

Cooling energy

transportable: **0.78** W/ft²
load: **0.83** W/ft²

Infiltration pressure test ACH50: **0.44** 1/hr
Total extract air demand: **4,511** cfm
Supply air per person: **18** cfm
Occupancy: **179**

Average air flow rate: **4,680.12** cfm
Average air change rate: **0.28** 1/hr
Effective ACH ambient: **0.11** 1/hr
Effective ACH ground: **0** 1/hr
Energetically effective air exchange: **0.11** 1/hr
Infiltration air change rate: **0.03** 1/hr
Infiltration air change rate (heating load): **0.08** 1/hr

Type of ventilation system: **Balanced PH ventilation**
Wind screening coefficient (e): **0.07**
Wind exposure factor: **15**
Wind shield factor: **0.05**

Ventilation heat losses: **270,369.95** kBtu/yr

Devices

Name	Sensible recovery efficiency [-]	Electric efficiency [W/cfm]	Heat recovery efficiency SHX [-]	Effective recovery efficiency [-]
Rental Unit Centralized ERV (BOD - AnnexAir ERP-E-05)	0.8	0.09	0	0.7
Rental Unit Centralized ERV (BOD - Ventacity VS 1000 RT)	0.8	0.07	0	0.8
Altogether	0.7	0.08	0	0.7

Ducts

Name	Length (total) [ft]	Clear cross-section [ft²]	U-value [Btu/hr ft² °F]	Assigned ventilation units
Supply / outdoor air duct	3	6	6.55	Rental Unit Centralized ERV (BOD - AnnexAir ERP-E-05)
Extract / Exhaust air duct	3	6	6.55	Rental Unit Centralized ERV (BOD - AnnexAir ERP-E-05)
Supply / outdoor air duct	3	2.5	3.86	Rental Unit Centralized ERV (BOD - Ventacity VS 1000 RT)
Extract / Exhaust air duct	3	2.5	3.86	Rental Unit Centralized ERV (BOD - Ventacity VS 1000 RT)
Σ	12			

*length * quantity ** thermal conductivity / thickness

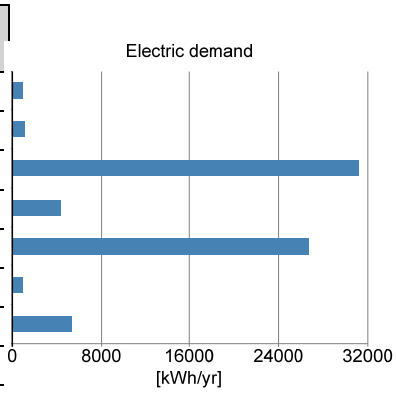
SUMMER VENTILATION

ACH night ventilation: **0** 1/hr

Overheating temperature: **77** °F

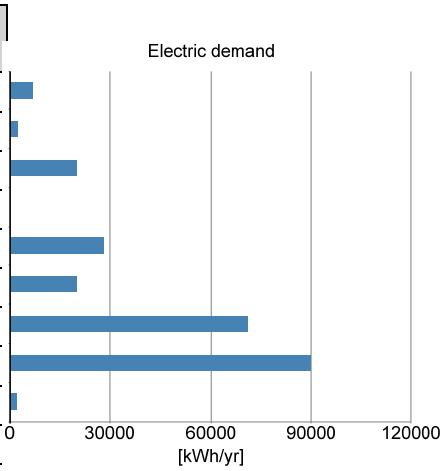
ELECTRICITY DEMAND - AUXILIARY ELECTRICITY

Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Source energy [kBtu/yr]
DHW circulating pump	1	yes	102.6 W	871.9	5354.6
Other	1	yes	1,123 W	1123	6896.6
Ventilation winter	1	no	1.4 W/cfm	31202.9	191624.9
Ventilation Defrost	1	no	22,441.6 W	4355.6	26749
Ventilation summer	1	no	1.4 W/cfm	26757.6	164325.2
DHW circulating pump	1	yes	102.6 W	872.3	5357.1
DHW storage load pump	1	yes	601.9 W	5230.4	32121.4
Σ				70413.8	432428.9



ELECTRICITY DEMAND RESIDENTIAL BUILDING

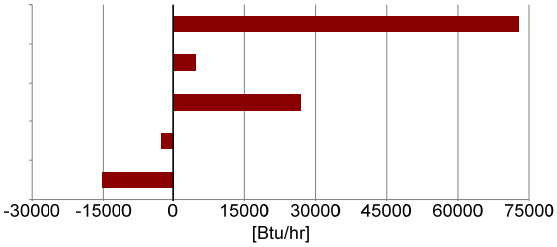
Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Non-electric demand [kWh/yr]	Source energy [kBtu/yr]
Kitchen dishwasher	1	yes	1.3	6531.8	0	40113.6
Laundry - washer	1	yes	0.3	2072	0	12724.7
Laundry - dryer	1	yes	3.9	19768.1	0	121400.8
Energy consumed by evaporation	1	yes	3.1	0	1964.7	12065.9
Kitchen fridge/freeze combo	1	yes	1.2	28035	0	172169.9
Kitchen cooking	1	yes	0.2	19690	0	120921.2
User defined MELs	1	yes	70,887	70887	0	435334.7
User defined lighting	1	yes	90,280	90280	0	554431.9
User defined lighting	1	no	1,803	1803	0	11072.7
Σ	9			239066.9	1964.7	1480235.4



INTERNAL HEAT GAINS

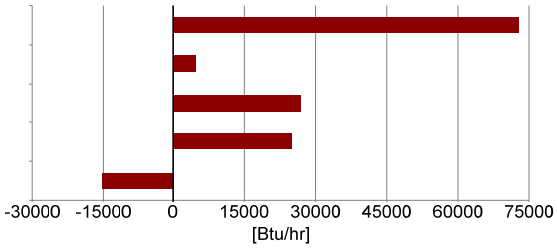
Heating season

Electricity total:	**72,991.6**	Btu/hr
Auxiliary electricity:	**4,587.6**	Btu/hr
People:	**26,874**	Btu/hr
Cold water:	**-2,541.1**	Btu/hr
Evaporation:	**-15,269.3**	Btu/hr
Σ:	**85,918.5**	Btu/hr
Specific internal heat gains:	**1.1**	Btu/hr ft²



Cooling season

Electricity total:	**72,991.6**	Btu/hr
Auxiliary electricity:	**4,587.6**	Btu/hr
People:	**26,874**	Btu/hr
Cold and hot water:	**24,949.9**	Btu/hr
Evaporation:	**-15,269.3**	Btu/hr
Σ:	**85,918.5**	Btu/hr
Specific internal heat gains:	**1.1**	Btu/hr ft²



DHW AND DISTRIBUTION

DHW consumption per person per day:	**6.6**	gal/Person/day
Average cold water temperature supply:	**52.5**	°F
Useful heat DHW:	**315,768.6**	kBtu/yr
Specific useful heat DHW:	**4,087.5**	Btu/ft²yr
Total heat losses of the DHW system:	**128,948.5**	kBtu/yr
Specific losses of the DHW system:	**1,669.2**	Btu/ft²yr
Performance ratio DHW distribution system and storage:	**1.4**	
Utilization ratio DHW distribution system and storage:	**0.7**	
Total heat demand of DHW system:	**444,717.1**	kBtu/yr
Total specific heat demand of DHW system:	**5,756.8**	Btu/ft²yr
Total heat losses of the hydronic heating distribution:	**0**	kBtu/yr
Specific losses of the hydronic heating distribution:	**0**	Btu/ft²yr
Performance ratio of heat distribution:	**100**	%

Region	Length [ft]	Annual heat loss [kBtu/yr]
Hydronic heating distribution pipes		
Σ	0	0
DHW circulation pipes		
In conditioned space	1500	85463.6
Σ	1500	85463.6
Individual pipes		
In conditioned space		0
Σ		0
Water storage		
Device 6 (Water storage: DHW): 285 Gal Storage Tanks		2870.9
Device 7 (Water storage: DHW): 150 Gal Swing Tank		2870.9
Σ		5741.8

Appendix F.2

Preliminary Solar Information

Madison Park Development Corporation

Going Solar

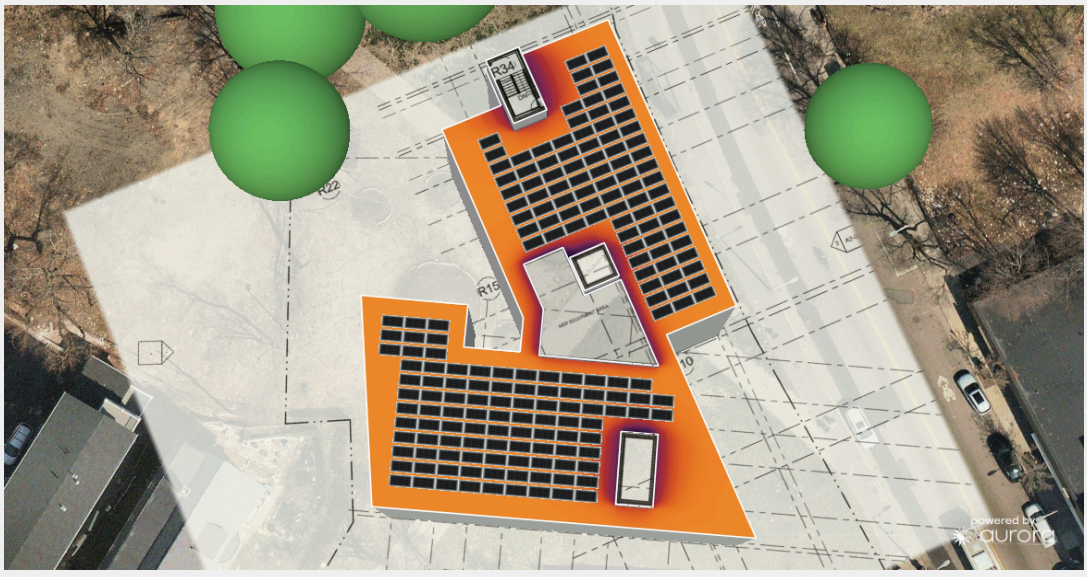
August 27, 2024

Madison Park Development Corporation
639 Warren Street
Boston, MA 02121

Thank you for your interest in going solar with Resonant Energy. We are pleased to present this proposal to Madison Park Development Corporation (MPDC) for installing solar panels on your rooftop.

In Direct Solar Ownership, MPDC purchases the panels and receives all of the electricity and state and federal incentives for solar. You may take out a loan to spread out the upfront cost for ten or more years.

	Direct Solar Ownership
Array Size	**185** panels (96.2 kW)
Estimated Annual Output	**106,878** kWh
Upfront Cost	**$322,270** ($3.35 per Watt)
Estimated Lifetime Savings	**$1,051,237**
Equivalent Trees Planted	**1,250** Trees



Solar Layout (96.2 kW, Tier 1, 520 Watt Panels)

Please note that the solar layout is a preliminary design, and the array size and output are subject to change based upon final structural and electrical engineering.

Direct Solar Ownership

MPDC may choose to purchase its own solar array, and receive all of the solar electricity and state incentives.

FINANCIAL BENEFITS: DIRECT OWNERSHIP

1. **Electricity Savings**: This solar array will be connected behind your existing electric meter, and will directly reduce your electric bill. The value of electricity produced in this way will be worth an average of $0.203 per kWh, and will likely become more valuable over time as electric rates continue to increase.

2. **State Incentives:** Your solar array will be eligible to receive cash incentives from the state solar policy known as SMART. MPDC will receive a constant incentive of approximately $0.153 per kWh for 20 years. This incentive rate is an estimate and is subject to change. See the Timeline section on the last page for more information. After 20 years, your solar array will qualify to receive a separate solar incentive known as Class 1 Renewable Energy Certificates (RECs), which are estimated to be worth $0.020 per kWh. Please note that this estimate cannot be guaranteed since RECs are traded on the commodity market and values fluctuate.

   This proposal includes a MA SMART incentive based on the SMART 2.0 straw proposal economics that the MA Department of Energy Resources (DOER) released in July 2024 for a successor program that will begin January 2025. As such, the economics are subject to change based on the final rules of the program but represent the most recent information available about the incentives that this project stands to benefit from.

3. **Tax Benefits:** Solar projects are eligible for federal tax credits and bonus depreciation.
   a. The Federal Tax Credit is worth 50% of qualified expenditures. In the event that you do not incur federal taxes equal to the tax credit, the tax credit may be carried forward to the following year. This proposal assumes your project locks in the Environmental Justice Federal Investment Tax Credit (ITC) adder and qualifies for a 20% ITC adder for a total tax credit value of 50%. Note this allocation is not guaranteed. Resonant Energy will use reasonable efforts to work with MPDC to secure this additional project incentive.
   b. Solar Bonus Depreciation allows solar owners to depreciate the cost basis of the system according to the 5 year MACRS Depreciation Schedule. We are not tax professionals and we recommend that you consult with your tax advisor when deciding to go solar.

MPDC may take out a loan to cover the upfront cost of installation. We can support you in selecting an affordable lender for solar installations.

50% FEDERAL ITC SCENARIO (INCLUDES 20% AFFORDABLE HOUSING ADDER)

Direct Ownership Cash Flow – 50% ITC

kW DC	96.2
Solar Array Cost	$322,270
Payback Period (yrs)	3

IRR	22.96%

Year	Est. Solar Output (kWh)	Est. Utility Savings			MA SMART Incentives			MA RECs			Tax Benefits			Estimated Insurance	Est. System Monitoring Services	Est. Operations & Maintenance		Annual Benefits	Cumulative Savings	ITC Compliance	Year
		Estimated Utility Rate ($/kWh)	Estimated Utility Savings		Estimated SMART Rate ($/kWh)	Estimated SMART Revenue		Estimated REC Rate ($/kWh)	Estimated REC Revenue		Federal (50%)	Depreciation								Replacement Reserve Transfer (Tenant Benefit)	
0																			($322,270)		0
1	106,878	$0.203	$21,729	+	$0.153	$16,400	+			+	$161,135	$12,085	-	($962)	($811)	($1,468)	=	$208,109	($114,161)	($10,826)	1
2	106,344	$0.209	$22,204		$0.153	$16,318						$19,336		($981)	($827)	($1,497)		$54,554	($59,607)	($10,826)	2
3	105,812	$0.214	$22,690		$0.153	$16,237						$11,602		($1,001)	($844)	($1,527)		$47,157	($12,450)	($10,826)	3
4	105,283	$0.220	$23,186		$0.153	$16,156						$6,961		($1,021)	($861)	($1,557)		$42,864	$30,413	($10,826)	4
5	104,757	$0.226	$23,693		$0.153	$16,075						$6,961		($1,041)	($878)	($1,589)		$43,221	$73,634	($10,826)	5
6	104,233	$0.232	$24,211		$0.153	$15,995						$3,481		($1,062)	($895)	($1,620)		$40,108	$113,742		6
7	103,712	$0.239	$24,740		$0.153	$15,915								($1,083)	($913)	($1,653)		$37,005	$150,748		7
8	103,193	$0.245	$25,281		$0.153	$15,835								($1,105)	($932)	($1,686)		$37,394	$188,141		8
9	102,677	$0.252	$25,834		$0.153	$15,756								($1,127)	($950)	($1,720)		$37,793	$225,934		9
10	102,164	$0.258	$26,399		$0.153	$15,677								($1,150)	($969)	($1,754)		$38,203	$264,137		10
11	101,653	$0.265	$26,976		$0.153	$15,599								($1,173)	($989)	($1,789)		$38,624	$302,762		11
12	101,145	$0.273	$27,566		$0.153	$15,521								($1,196)	($1,008)	($1,825)		$39,057	$341,819		12
13	100,639	$0.280	$28,169		$0.153	$15,443								($1,220)	($1,029)	($10,519)		$30,844	$372,663		13
14	100,136	$0.287	$28,785		$0.153	$15,366								($1,244)	($1,049)	($1,899)		$39,958	$412,621		14
15	99,635	$0.295	$29,414		$0.153	$15,289								($1,269)	($1,070)	($1,937)		$40,427	$453,048		15
16	99,137	$0.303	$30,057		$0.153	$15,213								($1,295)	($1,091)	($1,975)		$40,908	$493,956		16
17	98,641	$0.311	$30,714		$0.153	$15,136								($1,321)	($1,113)	($2,015)		$41,402	$535,358		17
18	98,148	$0.320	$31,386		$0.153	$15,061								($1,347)	($1,136)	($2,055)		$41,909	$577,267		18
19	97,657	$0.328	$32,072		$0.153	$14,986								($1,374)	($1,158)	($2,096)		$42,429	$619,696		19
20	97,169	$0.337	$32,773		$0.153	$14,911								($1,401)	($1,181)	($2,138)		$42,963	$662,659		20
21	96,683	$0.162	$15,659					$0.020	$1,934					($1,429)	($1,205)	($2,181)		$12,777	$675,437		21
22	96,200	$0.166	$16,001					$0.020	$1,924					($1,458)	($1,229)	($2,224)		$13,014	$688,450		22
23	95,719	$0.171	$16,351					$0.020	$1,914					($1,487)	($1,254)	($2,269)		$13,256	$701,706		23
24	95,240	$0.175	$16,709					$0.020	$1,905					($1,517)	($1,279)	($2,314)		$13,503	$715,209		24
25	94,764	$0.180	$17,074					$0.020	$1,895					($1,547)	($1,304)	($2,361)		$13,757	$728,967		25
Total	2,517,618		$619,674	+		$312,886	+		$9,572	+	$161,135	$60,426	-	($30,813)	($25,976)	($55,667)	=	$1,051,237	$728,967	($54,129)	Total

Please note that the increased “Est. Operations & Maintenance” payment in year 13 anticipates the cost of replacing the inverter as the initial warranty is assumed to last 12 years. Based on historic trends, your utility rate is expected to increase 2.7% per year. The performance of the solar array is expected to degrade 0.5% per year. These estimates account for the changing values in the columns, “Estimated Solar Output,” and “Estimated Utility Rate”.

30% FEDERAL ITC SCENARIO

Direct Ownership Cash Flow

kW DC	96.2
Solar Array Cost	$322,270
Payback Period (yrs)	4

IRR	18.06%

Year	Est. Solar Output (kWh)	Est. Utility Savings			MA SMART Incentives			MA RECs			Tax Benefits			Estimated Insurance	Est. System Monitoring Services	Est. Operations & Maintenance		Annual Benefits	Cumulative Savings	Year
		Estimated Utility Rate ($/kWh)	Estimated Utility Savings		Estimated SMART Rate ($/kWh)	Estimated SMART Revenue		Estimated REC Rate ($/kWh)	Estimated REC Revenue		Federal (30%)	Depreciation									
0																			($322,270)	0
1	106,878	$0.203	$21,729	+	$0.153	$16,400	+			+	$96,681	$13,696	-	($962)	($811)	($1,468)	=	$145,266	($177,004)	1
2	106,344	$0.209	$22,204		$0.153	$16,318						$21,914		($981)	($827)	($1,497)		$57,132	($119,872)	2
3	105,812	$0.214	$22,690		$0.153	$16,237						$13,149		($1,001)	($844)	($1,527)		$48,704	($71,168)	3
4	105,283	$0.220	$23,186		$0.153	$16,156						$7,889		($1,021)	($861)	($1,557)		$43,792	($27,376)	4
5	104,757	$0.226	$23,693		$0.153	$16,075						$7,889		($1,041)	($878)	($1,589)		$44,149	$16,773	5
6	104,233	$0.232	$24,211		$0.153	$15,995						$3,945		($1,062)	($895)	($1,620)		$40,572	$57,345	6
7	103,712	$0.239	$24,740		$0.153	$15,915								($1,083)	($913)	($1,653)		$37,005	$94,350	7
8	103,193	$0.245	$25,281		$0.153	$15,835								($1,105)	($932)	($1,686)		$37,394	$131,744	8
9	102,677	$0.252	$25,834		$0.153	$15,756								($1,127)	($950)	($1,720)		$37,793	$169,537	9
10	102,164	$0.258	$26,399		$0.153	$15,677								($1,150)	($969)	($1,754)		$38,203	$207,740	10
11	101,653	$0.265	$26,976		$0.153	$15,599								($1,173)	($989)	($1,789)		$38,624	$246,364	11
12	101,145	$0.273	$27,566		$0.153	$15,521								($1,196)	($1,008)	($1,825)		$39,057	$285,422	12
13	100,639	$0.280	$28,169		$0.153	$15,443								($1,220)	($1,029)	($10,519)		$30,844	$316,265	13
14	100,136	$0.287	$28,785		$0.153	$15,366								($1,244)	($1,049)	($1,899)		$39,958	$356,224	14
15	99,635	$0.295	$29,414		$0.153	$15,289								($1,269)	($1,070)	($1,937)		$40,427	$396,651	15
16	99,137	$0.303	$30,057		$0.153	$15,213								($1,295)	($1,091)	($1,975)		$40,908	$437,559	16
17	98,641	$0.311	$30,714		$0.153	$15,136								($1,321)	($1,113)	($2,015)		$41,402	$478,961	17
18	98,148	$0.320	$31,386		$0.153	$15,061								($1,347)	($1,136)	($2,055)		$41,909	$520,870	18
19	97,657	$0.328	$32,072		$0.153	$14,986								($1,374)	($1,158)	($2,096)		$42,429	$563,299	19
20	97,169	$0.337	$32,773		$0.153	$14,911								($1,401)	($1,181)	($2,138)		$42,963	$606,262	20
21	96,683	$0.162	$15,659					$0.020	$1,934					($1,429)	($1,205)	($2,181)		$12,777	$619,039	21
22	96,200	$0.166	$16,001					$0.020	$1,924					($1,458)	($1,229)	($2,224)		$13,014	$632,053	22
23	95,719	$0.171	$16,351					$0.020	$1,914					($1,487)	($1,254)	($2,269)		$13,256	$645,309	23
24	95,240	$0.175	$16,709					$0.020	$1,905					($1,517)	($1,279)	($2,314)		$13,503	$658,812	24
25	94,764	$0.180	$17,074					$0.020	$1,895					($1,547)	($1,304)	($2,361)		$13,757	$672,569	25
Total	2,517,618		$619,674	+		$312,886	+		$9,572	+	$96,681	$68,482	-	($30,813)	($25,976)	($55,667)	=	$994,839	$672,569	Total

Please note that the increased “Est. Operations & Maintenance” payment in year 13 anticipates the cost of replacing the inverter as the initial warranty is assumed to last 12 years. Based on historic trends, your utility rate is expected to increase 2.7% per year. The performance of the solar array is expected to degrade 0.5% per year. These estimates account for the changing values in the columns, “Estimated Solar Output,” and “Estimated Utility Rate”.

SOLAR INSTALLATION

We manage the development and installation of your solar system from start to finish. We work with local installers to conduct an engineering site visit and provide you with cost-effective and quality construction services through one of these partners. Subject to your approval, we select installers through a competitive bidding process and we require any installer we work with to have at least five years of installation experience, a labor warranty of at least five years, and to hold NABCEP certification.

MONITORING SYSTEM

Your inverter will come with a monitoring system that allows you to see the performance of each panel. Our installation partner will get notifications if any part of the system is underperforming. This system requires internet via Wifi or ethernet cable in order to keep you and the contractor up to date.

INSURANCE

Under direct ownership, your solar power system will need to be added to your building's insurance policy. In some cases, your current insurance policy can cover the solar array with no change to your premiums. Please contact your insurance provider to see if your current policy will cover your array.

PROPERTY TAX

According to Massachusetts state law, solar arrays are typically exempt from local property tax for a 15-year period. We advise you to consult with a tax advisor to learn how the statute is interpreted in Boston.

TAX ELIGIBILITY

This Direct Solar Ownership project will generate a new stream of income for your organization through SMART & REC revenue. Since you are a tax-paying organization, this new income may be subject to taxation. However, we advise you to consult with a tax advisor and develop your own understanding of the options available for your organization.

TIMELINE

Under the SMART policy, projects will receive a higher incentive rate the earlier they qualify to interconnect to the grid, enabling higher savings for you. The SMART incentives estimated for this proposal cannot be guaranteed for your project, but the earlier we get started, the better chance you have of receiving the highest possible savings. **This proposal is valid for 60 days.**

NEXT STEPS

Please notify us of any questions you may have after reviewing the above information. If you would like to proceed with installing a solar array, the next step is to sign a letter of intent. We will work with you and our selected contractor to schedule a site visit, finalize the design, and get your final contract in place. I'll be happy to meet or talk on the phone to answer any questions you may have. You can reach me at the phone number and email address listed below.

Sincerely,

Leonard Schloer
Senior Business Development Manager
Resonant Energy
(617) 615-6554
leonard@resonant.energy

Appendix: Utility Savings in Detail

Solar Credit Value and Net Metering Dynamics

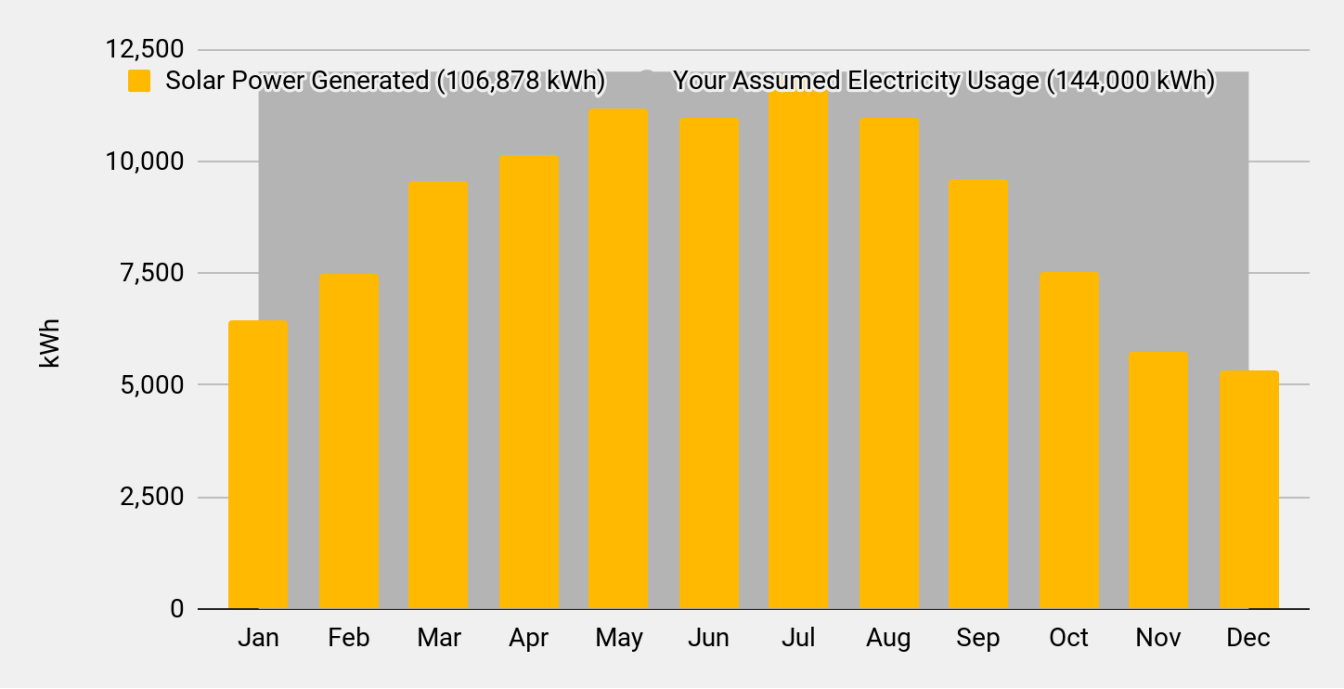
In the **Direct Solar Ownership** option**,** the solar power system will be installed behind your current utility meter. The utility meter will spin backwards whenever the system is producing electricity, and it will spin forwards when you are using electricity from the grid. You will save approximately $0.203 per kWh for all the solar energy you use in a given month. Please note that electricity rates are subject to change on a monthly basis.

During the summer months when the New England solar season is at its peak, the array may produce more electricity than you use in those months. Due to net metering regulations, the value of electricity that rolls over to following months is discounted, and will be worth approximately $0.193 per kWh (a 5% loss of value).

When comparing the solar electric output of the 96.2 kW array on your rooftop to your past electric use, you can expect 0% of the electricity to roll over into the following months at the discounted rate.

Therefore, the total value lost from rollover discounts is: 0% times 5% = 0%. We have adjusted the Estimated Utility Rate listed in your cash flow accordingly. A table showing the expected average annual breakdown is provided below.

	Solar Output (kWh)	Percent of Total Output	Estimated Average Rate Received for Solar Output	Total Estimated Savings
Full Solar Credit Value	106,878	100%	$0.203	$21,729
Rollover Credits	0	0%	$0.193	$0
Total Annual Solar Output	**106,878**	**100%**	**$0.203**	**$21,729**



Appendix: Technical Clarifications

Timeline Disclaimer

The SMART estimates provided in this proposal assume that the permanent electricity account information will be available by September 1, 2027. The SMART assumptions listed below assume that a Letter of Intent will be signed by January 9, 2025 and a final contract will be signed by March 10, 2025.

Rollover Clarification

This proposal assumes that you are billed under the most common electricity rate class for buildings like yours (the B0/B7 rate), that you will be charged sales tax on your electric bill, that your electric service is 3-phase, and that you will use at least as much electricity as the solar array will produce in any given month. If that is not the case, then the excess solar electricity from each month may carry forward to future months at a discount rather than at its original, full value. In order to confirm this, please provide a copy of a recent electric bill including all pages, or an estimate of the building's monthly electricity usage and phase of service.

Construction Requirements

Please note that the current system design assumes that there will be 4-foot setbacks around the edge of the roof. Since the building has a parapet wall that is less than 39 inches above the roof surface, you may need to install davits or fall protection around the edge of the roof in order to meet OSHA compliance.

Additional Costs

Please note that extra costs associated with electrical upgrades to the building electrical system, upgrades to the utility grid, or lack of fire code compliance have not been factored into the base price shown in this proposal. Please note that the proposal also does not include any additional costs for slips sheets or roof inspections. If they are required, any associated costs may be passed on to MPDC.

SMART Incentives

The cash flows in this proposal have assumed that your solar array will qualify for the following SMART adders.

Direct Solar Ownership

Rooftop Adder	Low Income Property Owner Adder

Please note the cash flows in this proposal assume that your solar arrays will qualify for the Low Income Property SMART adder. In order to qualify for this adder you must be able to demonstrate:

a. that at least 25% of the housing available at the properties served by the solar arrays is required to be rented to households that are at or below 80% of the Area Median Income (AMI); or
b. that at least 20% of the housing available at the properties served by the solar arrays is required to be rented to households that are at or below 50% of the (AMI).

A similar array developed by Resonant Energy at Dorchester Bay Economic Development Corporation.