City of Cambridge Community Development Department
344 Broadway
Cambridge, MA 02139

Dear Cambridge Community Development Department:

The 2072 Mass. Ave. project team is excited to share the current building sustainability features for this highly efficient 100% affordable multifamily development. Currently in schematic design, the project is targeting Passive House certification. 2072 Mass. Ave. is designed for resilience and incorporates a number of sustainable features including a green roof and all electric heating and cooling systems.

Incorporated in this submission package are the Net Zero Narrative discussing building envelope and building system performance. This includes current energy model outputs, as well as an outlined pathway to a Net Zero building on page 12 of the report. The project team would also like to note that page 5 of the Net Zero Narrative includes the current (preliminary) WUFI model summary of building performance, and pages 6-9 are detailed outputs on building energy consumption from the same WUFI model. Also included in this submission is the Ratings System Narrative outlining the building performance requirements required by PHIUS.

The project team expects 2072 Mass. Ave. to earn full certification as a Passive House under the PHIUS+ Core (PHIUS 2018) ratings system. The project team currently expects to start construction by the second quarter of 2022, and would be happy to share the WUFI energy model report with CDD as the project progresses.

As part of the PHIUS requirements, the project will also earn the EPA Indoor airPLUS certification and the ENERGY STAR Multifamily New Construction certification. The EPA Indoor airPLUS certification program focuses on high quality indoor air and low or no emissions from building materials (low/no VOCs).The project will include MERV 13 filters to maintain indoor air quality. In addition to these certification requirements, this project will follow all Massachusetts Department of Housing and Community Development (DHCD) design requirements.

The resulting building will be an exceptionally high performance structure demonstrating a careful focus on envelope performance including low air infiltration rates, a well-insulated envelope, and high quality indoor air with continuous energy recovery ventilation.

The project team looks forward to creating an affordable, resilient and high performance building with a focus on occupant comfort and high indoor air quality and to sharing informational updates on project progress with CDD.

Sincerely,

Francis Stone
New Ecology, Inc.

Green Building Project Checklist

Green Building Project Location: 2072 Massachusetts Avenue, Cambridge, MA 02140

Applicant

Name: Francis Stone of New Ecology, Inc. on behalf of CC HRE 2072 Mass Ave LLC

Address: 15 Court Square, Boston, MA 02108 (Karno Widjaja as named Green Bldg. Prof)

Contact Information

Email Address: stone@newecology.org

Telephone #: 617-557-1700 x7086

Project Information (select all that apply):

- ☑ New Construction – GFA: 65,710 with basement
- ☐ Addition – GFA of Addition: ______
- ☐ Rehabilitation of Existing Building – GFA of Rehabilitated Area: ______
  - ☐ Existing Use(s) of Rehabilitated Area: ______
  - ☐ Proposed Use(s) of Rehabilitated Area: ______
- ☐ Requires Planning Board Special Permit approval
- ☐ Subject to Section 19.50 Building and Site Plan Requirements
- ☐ Site was previously subject to Green Building Requirements

Green Building Rating Program/System:

- ☐ Leadership in Energy and Environmental Design (LEED) – Version: ______
  - ☐ Building Design + Construction (BD+C) – Subcategory: ______
  - ☐ Residential BD+C – Subcategory: ______
  - ☐ Interior Design + Construction (ID+C) – Subcategory: ______
  - ☐ Other: ______
- ☑ Passive House – Version: PHIUS+ Core (PHIUS+ 2018)
  - ☑ PHIUS+
  - ☐ Passivhaus Institut (PHI)
  - ☐ Other: ______
- ☐ Enterprise Green Communities – Version: ______

Project Phase

☑ **SPECIAL PERMIT**

Before applying for a building permit, submit this documentation to CDD for review and approval.

Required Submissions

All rating programs:

- ☑ Rating system checklist
- ☑ Rating system narrative
- ☑ Net zero narrative (see example template for guidance)
- ☑ Affidavit signed by Green Building Professional with attached credentials – use City form provided (Special Permit)

Please note that Karno Widjaja, Green Building Professional holds a current certificate as a PHIUS Certified Passive House Consultant (CPHC #3036) and PHIUS has not made a printed certificate available. Please find the attached link to the PHIUS list of Certified Professionals as verification of this current credential: https://www.phius.org/find-a-professional/find-a-phius-cphc-#M

2072 Mass Ave. Passive House Net Zero Narrative

2072 Massachusetts Avenue Passive House

2072 Mass Ave., Cambridge MA, 02140

October 16, 2020

Submitted To:

Community Development Department, City of Cambridge

344 Broadway, Cambridge MA, 02138

15 COURT SQUARE, SUITE 420 | BOSTON, MA 02108 | P (617) 557-1700 F (617) 557-1770

PROJECT PROFILE

DEVELOPMENT CHARACTERISTICS

Lot Area (sq.ft.):	~8,515 SF
Existing Land Use(s) and Gross Floor Area (sq.ft.), by Use:	BA-2 / Business A02, ~1,860 GSF
Proposed Land Use(s) and Gross Floor Area (sq.ft.), by Use:	Residential Use, ~65,710 GSF (w/Basement), ~57,400 GSF (no basement)
Proposed Building Height(s) (ft. and stories):	~89'-0", 8 Stories
Proposed Dwelling Units:	49 affordable
Proposed Open Space (sq.ft.):	0
Proposed Parking Spaces:	3 handicapped
Proposed Bicycle Parking Spaces (Long-Term and Short-Term):	51 long-term (48 Long-Term & 3 Tandem), 5 short-term

GREEN BUILDING RATING SYSTEM

The Rating System Selected for this project is as follows:

Passive House Institute US (PHIUS)			
Rating System & Version:	PHIUS+ Core	**Seeking Certification?**	YES

PROPOSED PROJECT DESIGN CHARACTERISTICS

BUILDING ENVELOPE

Roof	Roof Trusses w/ ~R-32 c.i. (~6” XPS Insulation) with proposed areas of green roof to mitigate heat island impacts
Foundation	Concrete Foundation w/ ~R-30 c.i. (6” Low GWP Closed-cell Spray Foam Insulation @ R-5/in)
Exterior Walls	6" metal stud wall w/ ~R-18 c.i. (3" Polyisocyanurate or XPS), exterior rainscreen system

Windows	PHIUS approved window assemblies, thermally broken storefront system
Window to Wall Ratio	~30%
Other Components	Project team is considering sun shades on the south facade

ENVELOPE PERFORMANCE

	Proposed Passive House Building		Baseline Building
	Area (sf)	U-value	U-Value
Window	~7,250 SF	U-0.17 (SHGC - 0.32)	U-0.38 (fixed), U-0.45 (operable), 0.38 (SHGC - South, East, West), 0.51 (SHGC - North)
Wall	~32,685 SF	~U-0.05	U-0.064
Roof	~7,500 SF	~U-0.031 c.i.	U-0.032

ENVELOPE COMMISSIONING PROCESS

The project team has planned to test and verify the envelope air barrier and air infiltration rates using bi-directional blower door testing both at construction midpoint and again after construction completion. Two (2) inspections will be performed after framing and air-sealing are complete but before insulation is installed, in order to identify any potential areas of thermal bridging and/or air infiltration. These inspections will be documented with site photos. Once installed, the air barrier will be tested with a bi-directional whole building blower door test conducted to PHIUS+ CORE standards. At the end of construction, the whole building blower door test will be repeated to confirm air-tightness, and 13 units will be blower door tested for air infiltration rates per RESNET sampling protocols. In addition, a two hour inspection using a thermal imaging camera will be conducted to show compliance with thermal bridging and air sealing protocols.

BUILDING MECHANICAL SYSTEMS

SYSTEM DESCRIPTIONS

System	System Description
Space Heating:	Central VRF (11.2 EER, 23.4 IEER, 3.30 COP at 47F, 24.7 SCHE)
Space Cooling:	Central VRF (11.2 EER, 23.4 IEER, 3.30 COP at 47F, 24.7 SCHE)
Heat Rejection:	See above systems
Pumps & Auxiliary:	See above systems
Ventilation:	Central rooftop energy recovery ventilator with 75% heat recovery efficiency wheel and DX coil for heating/dehumidification
Domestic Hot Water:	Central gas-fired boiler plant potentially located at a penthouse level mechanical room to allow for future conversion to an all-electric DHW system
Interior Lighting:	LED
Exterior Lighting:	LED
Other Equipment:	TBD

SYSTEMS COMMISSIONING PROCESS

The project will retain a licensed commissioning agent (CxA) who will develop a detailed commissioning plan based on the building specifications and systems. The CxA will develop a functional performance test sheet for each system to be commissioned, and will commission the following systems: Mechanical systems and equipment including Energy Recovery Ventilation (ERV) systems, common space exhaust fans, the central VRF heating and cooling system and all apartment fan coils, and all direct digital controls. For lighting systems, all common space lighting control systems including occupancy sensors will be commissioned and sampled at the appropriate rate. For plumbing systems, the domestic hot water heating system including hot water heaters, storage tanks, circulating pumps, thermostatic mixing valves, and controls will be sampled at the appropriate rate.

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REQUIREMENTS FOR PHIUS+ CORE CERTIFIED BUILDINGS

PHIUS sets strict standards for building certification under its PHIUS+ CORE rating system. PHIUS+ CORE sets requirements for building metrics in five areas: heating demand, cooling demand, heating load, cooling load and source energy consumption based on the expected number of residents. These 5 metrics, illustrated in the table below, are modeled, measured and verified by PHIUS using WUFI modeling. After preliminary modeling, the project is at or near passing in all categories and as the design progresses, we will be sure that the design meets all requirements.

PHIUS+ CORE Criteria	Units	Target Not to Exceed	Building Performance
Heating Demand	kBtu/ft2 per year	3.80	3.81
Cooling Demand	kBtu/ft2 per year	5.40	3.35
Heating Load	Btu/hr.ft2	3.70	3.42
Cooling Load	Btu/hr.ft	3.00	2.63
Source Energy	kWh/person per year	5500.00	5120.00

ANTICIPATED ENERGY LOADS AND GREENHOUSE GAS EMISSIONS

Assumptions
The project will pursue Passive House certification and utilize WUFI energy modeling to demonstrate energy loads and energy use. The anticipated baseline building (ASHRAE 90.1-2013) energy use is indicated in the table below. Building heating and cooling loads, hot water heating load, lighting in units and common spaces, appliance and plug loads as well as miscellaneous system loads were included in this preliminary energy model.

	Proposed	Baseline
Site EUI (kBtu/yr./sq.ft.)	20	43.9
Source EUI (kBtu/yr./sq.ft.)	48	124.8

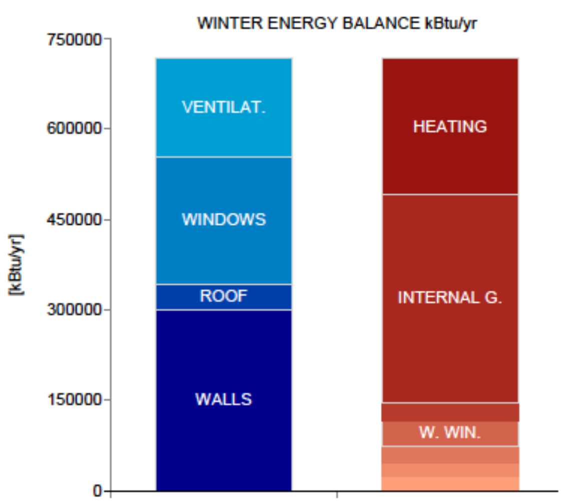
Annual Projected Greenhouse Gas (GHG) Emissions:
The annual expected Co2 emissions for the building based on the preliminary WUFI energy model are as follows:

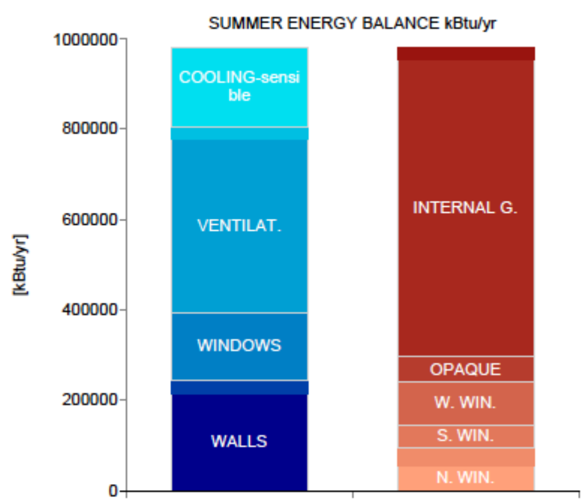
Utility	Co2 emissions in metric tons/yr.
Electricity	69.45
Natural Gas	14.98

Annual Projected Energy Consumption:
The annual expected energy consumption for the project is presented in the tables on the following pages. These tables were generated as part of the preliminary WUFI modeling exercise for the project.

ANNUAL HEAT DEMAND		
Transmission losses :	551,675	kBtu/yr
Ventilation losses:	164,937	kBtu/yr
Total heat losses:	716,611	kBtu/yr
Solar heat gains:	168,519	kBtu/yr
Internal heat gains:	399,611	kBtu/yr
Total heat gains:	568,130	kBtu/yr
Utilization factor:	86.2	%
Useful heat gains:	489,669	kBtu/yr
Annual heat demand:	226,943	kBtu/yr
Specific annual heat demand:	3,805.2	Btu/ft²yr

ANNUAL COOLING DEMAND		
Solar heat gains:	297,293	kBtu/yr
Internal heat gains:	656,805	kBtu/yr
Total heat gains:	954,098	kBtu/yr
Transmission losses :	836,470	kBtu/yr
Ventilation losses:	828,133	kBtu/yr
Total heat losses:	1,664,603	kBtu/yr
Utilization factor:	46.8	%
Useful heat losses:	779,693	kBtu/yr
Cooling demand - sensible:	174,405	kBtu/yr
Cooling demand - latent:	25,356	kBtu/yr
Annual cooling demand:	199,760	kBtu/yr
Specific annual cooling demand:	3.3	kBtu/ft²yr





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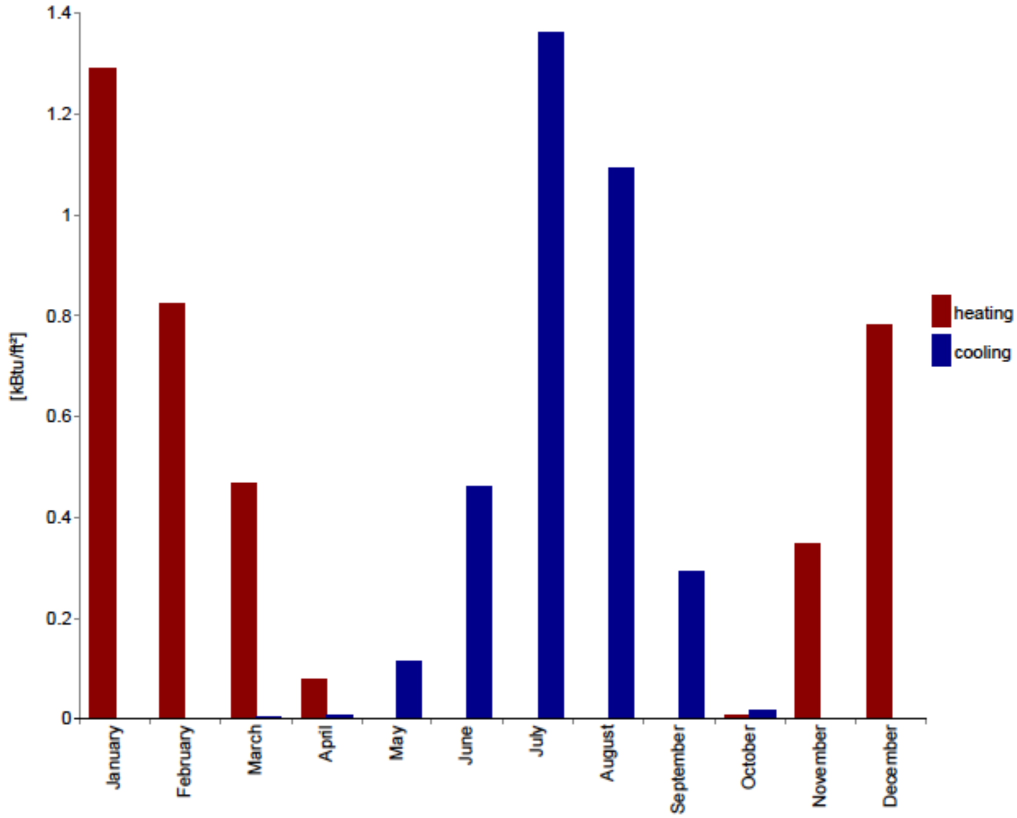
SPECIFIC HEAT/COOLING DEMAND MONTHLY



Month	Heating [kBtu/ft²]	Cooling [kBtu/ft²]
January	1.3	0
February	0.8	0
March	0.5	0
April	0.1	0
May	0	0.1
June	0	0.5
July	0	1.4
August	0	1.1
September	0	0.3
October	0	0
November	0.4	0
December	0.8	0

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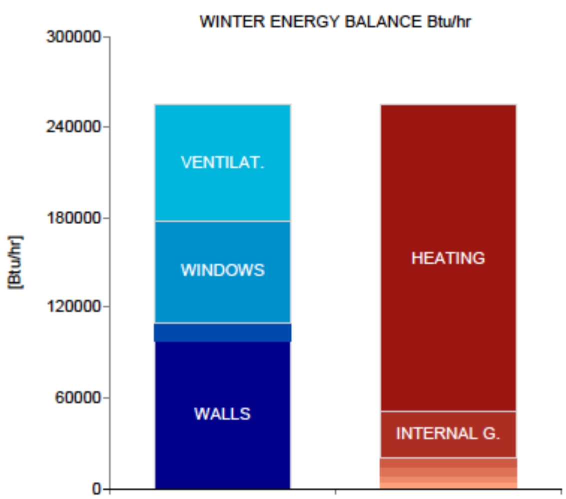
HEATING LOAD

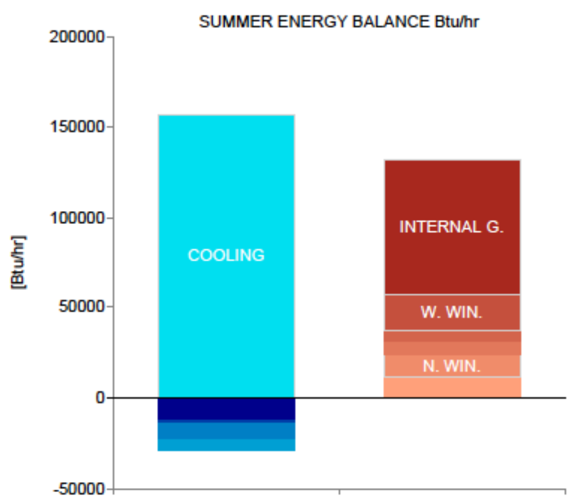
	First climate	Second climate
Transmission heat losses:	**178,137.7** Btu/hr	**126,703.6** Btu/hr
Ventilation heat losses:	**76,794.1** Btu/hr	**54,621.2** Btu/hr
Total heat loss:	**254,931.8** Btu/hr	**181,324.7** Btu/hr
Solar heat gain:	**20,522.7** Btu/hr	**11,605.6** Btu/hr
Internal heat gain:	**30,252.3** Btu/hr	**30,252.3** Btu/hr
Total heat gains heating:	**50,775** Btu/hr	**41,857.9** Btu/hr
Heating load:	**204,156.8** Btu/hr	**139,466.8** Btu/hr

Relevant heating load:	**204,156.8** Btu/hr
Specific heating load:	**3.4** Btu/hr ft²

COOLING LOAD

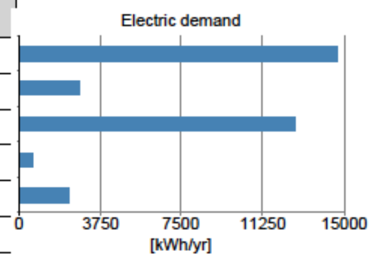
Solar heat gain:	**56,811.3** Btu/hr
Internal heat gain:	**74,985.1** Btu/hr
Total heat gains cooling:	**131,796.4** Btu/hr
Transmission heat losses:	**-18,131** Btu/hr
Ventilation heat losses:	**-6,751.1** Btu/hr
Total heat loss:	**-24,882.1** Btu/hr
Cooling load - sensible:	**156,678.6** Btu/hr
Cooling load - latent:	**0** Btu/hr
Relevant cooling load:	**156,678.6** Btu/hr
Specific maximum cooling load:	**2.6** Btu/hr ft²





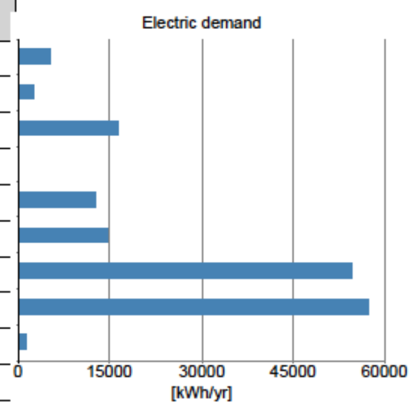
ELECTRICITY DEMAND - AUXILIARY ELECTRICITY

Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Source energy [kBtu/yr]
Ventilation winter	1	no	1 W/cfm	14719.2	140613.4
Ventilation Defrost	1	no	14,790.3 W	2777.6	26534.9
Ventilation summer	1	no	1 W/cfm	12813.5	122407.8
DHW circulating pump	1	yes	77.8 W	649	6199.6
DHW storage load pump	1	yes	418.9 W	2311.7	22083.8
Σ				33271	317839.5



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	1.2	5192.6	0	49605.4
Laundry - washer	1	yes	0.3	2381.6	0	22751.3
Laundry - dryer	1	yes	3.9	16487.5	0	157506.2
Energy consumed by evaporation	0	yes	3.1	0	1499.5	7350.9
Kitchen fridge/freeze combo	1	yes	0.7	12519.5	0	119599.5
Kitchen cooking	1	yes	0.2	14700	0	140429.9
User defined MELs	1	yes	54,532	54532	0	520947.1
User defined lighting	1	yes	57,607	57607	0	550322.8
User defined lighting	1	no	1,405	1405	0	13422
Σ	8			164825.2	1499.5	1581935.1



DHW AND DISTRIBUTION

DHW consumption per person per day:	**6.6**	gal/Person/day
Average cold water temperature supply:	**52.8**	°F
Useful heat DHW:	**249,984.9**	kBtu/yr
Specific useful heat DHW:	**4,191.6**	Btu/ft²yr
Total heat losses of the DHW system:	**32,418**	kBtu/yr
Specific losses of the DHW system:	**543.6**	Btu/ft²yr
Performance ratio DHW distribution system and storage:	**1.1**	
Utilization ratio DHW distribution system and storage:	**0.9**	
Total heat demand of DHW system:	**282,402.9**	kBtu/yr
Total specific heat demand of DHW system:	**4,735.1**	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**	%

BUILDING ENERGY PERFORMANCE MEASURES

Overview

Land Uses	The project is a mixed-use affordable housing transit-oriented development that is close to the Porter Square MBTA station. It also promotes walking and bicycling. Efficient use of limited building footprint includes approximately 525 square feet of amenity space, approximately 1040 square feet of neighborhood retail, and pedestrian scaled streetscapes.
Building Orientation/Massing	The proposed project is an eight (8) story tower with residential access to the building on Walden St, and retail space opening onto Mass. Ave.
Envelope Systems	High performance glazing and building envelope reduces the heating/cooling equipment sizes and low air infiltration rates improve indoor air quality and thermal comfort to the occupants.
Mech Systems	High efficiency mechanical systems include energy recovery ventilation, efficient air source heat pump technology, MERV 13 filtration, LED lighting, and low-flow plumbing fixtures.
Renewable Energy Systems	Preliminary WUFI energy models show that the project may meet the PHIUS site energy requirements without the inclusion of Solar PV. The project team will continue to track this item.
District Wide Energy Systems	N/A
Bicycle Parking and Green Roof	The project team has included 3 accessible parking spaces at the ground level and 2 temporary parking spaces to serve as a drop-off/pick-up area. The project has also focused on minimizing auto use, and has included 51 long term bike parking spaces (48 racks and 3 spaces for tandem or utility bikes). While there is no open space or landscaping on the site, planter boxes are proposed on Walden St. In addition, planters and fences supporting the growth of vertical green are located on the South facade of the Project at the openings to the parking and service areas. An intensive green roof is visible along Walden St above the parking entrance with a variety of non-invasive plant species, while an extensive green roof is being proposed on the roof to help with rainwater infiltration and reduce the urban heat island effect.

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INTEGRATIVE DESIGN PROCESS

The development team will present to the community on potential designs, design features, and the inclusion of affordable units as part of their early stage process. As part of the integrative design process, the developer, architect, mechanical engineer, and environmental consultant team have conducted a Green Charrette early on in the Schematic Design process and developed consensus on building systems and design that is consistent with PHIUS Passive House requirements.

SOLAR READY ROOF ASSESSMENT

To meet the very high level of performance required by the Passive House PHIUS+ CORE standard, results from preliminary energy models run by the project team indicated that this building likely does not require a PV array on the roof to meet the source energy goals. The project team is currently exploring placement of a mechanical room on the roof to enable a conversion to an all-electric DHW system in the future. This will limit available roof space for solar PV, but the building will be solar ready to allow for the potential addition of PV in the future. While this 49 unit building will be as energy efficient as possible, maximizing the potential to be a carbon neutral building in the future would likely involve purchasing renewable energy credits to offset the emissions from grid purchased power.

GREEN BUILDING INCENTIVE PROGRAM ASSISTANCE

Below is a description of programs applicable to this project that support improved energy performance or reduced greenhouse gas emissions, and which of those programs have been contacted and may be pursued.

The project plans to offset the costs of an energy efficient building envelope and electric heating and cooling system cost by utilizing all available rebate programs. The project is enrolled in the MassSave Passive House incentive program, and expects to use the Passive House Feasibility incentives from this program to offset the costs of energy modeling to meet Passive House standards. The project team plans to fully certify the building in order to be eligible for the full incentive package offered by MassSave. In addition, should the building systems qualify for the DOER Alternative Energy Certificate (AEC) incentive program, the project team will register for that incentive package as well.

NET ZERO SCENARIO TRANSITION

Below is a description of the technical framework by which the project can be transitioned to net zero greenhouse gas emissions in the future, acknowledging that such a transition might not be economically feasible at first construction. This description explains the future condition and the process of transitioning from the proposed design to the future condition.

	Net Zero Condition	**Transition Process**
Building Envelope	The building envelope will be built to PHIUS Passive House standards, making it an ideal structure to achieve Net Zero. The envelope will be well insulated and have a low level of air infiltration which will be tested and verified at construction.	This system will be a zero (site) emissions system at installation.
HVAC Systems	The heating system will be all-electric, with a highly efficient central VRF system installed at construction. In addition, central rooftop energy recovery ventilation will be used to capture energy from the ventilation system.	This system will have a zero (site) emissions system at installation.
Domestic Hot Water	A central gas-fired boiler plant will be included at construction. The project team is investigating the potential of locating these systems in a penthouse level mechanical room to allow for future conversion to an all-electric DHW system.	At the end of the system lifetime, the project team expects the all-electric DHW system technology to have advanced sufficiently to allow for conversion of this system to all-electric. The project team is investigating locating the DHW system on the roof specifically to allow for future conversion.
Lighting	The project will use LED lighting throughout at construction. The building energy model for this project, completed using WUFI modeling software for use in Passive House projects, does factor in and measure Lighting Power Density as a calculation in overall building energy	The building and management team will include updated technology as it is available and will update systems at the end of service life of the lighting systems.

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	consumption. Fixtures have been modeled and will be specified in project documents to meet or exceed the energy requirement of the WUFI model.	
Renewable Energy Systems	The building will be Solar Ready at construction.	In order to become fully carbon neutral, this project will likely have to purchase renewable energy credits given the building footprint and limited roof area.
Other Strategies	The project is actively considering and modeling the use of window shading to reduce building energy consumption during summer months, while also allowing solar thermal gains during winter months.	

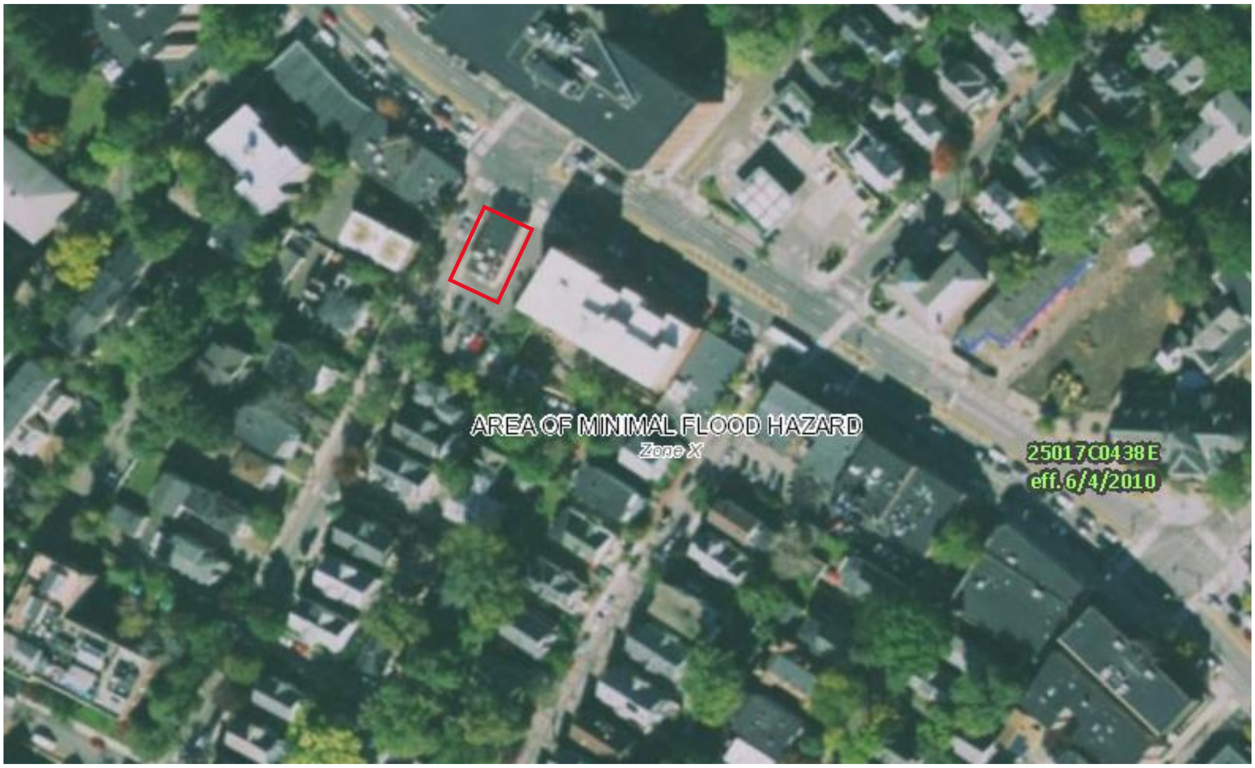
RESILIENCY

The project team has considered various resiliency strategies to reduce the project's and the residents' overall vulnerability. These resilience strategies are identified and summarized below in five sections.

EXISTING SITE ASSESSMENT

The project team has evaluated the flood risk based on current maps and future projections for the site and surrounding area. While the site is not located in a FEMA flood zone, and is not projected to be exposed to flood risk in forward looking models through the year 2070, the project team is actively considering resilience and risk mitigation strategies.

The project is at an average site elevation of ~35.95 ft-CCB, which translates to ~25.11 NGVD (ft-CCB is at 10.84 below NGVD). Based on the 2010 FEMA / FIRM Map, the site is located in Zone X Area of Minimal Flood Hazard, and is determined to be outside the 0.2% annual chance floodplain boundary (500-year flood scenario). Since the project is outside of the FEMA flood zones, FEMA has not determined a base flood elevation for this project site. The image below shows the project's location on the FEMA flood map.

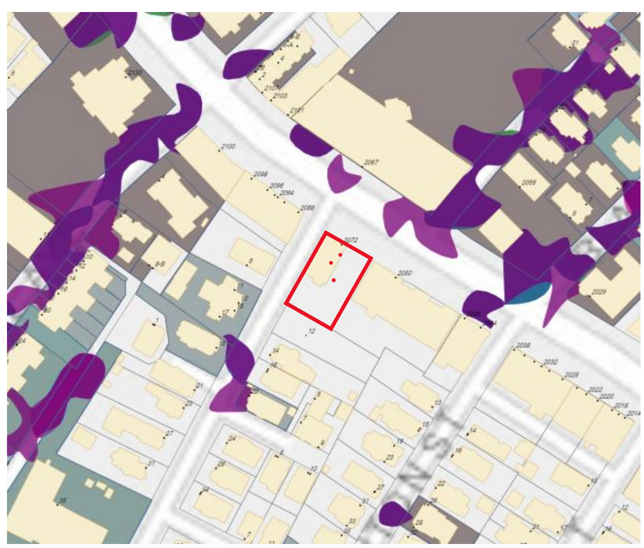


Based on the City of Cambridge FloodViewer v2.1, the site is outside the boundary of both the 2070 – 10 and 100 Year flood elevations. The below diagram indicates the extents of 2070 – 100 Year Precipitation nearby further down Walden St, and across Massachusetts Avenue. Although the project is not projected to be impacted by flooding, the project team has considered how to mitigate impacts from extreme events, and has outlined a number of resilience strategies and actions below.

Address: 12 Walden St

Ground Elevation Min:	35.70 ft-CCB
Ground Elevation Max:	38.90 ft-CCB
2070- 100 Year- SLR/SS	N/A
2070- 100 Year - Precip	N/A
2070- 10 Year - SLR/SS	N/A
2070- 10 Year - Precip	N/A
2030- 100 Year - Precip	N/A
2030- 10 Year - Precip	N/A
Present Day - 100 Year	N/A
Present Day - 10 Year	N/A
FEMA 500 Year	N/A
FEMA 100 Year	N/A

Selected Map-Lot: 200-22
Selected Address: 12 Walden St



PROTECTION STRATEGIES

The project will use strategies to reduce the building's vulnerability to extreme weather. The basement area will be waterproofed, as the building is outside of future projected flood risk zones. Flood resistant materials will be used in the basement, with concrete being the main material used. Sealants will be applied as needed and any cracks and penetrations will be sealed. Drywall use will be minimized in the basement, and any drywall used in the basement will be moisture, mold and mildew resistant purple board.

The transformer room will be waterproofed as needed based on its location in the building. Equipment located in the basement that must be on the floor will be located on 6" or 12" concrete pads as appropriate. Electrical outlets will be located 3'-0" above basement floor level. To prevent water intrusion, backwater valves will be installed as appropriate. In order to remove any water that does enter the basement, a sump pump will be installed and connected to emergency power. The project team will also work with the owner to develop an O&M manual which will include steps to take during flooding events.

ADAPTATION STRATEGIES

The project team is exploring the following strategies to improve the facility's ability to adapt to changing climate conditions. These strategies include both building elements and mechanical systems.

Building adaptation strategies include, but are not limited to, the following: Passive House level building envelope with operable windows to help with "passive survivability" – keeping the building habitable during extended power outages in any season. Reduced urban heat island effect enabled by the use of light colored and vegetated roofs. Window sunshades installed on the southwest façade to reduce solar heat gain during the summer, and interior window treatments (blinds) to reduce heat gain while allowing in light as needed.

Building mechanical system adaptation strategies include, but are not limited to, the following: Decentralized VRF heat pump mechanical system for both heating and cooling locates mechanical equipment on roof and in units instead of an area that can be potentially damaged by flooding.
Other mechanical equipment, including air handlers, energy recovery ventilators, and emergency generator, are located on the roof and away from flood risk. All residential living areas are elevated, all are located on the second floor or above. The project team is also actively considering the inclusion of a stormwater capture system, including infiltration tanks.

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BACKUP STRATEGIES

The project team is exploring how to provide for critical needs if the building loses power or other services. The project team plans to include an emergency generator located on roof and appropriate emergency lighting for evacuation and “sheltering-in-place”. Storage space will be available to provide access to water storage containers and access to potable water in the event of a power outage.

COMMUNITY RESILIENCE STRATEGIES

The project team is exploring how to encourage behavior which enhances resilience through cooperation. To enable this, the building’s amenity room encourages community building among residents. The planned amenity room includes communications resiliency measures e.g. phone charging, emergency refrigeration, and access to potable water as mentioned above. The project team will also evaluate the creation of an emergency operations manual for residents.

2072 Mass Ave. PHIUS+ CORE Ratings System Narrative

2072 Massachusetts Avenue Passive House

2072 Mass Ave., Cambridge MA, 02140
October 16, 2020

Submitted To:

Community Development Department, City of Cambridge
344 Broadway, Cambridge MA, 02138

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NEW ECOLOGY

Community-Based Sustainable Development

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PHIUS+2018 RATINGS SYSTEMS REQUIREMENTS

The project team will pursue Passive House certification to the standards set by the Passive House Institute US (PHIUS) for their PHIUS+ CORE rating system as well as certifying through the EPA Indoor airPLUS program. The PHIUS+ CORE rating system includes stringent and verified building performance metrics as well as professional testing of the building envelope and air sealing at two stages during building construction. EPA Indoor airPLUS certification includes verification of indoor air quality (IAQ) quality control measures including but not limited to: moisture control, HVAC venting and sealing, and use of low VOC materials in construction. The project team believes that these two ratings systems will result in a highly efficient building which protects occupant health through excellent indoor air quality.

While there is no rating system checklist for PHIUS+ CORE, there is a PHIUS Verifier workbook that will be completed as part of the field verification process as well as an EPA Indoor airPLUS checklist. The metrics measured and inspected by the PHIUS Verifier include:

- Building Envelope Air Infiltration & Compartmentalization
- Ventilation Air Flow Rates
- Heating and Cooling Equipment & Air Filtration Verification
- Domestic Hot Water System Specification Verification
- Appliance Energy Consumption Verification
- Indoor Air Quality Verification using the EPA Indoor airPLUS Verification Checklist

The PHIUS+ CORE rating system includes feasibility modeling to reach specified building performance metrics which are presented below in table format. The PHIUS verification process for the building energy model includes review and comments by a model evaluator from the PHIUS organization. This review of the model examines building assumptions for the envelope and mechanical systems, and is known to be a thorough and rigorous examination of building systems. The project team expects that the outcome of this modeling and review process, combined with envelope and air infiltration testing, will lead to a very high performance building with greatly reduced heating and cooling needs as compared with a baseline building.

REQUIREMENTS FOR PHIUS+ CORE CERTIFIED BUILDINGS

PHIUS sets strict standards for building certification under its PHIUS+ CORE rating system. PHIUS+ CORE sets requirements for building metrics in five areas: heating demand, cooling demand, heating load, cooling load and source energy consumption based on the expected number of residents. These 5 metrics, illustrated in the table below, are modeled, measured and verified by PHIUS using WUFI modeling. The project is at or near passing in all categories and as the design progresses, we will be sure that the design meets all requirements.

Table 1: PHIUS+ CORE Energy Modeling Requirements

PHIUS+ CORE Criteria	Units	Target Not to Exceed	Building Performance
Heating Demand	kBtu/ft2 per year	3.80	3.81
Cooling Demand	kBtu/ft2 per year	5.40	3.35
Heating Load	Btu/hr.ft2	3.70	3.42
Cooling Load	Btu/hr.ft	3.00	2.63
Source Energy	kWh/person per year	5500.00	5120.00

A rigorous and field-tested air-tightness standard is also applied to buildings seeking certification. The building envelope is tested twice using blower door testing. The first test is conducted after the installation of the air barrier, and the second at the completion of construction.

The PHIUS Passive House Air Tightness standard is as follows:

- Residential Units, Air Leakage: 0.30 CFM50 per sq. ft. of unit enclosure area, or less, demonstrated through blower door testing performed by the PHIUS+ Verifier following PHIUS sampling protocols.
- Whole Building, Air Leakage: 0.08 CFM50 per sq. ft. of building enclosure area, or less, demonstrated through a blower door test performed by the PHIUS+ Verifier.

Field Inspections During Construction:

A credentialed PHIUS+ Verifier will inspect, document and confirm the following features of the building envelope and building performance:

- Air Infiltration: Blower door testing will be done at project mid-point for the whole building and at project completion for both the units (sampled per RESNET protocols) and the whole building in order to ensure compliance with the requirements outlined above.
- Thermal Bridging and Air Infiltration Inspection: The project will be inspected after framing, but before insulation installation to inspect construction and identify potential areas of thermal bridging and air infiltration.
- Thermal Bridging: Thermal imaging inspection with an infrared camera to review and show compliance with thermal bridging and air sealing protocols.
- EPA Indoor airPLUS: review of compliance and documentation.
- HVAC: review of the HVAC functional test checklist, and four (4) site visits to observe testing and balancing of the HVAC systems as required by PHIUS.

REQUIREMENTS FOR EPA INDOOR airPLUS CERTIFIED BUILDINGS

The EPA Indoor airPLUS certification is a checklist based set of requirements focusing on building techniques that improve indoor air quality both through the construction process and throughout the lifetime of the building. Requirements are mainly focused on using low VOC materials, using proper procedures when building ductwork and systems, and following building procedures to prevent future water damage and/or mold growth. The EPA Indoor airPLUS certification is integral to the PHIUS+ CORE certification, and it will be independently reviewed and verified by a qualified reviewer.

The EPA Indoor airPLUS checklist requirements are assembled into the following categories: moisture control, radon, pests, HVAC systems, combustion pollutants, materials and final (inspection). The program requirements are outlined in the EPA Indoor airPLUS Construction Specifications Version 1 (Rev 04) and are summarized below. All requirements will be verified and confirmed by the qualified verifier and/or builder.

- Moisture Control
  - Drain or sump pump installed in basements and crawlspaces. In EPA Radon Zone 1, check valve also installed.
  - Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs AND radon techniques used in EPA Radon Zone 1.
  - Basements/crawlspaces insulated, sealed and conditioned.
  - Protection from water splash damage if no gutters.
  - Supply piping in exterior walls insulated with pipe wrap.
  - Hard-surface flooring in kitchens, baths, entry, laundry, and utility rooms
- Radon
  - Radon-resistant features installed in Radon Zone 1 homes in accordance with Construction Specification 2.1.
- Pests
  - Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed. (Not required for clothes dryer vents.)
- HVAC Systems
  - Duct systems protected from construction debris AND no building cavities used as air supplies or returns
  - No air-handling equipment or ductwork installed in garage.
  - Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer's instructions.
  - Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.

- Combustion Pollutants
    - Emissions standards met for fuel-burning and space-heating appliances.
    - CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.
    - Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.
    - Attached garages: Door closer installed on all connecting doors
    - Attached garages: In homes with exhaust-only whole-house ventilation EITHER ♦ 70 cfm exhaust fan installed in garage OR ♦ Pressure test conducted to verify the effectiveness of the garage-to-house air barrier.

- Materials
    - All composite wood products certified low-emission.
    - Interior paints and finishes certified low-emission.
    - Carpet, carpet adhesives, and carpet cushion certified low-emission.
- Final (Inspection)
    - HVAC system and ductwork verified to be dry and clean AND new filter installed.
    - Home ventilated before occupancy.
    - Equipment manuals, Indoor airPLUS label, and certificate provided for owner/occupant.

The project team looks forward to the construction of a very high efficiency building with a focus placed on reducing energy consumption and protecting resident health. The project team believes that following the above ratings systems, PHIUS+ CORE and EPA Indoor airPLUS will accomplish these goals and create a high quality living environment well into the future at 2072 Massachusetts Avenue.