Sustainability

The proposed HSL project will exemplify a holistic approach to sustainability, embracing dramatic operational and embodied carbon emissions reductions, low toxicity building materials, high indoor air quality, occupant comfort and health, watershed and habitat sensitive site interventions, renewable energy generation, and future-proof, resilient energy infrastructure. The biggest reductions in operational energy use will be realized by optimizing the building to use as little energy as possible and minimizing the need for external energy sources. We anticipate achieving this goal through a holistic application of passive design and resiliency strategies. The building will be designed to achieve Passive House certification through the Passive House Institute U.S. (PHIUS, leveraging the available incentives in their entirety (see “Incentives” below)). This will satisfy Stoughton’s Stretch Code requirements. Passive House performance buildings generally yield 80% heating demand reductions and 65% cooling demand reductions. These passive design measures prioritize and deliver energy savings via the most durable elements of the building. The envelope can last many years beyond the term of financing without degradation of its performance and outlast the useful life of mechanical systems several times over.

Building systems: This building will be all electric, including all mechanical systems, domestic hot water, and appliances. High performance heat pump systems with annual COP’s in excess of 3.4 will be employed for low operational energy consumption associated with heating and air-conditioning. This level of performance can be achieved through the use of several different system types, including VRF air-to-air, VRF air-to-water, or ground source heat pumps. We will explore the possibility of ground source heat pumps (often referred to as geo-thermal) or ‘Hybrid VRF’ air-to-water heat pumps systems. The heating / cooling distribution mechanism is an interior hydronic loop. Subsequently these systems utilize significantly less refrigerant (due to the dramatic reduction or total elimination of line sets.) Either the hybrid air-to-water or ground source heat pump systems can take advantage of simultaneous heating and cooling. The added benefit of ground source heat pumps is that they allow for an equipment-free roof, maximizing the on-site photovoltaic array.

Energy Recovery Ventilation with a minimum efficiency of 80% sensible recovery will be provided for all occupied spaces. The ventilation systems for the independent living units may be individual, or semi-centralized. Common area ventilation will be semi-centralized. Fully centralized systems use a significant amount of space for large ducts and prove difficult to balance for proper ventilation air distribution when commissioning, and over time. A centralized system also leads to total system failure if one piece of equipment fails. (See more at "Resilience".) The combined strategies of high performance, low refrigeration heat pumps and efficient energy recovery ventilation will yield the lowest possible carbon emissions associated with heating and cooling systems.

Semi-centralized heat-pump domestic hot water systems will be used in this building and will exceed a COP of 2. The project team will consider the use of CO2 refrigerant systems, such as R-32, to further reduce refrigerant leakage related climate impacts. The design team will explore various configurations of domestic hot water systems “neighborhoods” to reduce the number of units, controlling installation and ongoing maintenance cost, while limiting the energy demand of domestic hot water circulation. Smaller “regional” systems will have smaller circulation loops and pipe diameter than fully centralized systems and can be more responsive to demand diversity resulting in lower embodied carbon systems and less pumping energy demand.

Dehumidification is an important design consideration with the increase in extreme weather and changes in climate. While ERV's reduce the humidity loads associated with ventilation airflow, they do not actively manage humidity to within a specific range. Many HVAC designs simply assume dehumidification as a function of cooling will be sufficient. This is not a solution for coastal areas with high humidity in shoulder seasons. HSL and the project team will work together to determine humidity management appropriate for senior residents, and the design team will evaluate the cost and benefit of integrated dehumidification strategies. If the final systems selection does not include integrated humidity control functionality, the team will evaluate providing all residential units with wiring and plumbing for a dedicated dehumidification system in an interior closet should the need arise.

Electric vehicle ready infrastructure for 20% of parking spaces will be provided to support the overall goal of decarbonization and will satisfy both Stretch Code and PHIUS requirements.

Envelope: The team will explore all possible insulation and cladding materials, within the limits of fire/building code requirements, to maximize our carbon reduction and drawdown potential. We will work to eliminate all, or a vast majority, of foam products from the project. Foam insulation products generally have higher Global Warming Potential (GWP) and can pose significant toxicity risks, particularly during installation and in the event of a fire. There are currently many substitute insulation products on the market that will lead to greater carbon sequestration instead of emissions. Additionally, the project will evaluate shop-fabricated panelized construction, which would aim to maximize envelope panel dimensions using structural bay spacing. This construction method will minimize construction waste, thereby reducing embodied carbon, and shortening the construction schedule.

Interior Materials: Among the many benefits of Mass Timber, we can add possible significant savings on material use for interior furring and gypsum wallboard at walls and ceilings. The area of exposed structure will need to take fire/building code requirements into account for the building's construction type, but at least a portion of interior finish materials, including paint and fireproofing, may be eliminated, further reducing the total embodied carbon.

MEP Systems: With better envelopes, building peak loads are reduced, thereby reducing overall system size. Naturally this reduces the embodied carbon of the equipment as less material is needed to produce the system components.

Refrigerants: This project will employ 'Low Refrigerant' mechanical systems to reduce the carbon emissions of this often-overlooked carbon source and all but eliminate possible health concerns.

Renewable Energy: A building of this density, with limited roof size will always have a difficult time meeting 'Zero Energy' goals. Because of these challenges, all available roof space will be considered when designing the roof-based photovoltaic system in order to maximize on-site electrical generation.

One of the synergies of using the ground source heat pump systems described in the previous sections is the decreased need for rooftop space for mechanical equipment, which can then be used to increase the size and production of the PV array. In the case of the 'Hybrid VRF' system option, roof space is utilized, but less than on conventional buildings, due to the high performing Passive House envelope making a physically smaller mechanical system possible.

For remaining energy demands, beyond what can be served by the roof, site mounted PV arrays can be considered as parking shelters or patio awnings, or off-site solar energy may be purchased through Power Purchase Agreements (PPAs). The Stoughton Community Choice Electricity (CCE) program provides affordable and up to 100% renewable electricity.

Resilience: The first level of resiliency is having a safe and reliable shelter. Passive House provides a very good level of assurance of the proper application of building science principles for optimal indoor air-quality and comfort. The team will evaluate thermal bridging and the moisture profile of building assemblies to manage high humidity and condensation risks that can lead to mold and rot. The high-performance building envelope generally improves passive survivability. The team will further explore infrastructure hardening measures to ensure that systems and structures can withstand the stresses of natural disasters common to the climate zone. Higher R- values than are strictly required improve passive survivability, allowing all residents to stay in their homes during disruptions, something that is critical for HSL's senior population. We will also stress test the model to ensure that the building will continue to serve its residents as climate conditions worsen and become more extreme.

Full Energy Resilience requires a source of power to meet the remaining demands after efficiency is optimized. Enough energy to ensure health and safety and, if possible, to maintain comfort even when natural disasters occur. Our team will anticipate performing a thorough evaluation of the building's and residents' resiliency requirements and define critical energy loads. Critical building loads may include ventilation, emergency lighting and elevator use, heating and cooling zones, IT connectivity, the operation of personal medical devices, refrigeration of medicines and some quantity of food for the residents, and limited cooking operations. Renewable systems alone do not provide this level of energy resilience, unless combined with energy storage in an island-able micro-grid. If the sun is out, the system will be capable of self-power for all defined critical loads indefinitely. But at night and during inclement weather batteries will be required to support these functions. The resiliency study will determine the appropriate duration of battery powered operation, and battery storage will be sized to accommodate the critical loads for that duration.

Incentives: The project team's goal will be to yield the greatest incentives for this project, and to balance cost with performance. We will explore the following incentive programs and funding sources:

1. Mass Save:
    a. Feasibility: up to 100% of the feasibility costs, maximum $5,000 incentive, charette with design team, Passive to Positive, and Mass Save
    b. Energy Modeling: 75% of the energy model cost, $500/unit, maximum $20,000 incentive
    c. Pre-Certification with PHIUS: $500/unit
    d. Certification with PHIUS: $2,500/unit
2. Inflation Reduction Act:
    a. Section 48 Investment Tax Credit: tax credit for solar and energy storage such as geothermal and photovoltaic system, 30% tax credit amount for projects under 1MW,

non-profit, public entities can now qualify for 30% refund payment. Using US manufactured products can increase the potential tax credit to 40%.

b. Section 45L: transferable tax credit for new energy efficient DOE Zero Energy Ready Homes (ZERH) or Energy Star Homes
c. $1,000/unit for multifamily ZERH, $500/unit for multifamily Energy Star