CLEAN ENERGY AND RESILIENCY (CLEAR)

BOSTON PUBLIC HEALTH COMMISSION

APRIL 2022

Prepared for

Massachusetts Clean Energy Center (MassCEC)

Prepared by

Converge Strategies, LLC

MASSACHUSETTS CLEAN ENERGY CENTER

ABOUT MASSACHUSETTS CLEAN ENERGY CENTER

The Massachusetts Clean Energy Center (MassCEC) is a state economic development agency dedicated to accelerating the growth of the clean energy sector across the Commonwealth to spur job creation, deliver statewide environmental benefits and to secure long-term economic growth for the people of Massachusetts. MassCEC works to increase the adoption of clean energy while driving down costs and delivering financial, environmental, and economic development benefits to energy users and utility customers across the state.

To learn more about MassCEC, please visit: www.masscec.com

ABOUT CLEAN ENERGY AND RESILIENCY (CLEAR) PROGRAM

An increase in the frequency and severity of weather events associated with global climate change has increased the Commonwealth's need for resiliency in the face of major events and disturbances. The CLEAR Program seeks to support energy resilience investments in Massachusetts by advancing first-stage energy resilience system designs for critical facilities in Massachusetts communities. The findings of the CLEAR Program will also support the Commonwealth's consideration of energy resilience policy development in the future. The objectives of the CLEAR program are to:

1. Create resilient facilities to reduce economic losses from major power outage events.
2. Lower service interruption time for utility customers.
3. Provide a replicable model for outage recovery events.

The CLEAR program is a successor program to MassCEC's Community Microgrids Program, which initially funded fourteen (14) feasibility studies around the Commonwealth, seeking to identify scalable, broadly replicable microgrid business and ownership models to increase microgrid deployment and attract investment. Additional information on MassCEC's CLEAR program can be found here.

CONVERGE STRATEGIES

ABOUT CONVERGE STRATEGIES, LLC

Converge Strategies, LLC (CSL) is a consulting company focused on the intersection of clean energy, resilience, and national security. CSL works with civilian and military partners to develop new approaches to energy resilience policy and planning in the face of rapidly evolving threats, vulnerable infrastructure, and determined adversaries.

To learn more about CSL, visit: www.convergestrategies.com.

ACKNOWLEDGMENTS

The technical consultant team ("the Project Team") included:

Wilson Rickerson, Alex Pina, and Adair Douglas from Converge Strategies, LLC (CSL). CSL is a consulting company focused on the intersection of clean energy and resilience. CSL works with civilian and military partners to develop new approaches to energy resilience policy and planning in the face of rapidly evolving threats, vulnerable infrastructure, and determined adversaries.

Dave Korn and Matthew Piantedosi from Ridgeline Energy Analytics, a consulting firm that serves public and private clients in the energy field, providing energy engineering, data analysis, energy efficiency, and renewable energy services.

Benjamin Preston, Liam Regan, and Mike Wilson from the RAND Corporation. The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous.

Dr. Michael Stadler and Adib Naslé from XENDEE Corporation. XENDEE provides easy to use cloud computing software for microgrid, energy resilience, and renewable energy projects. XENDEE allows very fast and quick analysis so that investors can assess the attractiveness of their projects immediately.

The authors would like to thank the following individuals for their insights and expertise:

Boston Public Health Commission (BPHC)

- Robert Dillon, Director of Property Management
- Raul Gonzalez, Department Director, Property Management
- Michelle MacDougall, Project Manager (now with City of Boston Public Facilities)
- Steven Barry, Senior Admin Assistant
- Jonathan Olivo, Site Manager

Boston Planning and Development Agency (BPDA)

- Travis Anderson, Senior Infrastructure and Energy Planner
- Manuel Esquivel, Senior Infrastructure and Energy Planner
- Joe Christo, Senior Resilience and Waterfront Planner
- Anna Demina, Smart Utilities Program Associate
- Ted Walinskas Smart Utilities & Energy Planning Co-op

City of Boston Mayor's Office of Energy, Environment and Open Space (EEOS)

- Bradford Swing, Director of Energy Policy and Programs
- Christopher Kramer, Energy Manager
- Sanjay Seth, Climate Resilience Program Manager

City of Boston Mayor's Office of Emergency Management (OEM)

- Sarah Eig, Director of Planning and Preparedness
- Matthew Kearney, Planning Unit Supervisor
- Benjamin McNeil, Director, Emergency Operations Center

The project benefited from the expertise and input of Silas Bauer (Seal Rock Energy), Joanne Bisetta (Massachusetts Department of Energy Resources), Steven Casey, Brandon Carr, Michael Hickey (Eversource), Richard Holland (KP Law, P.C.), Dragica Ivanis (City of Chelsea), Joe LaRusso (City of Boston), Meg Lusardi (PowerOptions), David Musselman (City of Boston), Heather Takle (PowerOptions), Tyler Thibault (Eversource), and Jen Stevenson Zepeda (climable.org). The Project Team would also like to thank Ariel Horowitz, Rees Sweeney-Taylor, and Rhys Webb from MassCEC for their guidance and leadership.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The City of Boston has established ambitious policies to achieve carbon neutrality and prepare for climate change in alignment with the Boston Green New Deal. Clean energy technologies can provide backup power to municipal facilities to support both decarbonization and climate resilience goals. Energy resilience is an emerging field for cities that requires new types of collaboration across multiple disciplines. The unique inter-agency team that supports the CLEAR project bridges across the City's public health, planning and economic development, emergency management, energy, and climate change functions.

The CLEAR project's focus is to provide energy resilience for residential recovery services programs located in two buildings (201 River Street and 209 River Street) on the Boston Public Health Commission's Mattapan Campus. Both buildings are designated as critical facilities by the Mayor's Office of Emergency Management. Neither building has backup power and residents would need to evacuate to another City facility during a power outage. The CLEAR project's primary goal is to allow the programs' clients to shelter in place during emergencies.

There are limited opportunities for energy resilience by reducing energy demand. Both buildings had recent interior and exterior LED lighting retrofits and cannot gain additional energy savings from lighting replacements. Both of the building envelopes are inefficient, and improved insulation and air sealing would enable residents to shelter in place for longer. 201 River Street has an unexplained winter load that may be the result of equipment malfunction, metering error, or connection to non-BPHC loads. This should be investigated and addressed.

There are suitable solar photovoltaic sites adjacent to 201 River Street. When coupled with battery storage, solar photovoltaic systems at these sites could power 201 River Street for multiple days during a power outage. There are no suitable PV sites near 209 River Street as a result of space constraints and shading.

BPHC could pursue a solar and storage system at 201 River Street that could be economically feasible, based on federal and state incentives for solar photovoltaic (e.g., the SMART program), and utility incentives for battery storage (e.g., the ConnectedSolutions Program).

A microgrid connecting the two buildings would be technically feasible, but the costs to upgrade the local distribution system would be high. The revenues and savings generated by the solar PV and battery storage systems would not be sufficient to cover the costs of the upgrade. It is recommended that BPHC move forward with a stand-alone PV and battery system at 201 River Street and consider an emergency generator for 209 River Street. The two systems could potentially be connected as a microgrid in the future if additional funding, such as from the federal Bipartisan Infrastructure Law, becomes available.

There are multiple procurement pathways that BPHC could explore for acquiring a resilient solar PV and battery system. For example, BPHC could issue its own RFP for a third-party to own and operate the system or it could partner with an entity to run a competitive process on BPHC's behalf. Since energy resilience procurement is relatively new in Massachusetts, BPHC could rely on the expertise within the City of Boston's Municipal Energy Unit, and the Boston Planning and Development Agency to navigate state and city authorities.

INTRODUCTION

This report summarizes the findings of the energy resilience analysis conducted on behalf of the Boston Public Health Commission (BPHC), in partnership with the Boston Planning and Development Agency (BPDA), the Mayor's Office of Environment, Energy, and Open Space (EEOS), and the Mayor's Office of Emergency Management (OEM). The analysis was conducted as part of the Clean Energy and Resiliency (CLEAR) program supported by the Massachusetts Clean Energy Center (MassCEC).

Boston was one of nine communities and institutions awarded support under the CLEAR program. The Boston CLEAR analysis centered on the BPHC's campus in the Mattapan neighborhood. The BPHC Mattapan Campus contains BPHC facilities, City of Boston facilities, and buildings leased by other organizations. The CLEAR analysis focused specifically on BPHC recovery services programs[1] located in buildings on the east side of the campus:

- **Entre Familia**, a residential substance use treatment program for women and their children in 209 River Street; and
- **Transitions**, a short-term transitional support services program, and **Wyman Re-Entry**, a residential recovery program, both located at 201 River Street.

[1] An overview of the types of recovery services programs provided by BPHC can be found in the Substance Abuse Prevention and Treatment Services report from the BPHC.

The buildings that house these programs are included on the OEM's list of critical facilities, which documents the essential programs and facilities that are prioritized during response and recovery operations. The location of the buildings in the BPHC Mattapan Campus can be seen in Figure 1 below.

Figure 1. BPHC Mattapan Campus

The goals of the Boston CLEAR analysis are to:

- Identify actionable steps to create a future where clients of these facilities can shelter in place for at least 72 hours (3 days) in their individual rooms with a functioning common area that serves group needs during power outages.
- Identify technically and financially feasible resilience solutions that maximize the use of clean energy technologies such as solar photovoltaic (PV) systems.
- Explore acquisition pathways that use third-party capital, such as power purchase agreements (PPAs) for PV development paired with storage, that could be procured through a competitive bid and free up capital budget dollars for other BPHC expenditures.

Another goal of the CLEAR Program is to analyze how individual buildings might backup their critical loads with clean energy. The MassCEC Community Microgrids Program (CMP) supported feasibility studies of multi-user, multi-tenant microgrids at four sites across Boston.[2] A key lesson from the CMP is that large community microgrids are highly customized and difficult to replicate and scale. By focusing on specific building types, the CLEAR Program aims to identify replicable resilience solutions that could be scaled at building types with similar critical functions and loads. This report focused primarily on individual buildings, but the project consulting team of Converge Strategies, Ridgeline Energy, XENDEE, and RAND Corporation ("the Project Team") also considered a microgrid configuration as part of an analysis of alternatives.

This report is organized as follows:

- **Section 1** provides an overview of the City of Boston's climate, energy and resilience strategy, and the energy resilience initiatives of the four municipal organizations supporting the CLEAR program.
- **Section 2** reviews the findings of the energy resilience assessment conducted for BPHC's Mattapan facilities, including their energy resilience requirements, their existing energy resilience capabilities, and new opportunities to support resilience with clean energy.

[2] Chinatown, the Raymond J. Flynn Marine Park, the Charlestown Navy Yard, Wentworth Institute of Technology. *See* MassCEC (2020). Community Microgrid - Final Reports.

1. ENERGY, CLIMATE, AND RESILIENCE IN BOSTON

1.1. Boston Policy Background

The City of Boston is committed to reducing carbon, making advancements to shift to renewable energy, and prioritizing the stability of Boston's future for years to come, under the leadership of Mayor Michelle Wu.[3] In August 2020, Mayor Wu laid out a plan for a *Boston Green New Deal & Just Recovery*[4] focusing on climate justice and accelerated decarbonization. Mayor Wu's vision for Boston to achieve carbon neutrality by 2040, 100 percent renewable electricity by 2030, and a net-zero municipal footprint by 2024 builds on the city's existing climate and energy commitments.

Boston introduced a goal to reduce its carbon emissions 80% below 1990 levels by 2050 in its 2007 climate action plan.[5] In 2017, Mayor Walsh committed to achieving 100% carbon neutrality by 2050,[6] and the city's long-term strategic plan, *Imagine Boston*, set an interim carbon reduction goal of 50% by 2030.[7] The City's *Climate Action Plan 2019 Update* set forth 18 separate strategies to achieve carbon neutrality[8], with progress on each of the strategies tracked in the *Climate Action Fiscal Year 2021 Report*.[9]

In parallel with its decarbonization commitments and actions, the City is also leading efforts to prepare for climate change under Climate Ready Boston[10] and through the City's *2021 Natural Hazard Mitigation Plan Update*.[11] Climate Ready Boston is an ongoing initiative to enhance community resilience and address vulnerabilities. The initiative builds on the City's initial *Climate Ready Boston* report from 2016.[12] The Natural Hazard Mitigation Plan (NHMP) is a planning process managed by OEM that focuses on both hazard mitigation planning and climate adaptation. The City is required to publish an updated NHMP annually to remain eligible for hazard mitigation funding through the Federal Emergency Management Agency (FEMA).

---

[3] City of Boston (2021). Mayor Wu Signs Ordinance to Divest City Funds from the Fossil Fuel Industry.
[4] Office of City Councilor Michelle Wu (2020). Planning for a Boston Green New Deal & Just Recovery.
[5] City of Boston (2007). Climate: Change - The City of Boston's Climate Action Plan.
[6] City of Boston (2017). State of the City 2017.
[7] City of Boston (2019). Imagine Boston 2030.
[8] City of Boston (2019). City of Boston Climate Action.
[9] City of Boston (2021). Climate Action Fiscal Year 2021 Report.
[10] City of Boston (2021). Preparing for Climate Change.
[11] City of Boston (2021). 2021 Natural Hazard Mitigation Plan Update.
[12] City of Boston (2016). Climate Ready Boston Final Report.

1.2. Energy Resilience as a Priority Across City Organizations

Energy resilience is a comparatively new field of practice that cuts across multiple disciplines and requires alignment between City cabinets, departments, and agencies. The Boston organizations supporting the Boston CLEAR project represent a ground-breaking collaboration that aligns municipal functions related to public health, planning and economic development, emergency management, energy, and climate change. This section provides a short overview of each organization and their relation to energy resilience planning.

1.2.1. Boston Public Health Commission (BPHC)

BPHC is an independent public agency providing a wide range of health services and programs. It is governed by a seven-member board appointed by the Mayor. The BPHC completed a facility assessment report in 2020 which resulted in a 15-year capital plan. The intent of the plan is to inform the Commission’s annual budget allocation and decision-making. The BPHC intends to use the Boston CLEAR project to inform future facility investments identified in the capital plan.

1.2.2. Mayor’s Office of Environment, Energy, and Open Space (EEOS)

EEOS is one of the Mayor’s Cabinet Offices and includes the City’s Environment Department and the Parks and Recreation Department. EEOS also contains the City’s Energy Policy and Programs function and the Municipal Energy Unit. The mission of EEOS is to enhance environmental justice and quality of life in Boston by protecting air, water, climate, and land resources, as well as preserving and improving the integrity of Boston's architectural and historic resources. EEOS leads the City’s Climate Action Plan and carbon-neutrality goals, including decarbonizing municipal buildings. EEOS also co-leads the Climate Ready Boston efforts, and has been working to integrate energy resilience into City policies and programs:

- **Climate Action Plan (CAP).** One of the central strategies of the 2019 CAP is to “Plan for the Deployment of Carbon-Neutral District Energy Microgrid Systems.” The BPDA Smart Utilities Policy (see Section 1.2.4) and the CLEAR project are explicitly included as lines of effort under this strategy.
- **Climate Ready Boston.** The initiative includes a focus on energy infrastructure vulnerability to flooding, extreme heat, and extreme weather. The 2016 report specifically recommends solar PV and microgrids for energy resilience and outlines a strategy for “developing district-scale energy solutions to increase decentralization and redundancy.”

1.2.3. Mayor's Office of Emergency Management (OEM)

OEM is a department within the Public Safety Cabinet. OEM is tasked with enhancing the City's capacity to prevent, protect against, respond to, and recover from major emergencies. OEM planning efforts prioritize finding solutions to enhance the resilience of all critical facilities and programs using localized strategies to ensure that Boston residents, especially the most vulnerable, are supported equitably during an emergency. Under the 2021 NHMP, the City published a list of over 50 hazard mitigation and climate adaptation strategies that will reduce adverse impacts of natural hazards while supporting the health and well-being of Boston's residents. The NHMP features a number of strategies that focus specifically on energy, including installing energy storage for emergency evacuation route lighting, siting battery storage to reduce stress on the grid, and assessing district energy for large-scale real estate developments. Examples of NHMP strategies that focus specifically on installing resilient distributed energy at critical facilities include:

- **Backup Energy for Critical Facilities.** The City should complete an inventory of energy resilience and backup power assets at Boston's 6,000 critical facilities. The NHMP states that after completing the inventory, "the next step would be to work towards implementing adequate backup power for continuity of services by exploring microgrid systems with renewable energy sources or other alternatives."
- **Emergency Shelters for Natural Hazard Protection.** The City should adapt shelters to be more resilient to climate change impacts; and work towards all shelters having backup power supply (generators, transfer switches, or microgrids) and central air conditioning so that they can operate as cooling centers.
- **Expand Backup Power of Private Buildings that Serve Vulnerable Populations.** The City should conduct outreach to owners and operators of privately owned facilities that serve significant concentrations of vulnerable populations, but that are not currently required to have operational preparedness and evacuation plans under state and local regulations. The purpose of this outreach would be to encourage the owners and operators of these facilities to develop operational preparedness and evacuation plans for situations when sheltering in place is not feasible, as well as to make needed capital upgrades

The NHMP also specifically mentions that the City plans to use the Boston CLEAR project "to serve as a template for similar work in other quasi-agencies, community organizations, and private facilities."

1.2.4. Boston Planning and Development Agency (BPDA)

BPDA is the planning and economic development agency for the City of Boston. The BPDA is a self-sustaining agency governed by four board members that are appointed by the Mayor and confirmed by the City Council, and one Board member appointed by the Governor of Massachusetts. For more than a decade, BPDA has had a focus on energy resilience and microgrid planning and co-leads the Climate Ready Boston initiative with EEOS. Examples of BPDA's initiatives include:

- **Boston Smart Utilities Program (BSU).** The BSU is a process for integrated utility planning embedded with the BPDA's Article 80 Development Review for large projects.[13] Real estate developers must integrate five Smart Utility Technologies, including district energy microgrids, into Article 80 projects. Proposed projects larger than 1.5 million square feet of floor area must develop and implement a District Energy Microgrid Master Plan if microgrids are determined to be feasible.[14]

- **Community Energy Planning.** The BPDA runs a Community Energy Planning initiative[15], through which BPDA works collaboratively on energy supply issues with communities, regulators, and utilities. The BPDA identified "hot spots" for community microgrids through its *Community Energy Study*[16], and subsequently began planning for a microgrid at the Raymond J. Flynn Marine Park with support from the MassCEC CMP.[17] The Marine Park microgrid project is also identified as a strategic focus in *Imagine Boston 2030*.

These organizations have stated their intent to leverage the Boston CLEAR project to establish a long-term relationship in support of energy resilience for the City's critical facilities and most vulnerable populations. The organizations have also stated that they are particularly interested in finding scalable and replicable solutions to apply to other facilities and operations across the City.

Boston's focus on public critical facilities under CLEAR is an example of "resilient public infrastructure in our neighborhoods" as described in Mayor Wu's Boston Green New Deal plan designed not only to "set up our communities for a resilient future, but serve as proof points for the practicality and benefits of sustainable management."

---

[13] BPDA. (2021). Boston's Article 80 Process.
[14] BPDA (2020). Smart Utilities Policy for Article 80 Development and Review - October 2020 Update.
[15] BPDA. (2021). Community Energy Planning.
[16] BPDA. (2016). Boston Community Energy Study.
[17] Microgrid Institute & S&C Electric Company (2020). Raymond L. Flynn Marine Park District Energy Microgrid MassCEC Feasibility Assessment.

2. ENERGY RESILIENCE OPPORTUNITY ASSESSMENT

2.1. PROJECT APPROACH

The Project Team conducted the energy resilience analysis in several phases during 2021 to determine the feasibility for residents to shelter in place at 201 River Street and 209 River Street for at least 72 hours (3 days). The phases included:

- **Stakeholder Interviews.** The Project Team conducted structured interviews with representatives from the Boston municipal organizations to develop a preliminary assessment of the critical functions that the facilities would need during an emergency. The interviews also sought to characterize the electrical loads necessary to support those critical functions. These interviews set the stage for an in-person site visit.
- **Site Visit.** In December 2020, Ridgeline Energy Analytics conducted an in-person site assessment of the facility. Ridgeline Energy Analytics conducted an energy system review in partnership with BPHC staff and completed an assessment of potential solar PV sites. Solar PV analyses were completed using the HelioScope solar design software suite.[18] An overview of the findings is contained in Section 2.5.3.
- **Incentive and Funding Assessment.** In addition to reviewing local policies related to energy, climate, and emergency preparedness, the Project Team also conducted a review of how incentive and funding programs available from state, federal, and utility partners could be combined to support the investment opportunities identified. The assessment considered both programs to support clean energy and programs that can support backup power for emergency management purposes.
- **Utility Consultation.** The Project Team met with representatives from Eversource to review the distribution system that serves the BPHC Mattapan Campus and assess whether upgrades would be necessary to accommodate the proposed energy resilience solutions.

---

[18] *See* HelioScope.

2.2. ENERGY RESILIENCE ASSESSMENT STRUCTURE

Sections 2.3 - 2.5 organize the findings of the BPHC energy resilience assessment using the following categories:

- **Energy Resilience Requirements**. The energy needs of the BPHC Mattapan Campus under both normal and emergency operating conditions. This includes a general description of the essential functions contained within each building and the amount of electrical load required to perform those functions.
- **Energy Resilience Capabilities.** The existing energy generation and backup power systems (i.e., generators) that are already installed at the campus, the length of time that the estimated critical loads can be sustained using the existing backup power systems, or the plan for evacuating the building if required.
- **Resilience Opportunities.** Opportunities to improve the energy resilience of the facility through changes in operations or through new investment. This includes, for example, energy efficiency upgrades to reduce the load of the building (and make it easier to sustain or restore during an emergency), and onsite solar PV installations.

2.3. ENERGY RESILIENCE REQUIREMENTS

2.3.1. MATTAPAN TRANSITIONS AND WYMAN RE-ENTRY (201 River Street)

Figure 2. Mattapan Transitions and Wyman Re-Entry at 201 River Street

Essential Community Function

Both programs offer a safe and therapeutic environment to support clients in their recovery and transition. The programs facilitate client discussion groups that meet daily to explore life issues related to substance use, education sessions that provide clients with information about the consequences of substance use, as well as individual sessions that help clients choose a suitable placement for the continuation of treatment.

- **Mattapan Transitions** is a 40-bed, short-term substance use treatment program for adults seeking continued treatment after detox.[19] Mattapan Transitions focuses on relapse prevention, behavior modification, and re-socialization skills. The program provides services such as case management, counseling, education, aftercare planning and referrals, and help with family unification.
- **Wyman Re-Entry** is a 30-bed substance use recovery program that provides services to individuals who wish to re-engage in activities such as school or work in a supportive environment. Wyman Re-Entry provides similar services to those provided by Mattapan Transitions, but on a 4-6 month residential basis.[20]

---

[19] BPHC. Transitions.
[20] BPHC. Wyman Recovery Home.

Energy Usage And Demand

- The annual electricity consumption for 201 River Street is 574 megawatt-hours (MWh). The largest electrical load in 201 River Street is cooling, which is provided by a 50-ton chiller on the upper three floors, and by a 2.5-ton central air conditioner and window units in the basement. The total cooling demand is approximately 50 kilowatts (kW). The interior and exterior lights were replaced with LEDs in 2020, and the current lighting demand is 11 kW. There are small additional electric loads associated with the heating system, hot water pumping, and cooking. The total estimated peak load of the building is 90 kW in summer, which is higher than expected for a facility of this size, with lower loads in winter since cooling loads are low and heating is not provided by electricity. As discussed below, however, there is a large and unexplained electrical peak of more than 80 kW during winter that does not appear consistent with the building-scale equipment.
- The building is heated by two 20-year old gas-fired steam boilers that feed steam radiators. A high-efficiency gas-fired condensing heater provides hot water to the building.

2.3.2. ENTRE FAMILIA (209 River Street)

Figure 3. Entre Familia at 209 River Street

Essential Community Function

Entre Familia is a 6- to 12-month residential substance use treatment program that provides bilingual, bicultural, and gender-specific substance use disorder treatment to pregnant and postpartum women and their children.[21] The program provides:

- core clinical treatment services including screening, assessment, referrals to medical and mental health services, residential care, comprehensive case management, childcare services, and referrals for specialized services to address developmental and behavioral difficulties and early intervention; and
- clinical support services including enhanced case management, individual family treatment planning, and case coordination of services for children.

Energy Usage And Demand

- The annual electricity consumption for the building is 101 MWh. Similar to 201 River Street, the largest electrical load in 209 River Street is cooling, which is provided by a 40-ton chiller. The total cooling demand is approximately 40 kW. The interior and exterior lights were also replaced by LEDs in 2020, and the lighting demand is 3.5 kW. There are small additional electric loads associated with the heating system, domestic hot water, cooking, and pumping for the HVAC system. The total estimated peak load of the building is 50 kW during summer days, and 20 kW during non-summer days.
- The building is heated by two gas-fired water boilers. One of the boilers serves the space heating loads, while the other boiler serves the domestic hot water load.

[21] BPHC. Entre Familia.

2.3.3. CRITICAL LOADS

The primary critical loads that would need to be sustained in an emergency to enable residents to shelter in place for at least 72 hours (3 days) include lighting, cooling, refrigeration for medication and food, and the minimal electric loads required to start and operate the heating systems. For the purposes of this analysis, the Project Team assumed that the critical load would equal to 50% of the normal peak load. This reduced peak could be achieved by cooling the buildings to an emergency temperature of 78 degrees, rather than 72 degrees, and by manually disconnecting and turning off certain non-critical loads. BPHC should validate the critical load amount for each facility to ensure any backup power assets are sized appropriately.

2.4. ENERGY RESILIENCE CAPABILITIES

There are no existing distributed generation systems, such as solar PV systems or backup generators, on the BPHC Mattapan Campus that could be integrated into an energy resilience solution. There is a 150-kW diesel generator on the campus, but it is not owned by BPHC, and it is sized to only serve the Boston Emergency Medical Services fleet garage.

In the event of an emergency that causes an extended power outage, BPHC would plan to move the programs' residents to other City shelter facilities. Such operations would be challenging under normal conditions, and more difficult under a city- or region-wide emergency event that impacts energy and transportation networks. The City could move mobile diesel generators to the site in order to allow residents to shelter in place. However, neither 201 River Street nor 209 River Street currently have the equipment necessary to accept power from a mobile generator.[22] The fleets of mobile generators owned by the City (or available through other state and federal partners[23]) are also limited, and it is not clear where the BPHC Mattapan Campus would fall in the prioritization order in the case of a widespread power outage that affects critical facilities across Boston.

[22] This might include a quick disconnect outlet, a manual transfer switch, an electric subpanel for building emergency loads, and the associated cabling to connect the new equipment. In this example configuration, the generator would serve only those loads on the subpanel during a power outage, rather than the entire building.

[23] Boston can source generators from the Metro Boston Homeland Security Region (MBHSR), and request additional generators through the Massachusetts Emergency Management Agency (MEMA). Depending on the scale and cause of the outage, the Commonwealth can reach out nationally through the Emergency Management Assistance Compact (EMAC), and request support from the Federal Emergency Management Agency if a disaster is declared.

2.5. RESILIENCE OPPORTUNITIES

The Project Team evaluated strategies to decrease the critical load during an emergency, and/or to generate electricity for an emergency backup power system. The Project Team also prioritized zero-emission generation sources such as solar PV over fossil-fueled systems (such as combined heat-and-power) given the City's decarbonization and climate justice objectives.

2.5.1. Energy Efficiency Upgrades

The Project Team conducted an energy audit for both buildings that focused primarily on electrical load. The Project Team also conducted a high-level assessment of the heating systems. The following observations relate to both buildings, followed by more detailed, building-specific findings below.

- **Lighting.** Both facilities completed extensive interior and exterior LED lighting retrofits in 2020, which reduced the lighting load by half, and decreased the load that would need to be sustained during a power outage. No additional lighting retrofits are recommended.
- **Building envelope.** The building envelopes of both buildings are inefficient. This study focused primarily on electrical loads and the Project Team did not conduct a full audit of building insulation and air sealing. A dedicated energy efficiency audit of both buildings should be conducted to determine whether there are opportunities to insulate the attic spaces and walls, and to conduct air sealing. Additional insulation would improve resident comfort during normal operations, reduce natural gas consumption for heating, and reduce the need for residents to use their own plug-in heaters. Improved insulation would also improve resilience by reducing the speed and magnitude of temperature swings, and by preventing or delaying the need to evacuate residents during power outages.
- **Heating systems.** The heating systems in both buildings are low- to moderate-efficiency and use natural gas for fuel. There may be opportunities to replace the heating system with high-efficiency electric heating systems, such as variable refrigerant flow (VRF)[24] heat pumps. Detailed consideration of heating system replacement, however, is beyond the scope of this report, but would be covered during a dedicated energy efficiency audit.

[24] *See* MassCEC. Learn about Variable Refrigerant Flow and Other Air-Source Heat Pumps.

201 River Street

The energy intensity of the building is 200 kilo-British thermal units per square foot per year (kBTU/SF/year) which is extraordinarily high. In particular, the high electricity demand in non-cooling months at 201 River Street should be investigated. Although some residents use personal heaters in their rooms, these heaters would not account for the magnitude of the additional peak load. There may be, for example, an issue with the chiller, other unknown loads that are connected to the building, or a metering error. Clarifying the root cause of the unexpected demand would enable more informed and targeted resilience planning while saving BPHC money on future utility bills.

Eversource does not have visibility into the potential causes of the load. BPHC would need to conduct an electrical load study that would determine the power draw of each circuit on the main electrical panel. BPHC would also need to conduct an electrical circuit mapping study to determine which devices in the facility are powered by each circuit. If these studies are unable to identify the device(s) that are causing the unexpected loads, BPHC could employ a surveyor to detect any underground non-utility lines that may be incorrectly connected to the 201 River Street electrical meter. If a non-BPHC load is connected to BPHC's meter, then BPHC could either direct the owner of the other load to get their own Eversource connection or develop a billing arrangement to compensate BPHC for the electricity consumed.

209 River Street

The energy intensity of the building is 147 kBTU/SF/year, which is high but two-thirds the energy intensity of 201 River Street. Some of this high energy intensity may be due to system operations. In particular, gas usage for the building in spring is high for a residential building, which could point to leaving the boilers operating for too long in the shoulder season. The building water pumps may also be running during periods when there is no heating or cooling required.

The high gas usage may also be driven by inefficient equipment. A BPHC condition report stated that the HVAC equipment had been installed within the last 10 years. A review of the HVAC serial numbers, however, reveal that the equipment is more than 10 years old.

- The chiller is 19 years old and is moderately efficient.
- The heating and domestic hot water boilers are more than 13 years old and are low efficiency (i.e., ~80% efficiency). The domestic hot water heater could be replaced with a high-efficiency gas storage heater similar to the unit installed in 201 River Street. A higher efficiency gas unit could reduce fuel consumption by 10%.

2.5.2. Onsite Generation and Storage Design Considerations

The Project Team assessed multiple options for solar PV, battery storage, and fossil-fueled generators to provide backup power to 201 River Street and 209 River Street. **The analysis found that solar and storage - without a diesel generator - could sustain the critical loads of the BPHC buildings for at least three days.** The economics of resilient solar and storage systems depends on their configuration and ownership models. A stand-alone solar and storage system that serves just 201 River Street could be economically attractive if BPHC were able to partner with a third-party that would own and operate the systems and monetize available federal tax incentives on the city's behalf. The Project Team has provided economic analysis of multiple scenarios conducted using the XENDEE platform to the City of Boston.[25] Although such models are common for solar PV and storage, the pathways to acquire third-party owned solar and storage for resilience are less proven in Massachusetts (Section 2.6). A microgrid that connects 201 and 209 River Street is technically feasible, but the cost of the upgrades required to do so would make the project difficult to finance, even under the third-party ownership model, without additional public sector funding. This section provides additional detail on the key assumptions and findings of the analysis.

- **Technology selection.** The Project Team used the XENDEE microgrid and distributed energy resources (DER) model to assess the economics and the carbon dioxide (CO_2) emissions reduction potential for multiple technology combinations. XENDEE uses an enhanced version of the U.S. Department of Energy's Distributed Energy Resources Customer Adoption Model (DER-CAM) to determine the optimal mix, capacity, placement, and operation of DER resources within new or existing microgrids.[28] XENDEE's model delivers the optimal technology mix, as well as operation (e.g., when to charge or discharge a battery for example) based on utility bill data, weather data, incentives, technology parameters, and outage scenarios.

- **Historical power interruptions**. The BPHC reports it had at least 10 power outages during the past five years, but the outages did not require site evacuation. The Project Team also examined historical reliability data of the specific circuits that serve the BPHC buildings, as reported in Eversource annual service quality filings to the Massachusetts Department of Public Utilities (DPU).[26] The Project Team used historical data as a benchmark, but developed forward-looking power interruptions scenarios for the purpose of analysis.

---

[25] These analyses have not been included in the report because they are business sensitive.
[26] See DPU (2022). Service Quality, and search for Docket Number 21-SQ-13 in the DPU online file room.

- **Power interruption scenarios.** The City of Boston does not have a specific resilience target for critical community facilities, and no national standards specify the amount of time that facilities such as those at the BPHC Mattapan Campus need to stay up and running during a power outage. The Marine Park District Energy Microgrid study used resilience duration cases of 15 minutes, 4 hours, and 24 hours - but these durations were based on historical outages, and not based on the longer-duration, widespread outages that may occur in the future.[27] To establish an upper bound for resilience analysis, the Project Team reviewed resilience targets from around the country. The National Electrical Code Article 708 on Critical Operations Power Systems, for example, states that facilities designated as "critical operations areas" have backup power that can carry its full load for 72 hours (3 days).[28] The State of Florida passed a law requiring nursing homes to install backup power with fuel sufficient for a 96 hour outage, following heat-related deaths after Hurricane Irma in 2017.[29] The U.S. Department of Defense requires facilities that support critical missions to operate independent of the grid for 7 to 14 days, depending on the military service. The Project Team selected 3- and 7-day durations for its analysis.

- **Policy.** The economic analysis conducted for the sites assumes that the solar PV systems would take advantage of the available Solar Massachusetts Renewable Target (SMART)[30] incentives, and that battery storage would participate in the Eversource ConnectedSolutions demand response program[31] during non-emergency operations. Private sector partners would also claim the federal investment tax credit and accelerated depreciation tax benefits under third-party ownership scenarios.[32] President Biden signed the Bipartisan Infrastructure Law (BIL) in 2021, which includes significant funding for clean energy, energy resilience, and power grid upgrades through new federal programs. The BIL also includes funds that are provided directly to states and cities for their own programming, such as the $550 million Energy Efficiency and Conservation Block Grant Program (EECBG). The EECBG funds flow directly to municipalities, with the first funding opportunity expected in Fall 2022.[33] The proposed BPHC system could serve as a

[27] The President's National Infrastructure Advisory Council. (2018). Surviving a Catastrophic Power Outage.
[28] Divine, T. (2016). Putting COPS into Context. *Consulting - Specifying Engineer.*
[29] Florida Agency for Health Care Administration. (2022). Emergency Power Plan Rules.
[30] Commonwealth of Massachusetts. (2021). Solar Massachusetts Renewable Target (SMART).
[31] Eversource (2022). Demand Response.
[32] These include, for example, the solar investment tax credit, accelerated 5-year depreciation under the modified accelerated cost-recovery system (MACRS), and bonus depreciation, as applicable. *See* U.S. Department of Energy. (2021). Guide to the Federal Investment Tax Credit for Commercial Solar Photovoltaics.
[33] White House (2022). A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners.

"shovel ready" or "shovel worthy" project for infrastructure funding, but such funds were not considered as part of this analysis.[34]

- **Value of avoided power outages.** There are many methods for quantifying the value of avoided power outages.[35] For benchmarking purposes, the Project Team examined the avoided costs of installing hook-ups for mobile diesel generators, the avoided cost of adding fixed diesel generators, and the costs associated with evacuating and caring for clients in a case with no backup power.

2.5.3. Solar PV Siting and Sizing

The Project Team identified three potential sites for solar PV installations: two ground-mounted systems outside of 201 River Street and the rooftop of a decommissioned power plant building at 206 River Street. There is not a suitable site for solar PV at 209 River Street as a result of shading and space constraints. However, the Project Team considered opportunities to connect the 201 River Street and 209 River Street buildings as a microgrid (see Section 2.5.5). The table below shows the potential layouts, sizes, and projected production for each of the PV systems.

[34] *See* H.R.3684 - Infrastructure Investment and Jobs Act.

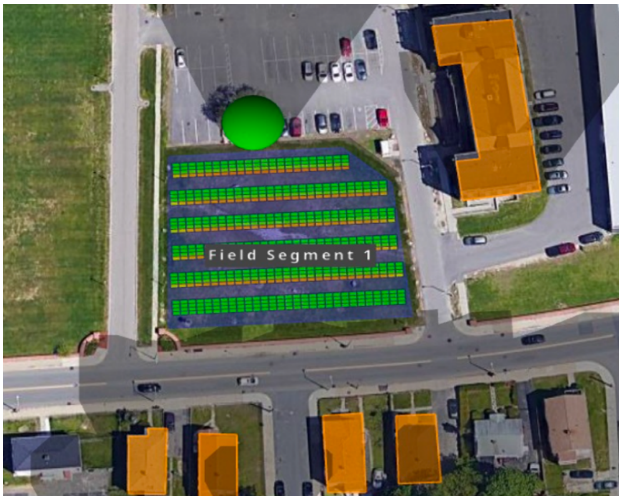
[35] National Association of Regulatory Utility Commissioners and National Association of State Energy Officials (2022). Valuing Resilience for Microgrids: Challenges, Innovative Approaches, and State Needs.

201 River Street

Site: New canopy constructed in the parking lot of 201 River Street.

Capacity: 268 kW_{dc}

Est. annual production: 330 MWh

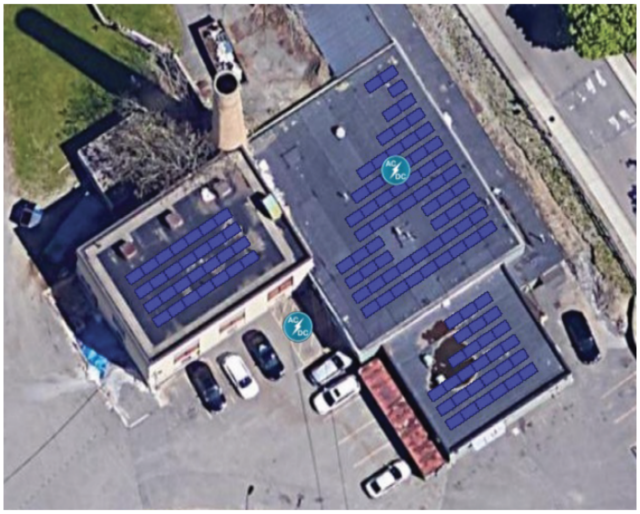


201 River Street

Site: Ground-mounted PV system on the lawn to the east of the building.

Capacity: 241 kW_{dc}

Est. annual production: 315 MWh



206 River Street

Site: Rooftop mounted PV system on former power plant building.

Capacity: 44 kW_{dc}

Est. annual production: 57 MWh

Figure 4. Proposed solar PV installations for 201 River Street and 209 River Street

BPHC identified the 268-kW parking lot canopy system as the top priority site, instead of the lawn or the power plant rooftop. The XENDEE analysis found the parking lot canopy, combined with energy storage, would be sufficient to sustain 201 River Street during multi-day outages, but additional sites might be needed if 209 River Street were also powered as part of a microgrid for a longer-term outage.

2.5.4. Battery Siting and Sizing

There is sufficient space in the parking lots on the BPHC Mattapan Campus to house multiple battery containers. Based on the XENDEE analysis, a backup power system that relies only on solar and storage to support critical loads for 7 days would require 1 to 2.5 MWh of DC-coupled battery storage, depending on whether the system is sized to supply one or both buildings. This amount of battery storage would require multiple shipping containers, occupying the equivalent of roughly 3 to 10 standard parking spaces. The amount of battery storage - and the footprint required - would be reduced if BPHC decreased the outage duration that the system would be designed to support (e.g., from 7 days to 1 day) and/or added fossil fuel backup power in parallel with the solar PV and storage.

2.5.5. Microgrid Considerations

As discussed above, the suitable solar PV in and around 201 River Street and 209 River Street is located in proximity to 201 River Street. It may be possible to connect 201 River Street and 209 River Street as a microgrid energized by the three solar PV systems described in Section 2.3.4. The advantages of microgrid development have been well documented by the City of Boston and its partners as described in Section 1.[36] Since 201 River Street and 209 River Street sit on the same campus and could be connected without crossing a public way, a microgrid would not raise questions related to electrical connections between buildings with different owners and on different properties, which may require utility ownership under franchise rights.

The Project Team conducted economic analyses of potential microgrid configurations using the XENDEE platform. Significant uncertainties remain, however, about the cost to connect the two buildings together, and then the cost to interconnect the microgrid to the commercial distribution system. The primary issue is the different voltage levels of the electrical service that feeds the two buildings.

---

[36] Pace Energy and Climate Center & International District Energy Association. (2015). Microgrids & District Energy: Pathways to Sustainable Urban Development. Urban Sustainability Directors Network.

When the BPHC Mattapan Campus electricity system was originally built, it was designed to distribute electricity with 4 kilovolts (kV) of voltage. In 1999, Trinity Financial leased a former hospital on the campus from BPHC and redeveloped it as the Foley Senior Residence, a 98-unit mixed income, independent and assisted living facility.[37] As part of the redevelopment during 1999-2003, Trinity Financial worked with NSTAR (now Eversource) to upgrade the distribution system to their current standard distribution voltage of 13.8 kV. The upgrade improved the distribution system efficiency while increasing capacity. The Foley building is on the same distribution circuit as 209 River Street and so both buildings benefited from the upgrade.

The distribution system serving 201 River Street, however, is served by a separate circuit at the original voltage of 4 kV.[38] In order to connect 201 River Street and 209 River Street, the 4 kV circuit serving 201 River Street would need to be upgraded to 13.8 kV, including adding a new transformer near the building and running new conduit underground from the Eversource grid to the transformer, and then into the building. Eversource plans to retire and upgrade 4 kV service in its territory over the next two decades, but there is not a near-term plan to upgrade the service at the BPHC Mattapan Campus. Eversource can work with customers to upgrade 4 kV service to 13.8 kV, but customers need to finance the upgrade themselves rather than Eversource paying for the project and recovering the costs from ratepayers through its general electricity rates.

In order to connect the buildings as a microgrid following the distribution system upgrade, the most straightforward approach would be to build a secondary, non-Eversource-owned 13.8 kV circuit to connect the 201 River Street and 209 River Street transformers. Switchgear with remote operation capability would also need to be added to each building. The solar PV and battery storage systems would need to be connected downstream of the switchgear, but upstream of the 13.8 kV transformer and secondary circuit.

The distribution system upgrades required on the campus means a microgrid configuration would not be economically feasible in the near-term without additional funding. The precise cost of the required upgrades to the Eversource-owned 4 kV distribution system would not be known until the proposed project advances through the interconnection process. However, it

---

[37] Trinity Financial (2016). The Foley.

[38] The specific circuits that serve 201 River Street and 209 River Street, as well as the substation that they are connected to, can be found on the Eversource distributed generation Hosting Capacity map website.

is certain that the costs would be too high to be justified by the project's projected revenues.[39] Seeking federal funding for the infrastructure upgrades may be a viable alternative.

In order to provide energy resilience to the campus programs in the near-term, the BPHC could consider developing a solar and storage system that provides resilience only to 201 River Street, and separately installing a lower-emission (e.g., EPA Tier 4 Certified) diesel generator at 209 River Street. The two systems could advantageously be interconnected at a later date as part of a microgrid if and when additional funding for the distribution system upgrade could be secured. The next section assumes that BPHC would procure a solar and storage system for 201 River Street and discusses potential acquisition pathways.

[39] The costs of distribution system upgrades and microgrid controls can be hundreds of thousands to millions of dollars, based on preliminary estimates by the Project Team and on the findings of other studies conducted under the CLEAR program. *See* GE Energy Consulting & Nexant. (2021). Town of Cohasset Elm Street Site and Town of Bedford Town Center Site.

2.6. Solar PV and Battery Storage Acquisition

BPHC has several options to acquire resilient solar and storage systems. The City of Boston and the Commonwealth of Massachusetts have both supported the development of innovative procurement pathways for renewable energy and energy efficiency during the past decade. The existing clean energy procurement models were not purpose built for energy resilience, however, and so BPHC would be at the forefront of municipal entities attempting to procure clean energy resilience **BPHC could consider entering into a power purchase agreement (PPA) through a request for proposals, or leveraging an existing energy-buying consortium that has procurement authority on behalf of Massachusetts public entities.** Some of the key considerations and tradeoffs when selecting a procurement strategy are discussed below, and the potential pathways are summarized in Figure 5:

- **Combining design and build bids.** A key distinction is whether BPHC would use vehicles such as energy management services contracts, which combine design and build procurements into a single acquisition (i.e., design-build), or bid out design and build separately (i.e., design-bid-build). Many successful clean energy projects within Massachusetts have been acquired through combined design-build procurement. Municipal agencies are familiar with design-bid-build procurement, but design-bid-build is not well suited for energy procurement and for energy resilience in particular. Several Commonwealth-funded municipal energy resilience projects that have bid out design and construction separately stalled when the project designs were not successful in attracting competitive bids.

- **City-owned vs. third-party owned.** BPHC can opt to own and operate the system itself, or partner with a third-party to own and operate the solar and storage system on BPHC's behalf. BPHC would then pay for the energy generated by the solar PV systems, similar to how they pay Eversource for electricity. Third-party ownership allows the solar PV projects to be financed, rather than purchased upfront, and transfers the system operation and maintenance risk to the project owner. The City of Boston has partnered with third-party developers to own and operate solar PV systems (e.g., Boston Police Headquarters), and Municipal Energy Unit staff could advise BPHC on their experiences and processes.

- **Request for qualifications and request for proposals.** There are several procurement pathways that combine design and construction for energy projects while allowing third-party ownership, including requests for qualifications (RFQ) for energy management (M.G.L. c. 25A §11I), requests for proposals (RFP) for energy management services (M.G.L. c. 25A §11C), or competitive procurements under M.G.L. c. 30B. The City of Boston has used 25A §11I to structure the Renew Boston Trust (see Figure 5), but BPHC facilities are not currently eligible to acquire projects under the Trust contract. The City of Boston has also released a competitive procurement for a solar and storage project on Moon Island in 2021, which could serve as a template for BPHC.[40] As an alternative to a 25A procurement, BPHC could also consider a competitive procurement under Chapter 30B.[41] Chapter 25A requires municipalities to file their RFPs with the Massachusetts Department of Energy Resources (DOER) for review before issuing them, and file annual reports with DOER during the contract term. Chapter 25A also limits contract terms to 20 years. Chapter 30B does not require DOER review or reporting and does not require contract term limits.[42]

- **RFPS for ground-mounted vs. building-mounted energy projects**. Chapter 30B can be used for projects sited either on buildings or on land.[43] In the past, state agencies have encouraged the use of Chapter 25A for building-mounted systems, and 30B for ground-mounted projects.[44] There is precedent in Massachusetts, however, of municipalities using 30B for both building-mounted solar PV systems. Since the proposed BPHC system could include both ground- and roof-mounted elements, BPHC could consider using either 25A or Chapter 30B.

- **Energy consortium-led procurement.** Instead of running its own procurement, there may be an opportunity to procure through an energy buying consortium as authorized under M.G.L. c. 164 §137. For example, PowerOptions procures third-party solar PV and storage on behalf of its members. Through a PowerOptions procurement, BPHC would have the advantage of the buying and negotiating power of the consortium, and would save the costs of administering its own procurement.

---

[40] EEOS. (2021). Design, Construct, and Install Solar Photovoltaic and Battery Energy Storage Systems. Project Number EV00009786.

[41] Massachusetts Office of the Inspector General. (2016). Buying Electricity for your Town Buildings: Power Purchase and Net-Metering Agreements. *Procurement Bulletin, 22*(2), 4-5.

[42] Chapter 30B contracts are limited to a contract term of three years. However, the three-year limit may be extended by the municipal legislative body to a contract term of any length.

[43] DOER. (2017). Community Shared Solar: Implementation Guidelines for Massachusetts Communities.

[44] DOER. (2015). Energy Management Services: Frequently Asked Questions; Holland, R.T. (2012). Examining the Rules and Risks Surrounding Procurement of Renewable Energy Facilities. *The Municipal Advocate, 26*(4), 22-28.

- **Procuring resilience.** The practices of procuring energy resilience are new. M.G.L. c. 25A, for example, is intended for energy efficiency or for onsite generation. Although some jurisdictions have integrated energy resilience into their procurement policies,[45] Massachusetts energy procurement law does not address energy resilience specifically. The state has also not issued guidance on how to use existing procurement authorities for energy resilience acquisition.[46] Despite the gray area, some jurisdictions are moving forward with energy resilience procurements. The City of Chelsea, for example, released a competitive bid for a third-party owned microgrid in 2021,[47] based on the findings of the MassCEC CMP report.[48] By procuring an energy resilient solar PV system, BPHC would be helping to break new ground and could draw on the expertise of the City of Boston Environment Department's Municipal Energy Unit, as well as on the BPDA's extensive experience with microgrid feasibility analysis and procurement innovation.

[45] Office of the Assistant Secretary of Defense for Sustainment (2018). Policy on Energy Savings Performance Contracts and Utility Energy Service Contracts.
[46] Cadmus (2015). Final Report: Community Clean Energy Resiliency Initiative.
[47] City of Chelsea (2021). Request for Proposals for Clean Energy Systems and Energy Services Chelsea Microgrid Project - Contract # 2021-425.
[48] Clean Energy Solutions, Inc. (2020). Chelsea Community Microgrid Feasibility Assessment: Task 6 Report.

Model (Authority)	Ownership	Description	Pros and Cons
Renew Boston Trust **(M.G.L. c. 25A §11i)**	Third-party	The Renew Boston Trust[49] (RBT) is a $45 million City of Boston initiative to make building improvements that reduce energy and water use under a performance contract with an energy services company (ESCO). City facilities can finance energy upgrades and on-site generation based on projected savings without tapping into capital budgets. The City completed the first of its investment in 14 municipal buildings in 2021.	The RBT performance contract can be accessed by the 266 facilities identified in the preliminary audit by the City's ESCO partner, Honeywell. BPHC's facilities, however, were not included in the initial audit, and therefore cannot participate in the current RBT contract. In order for BPHC to participate, the City would have to re-procure its municipal buildings under the Trust structure and include BPHC facilities in it. The City does not currently have plans to re-procure the Trust contract.
Power Purchase Agreement (PPA) **(M.G.L. c. 25A or c. 30B)**	Third-party	BPHC could purchase power from the solar PV system under a power purchase agreement (PPA) for a specific $/kWh rate. BPHC could put out a bid under Chapter 30B or under M.G.L. c. 25A.	BPHC has not yet procured solar PV under a PPA. BPHC staff, however, could work with the City of Boston Environment Department's Municipal Energy Unit and draw on their experience with navigating the RBT. There are not clear state regulations or guidance on how energy resilience can be integrated into PPA procurements. Based on interviews with state officials, however, resilient solar and storage could be procured under M.G.L. c. 25A (as long as the third-party owner guarantees energy savings) or under M.G.L. c. 30B.

[49] City of Boston (2022). Renew Boston Trust.

Model (Authority)	Ownership	Description	Pros and Cons
PowerOptions **(M.G.L. c. 164 §137)**	Third-party	BPHC could join an organization such as PowerOptions. PowerOptions is an energy consortium of more than 470 New England public sector entities and nonprofits that leverages the buying power of its members to obtain competitive pricing and unique contract terms and conditions. PowerOptions offers a solar-only membership, under which BPHC could select a solar and storage vendor to own and operate the solar PV and storage system without having to issue its own RFP, as authorized under M.G.L. c. 164 §137.	A membership in an organization with energy procurement expertise such as PowerOptions could streamline the solar PV and storage procurement process and would not require BPHC to spend the time and resources to design and issue its own procurement. PowerOptions is updating its solar and storage procurement for resilience. There may be an opportunity for BPHC to work with PowerOptions or similar organizations to pilot resilient solar and storage procurement. For benchmarking purposes, the one-time dues for a solar-only membership with PowerOptions is $500.
Design-Bid-Build **(M.G.L. c. 149 §44A)**	BPHC	BPHC could use its own capital budget to first procure design services for the project, and then bid out the resulting design for construction. BPHC's capital budget is fairly limited and it is likely that BPHC would need to request funds from the City of Boston's capital budget to fund the full amount of the design-bid-build process. The BPHC project would need to compete against other citywide budget priorities.	Municipal agencies are familiar with design-bid-build procurement, but design-bid-build is not well suited for energy procurement and for energy resilience in particular. Several municipal energy resilience projects funded by the Commonwealth stalled when the project designs were not successful in attracting competitive bids.

Figure 5. Potential pathways for acquiring solar and storage systems