Town Of Truro – Beach Office

Climate Leader Communities Decarbonization Roadmap Report

36 Shore Rd, Truro MA

Prepared on November 4th, 2024

Hossam Mahmoud & Julian Joffe
HMahmoud@theRISEgroupinc.com; JJoffe@theRISEgroupinc.com

Contents

Contacts

Facility / Project Location			
Truro Beach Office 36 Shore Rd Truro, Massachusetts 02666			
Program Administrator Representative(s)			
Laura Selmer	Energy Efficiency Analyst	Cape Light Compact	(508) 375-6644 Laura.Selmer@Capelightcompact.org
RISE Engineering			
Hossam Mahmoud	Senior Energy Engineer	RISE	(774) 994-7269 HMahmoud@theRISEgroupinc.com
Julian Joffe	Senior Energy Engineer	RISE	(401) 230-7464 JJoffe@theRISEgroupinc.com
Site Contact(s)			
Jarrod Cabral	Director – Dept. Of Public Works	Town of Truro	(508) 214-0400 jcabral@truro-ma.gov

Executive Summary

Overview

Cape Light Compact has retained RISE to evaluate the energy consumption and a potential decarbonization pathway that includes standard efficiency, load reduction, and electrification measures for multiple buildings owned and operated by the Town of Truro, MA. The intent of this review is to summarize and benchmark the site's existing energy consumption with respect to the policies set forth by the Massachusetts Department of Energy Resources (DOER) and to create a Municipal Decarbonization Roadmap to meet 2030 and 2050 net-zero goals. These measures will help offset the site's reliance on fossil fuels, improve efficiency levels, and move toward the town's overall decarbonization goals. All costs, savings, and incentives[1] are representative of findings observed on site.

The efficiency measures listed within this report as energy conservation measures (ECMs) will decrease the site's energy consumption and support the decarbonization pathway. Further measures such as load reduction, renewables, and electrification, will also support the reduction of on-site fossil fuels and grid-based energy consumption. Incentives and tax credits may be available to help defer the cost of implementation. These tax credits and incentives are subject to change based on programs sponsored by the government, the utilities, or other parties involved in determining eligibility. The energy savings and project costs presented below are based on preliminary data and are subject to change pending confirmation of existing conditions and formal proposals being developed for the identified energy efficiency measures. The building management team is interested in pursuing electrification measures to reduce emissions and operating costs while maintaining or increasing occupant comfort within the space(s).

This report details potential decarbonization measures found at the Beach Office in Truro, Massachusetts.

Summary of Findings

Year	EUI (kBtu/sf/yr)	CEI (MTCO2e/sf/yr)
2022	45.0	0.0006
Current (2023 Usage)	26.2	-
2030 Target	33.7	0.0004
2030 Projected	14.6	0.0003

Table 1: EUI & CEI Summary (Target Values Based on a 25% EUI and 35% CEI Reduction from 2022 Consumption Values)

[1] Further site review may be necessary to develop final incentive approval.

Measure Type	Estimated Electric Savings (kWh)	Estimate Propane Savings (Gallons)	Savings ($)[2]	Incentive ($)	Net Cost ($)
Insulation (Crawl Space)	907	-	$200	$406	$2,782
Solar	7,121	-	$1,567	$5,796	$13,524
TOTAL:	**1,766**	**-**	**$1,767**	**$6,202**	**$16,306**

Table 2: Measures, Savings, and Cost Summary

Cost Savings are based on the estimated cost $0.22/kWh for electricity and $3.50/Gallon for propane.

Efficiency Measures	Load Reduction Measures	Electrification Measures	Renewables

Facility Overview

General Facility Information

Building Use

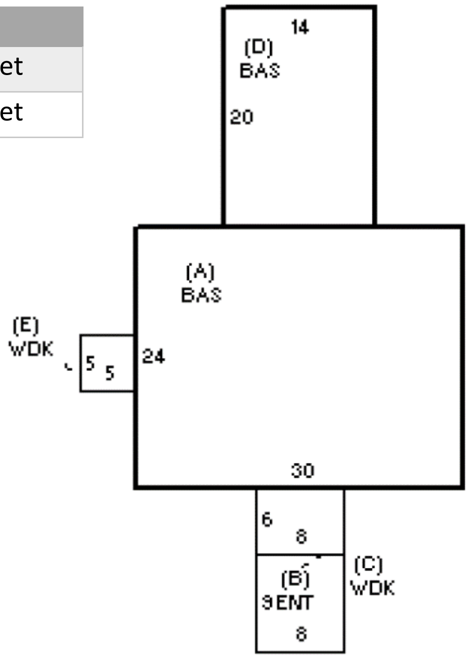
The Truro Beach Office building was constructed and opened in 1961 as a small Library according to tax assessor records. Based on the site assessment performed, there have been no major additions or renovations to the facility. The core use of this building is devoted to the Truro Recreation and Beach Department for administrative activities. Town residents visit the facility to obtain valid beach stickers and parking permits. The overall space is relatively small with a front area for customers and a middle and rear section for the staff. The typical hours of use of this facility are 7 days per week, 9AM-5PM, between June 1st and Labor Day which equates to approximately 672 total hours. The facility operates only during summer peak demand hours. There are typically around (5) people that work in the facility on a regular basis during the summer season and none during the winter season.

Gross Floor Area

Below is a summary of the building areas which notes the size of each floor and size of the space occupied:

Area Description	Floor Area
Full Building	1,000 Square Feet
1st Floor	1,000 Square Feet

Table 3: Floor Area & Square Footage



Building Overview

Year of Construction: 1961

Number of Stories: 1

Structure Material: Wood Frame

Building Type: Office (seasonal)

Conditioned Floor Area: 1,000 sq. ft.

General Conditions of Facility

This facility is in good condition and operates sufficiently for the type of occupancy. There have not been any significant upgrades to the structure although some upgrades have been implemented which include new double paned windows, blown insulation in the ceiling, and several new heat pump mini splits. The roof is shingled and in good condition. The foundation is a concrete slab. The flooring is carpeted and expected to have vinyl flooring original to construction beneath it. There is no insulation between the floor and the crawlspace below. There are no renewables on-site but there is a propane tank that only serves the backup generator.

System	Condition	Approximate Age	Useful Life (years)	Remaining Life (years)
HVAC	Good	5	18	12
DHW	Good	6	13	7
Windows	Good	<10	20	15+
Envelope	Good	-	-	-
Lighting Systems	Good	<5	10+ *at current operating hours	5+
Renewable Energy Systems	N/A	-	-	-

Table 4: Facility and System Conditions

Site Summary

The Truro Beach Office was built in 1961 and serves the Truro community. The site relies only on electricity to operate but utilizes propane for a backup generator if needed. However, to align with the local and state electrification goals there will be measures that will need to be implemented to reach the usage and emissions requirements by the benchmark years 2030 and 2050.

System	Description
Building Enclosure	Insulated walls (expected to be R-13 fiberglass batt) are known to have newly spray foam ceiling insulation. New double-paned windows. Exterior door weather stripping in good condition. Shingles on the roof appear to be in good condition. Insulation between 1st floor and crawlspace is recommended.
Electrical Infrastructure	The electric meter can provide 200A service although the main disconnect in the electric panel is a 2-pole, 60A breaker. There is a second electric panel which is not labeled well enough to identify the connected loads.
Carbon-Based Fuel Sources	There is one propane tank powering (1) 14kW generator. There is no other carbon-based fuel sources used on-site.
Lighting Systems	The primary lighting fixtures within the space are 2LT8 LED Surface Wrap fixtures that have been recently retrofitted in place of fluorescent lamps. There are still a couple remaining compact fluorescent downlight fixtures that should be replaced with LED.
HVAC	This facility utilizes Heat Pump Mini Split systems. There are (3) indoor fan coil units and (2) outdoor condenser units providing a maximum combined total of 3.25 Tons of cooling.

Domestic Hot Water	The domestic hot water load is minimal due to the number of occupants. There is (1) 6-gallon, 6-year-old electric water heater located in the crawlspace.
Building Controls	There are no building controls other than the remote controls for the Heat Pump equipment.
Process Systems	There is one large ice-making machine inside and one large freezer outside.
Renewable Energy Systems	There are no existing renewable energy systems on-site. There is roof space facing south and west that can be used to implement a solar array. The site also has the potential for a car-port solar array.
EV-Charging	The town has plans to implement an EV-charging station at this facility in the near future.

Table 5: Description of Systems

Energy Use Overview

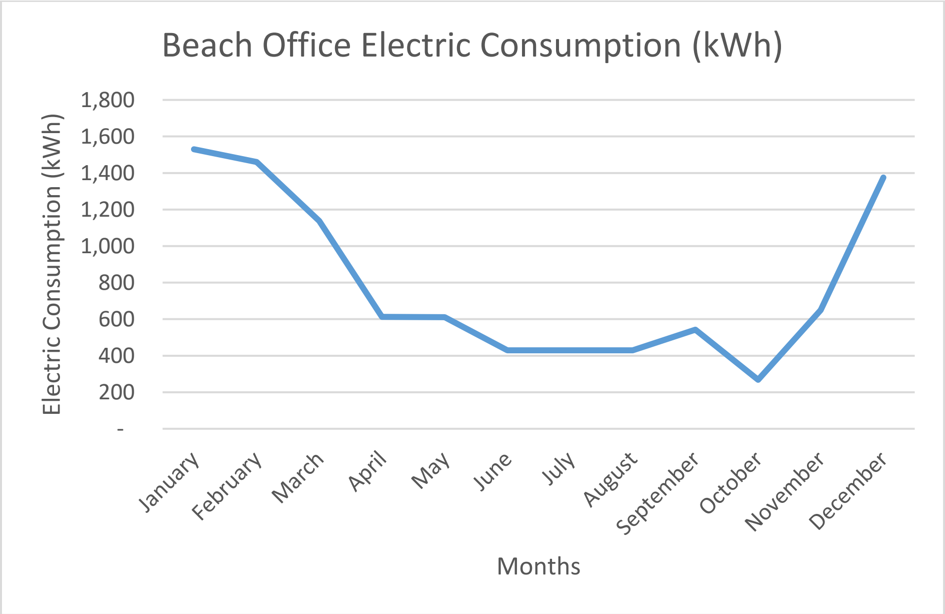
Electricity Consumption

The site has one electric account, Acct# 13822170018, that serves the entire facility. There is one electric meter (Meter# 2327098) feeding the 60A, 120/240V main electric panel to energize the facilities loads. The facility utilizes a gas-powered generator capable of providing 14kW to one transfer switch that is tied into the electric meter.

Normalized Electric Usage

Month	2022 Electricity Consumption (kWh)	2023 Electricity Consumption (kWh)	Normalized Electricity Consumption (kWh)
January	1,571	687	1,530
February	1,394	952	1,460
March	1,034	795	1,137
April	576	345	613
May	591	331	611
June	644	590	430
July	1,168	1,060	430
August	1,003	750	430
September	528	537	542
October	268	353	268
November	596	683	649
December	1,221	595	1,375
Totals:	**10,594**	**7,678**	**9,474**

Table 6: Electricity Usage (2022 Usage, 2023 Usage, & Weather Normalized to Represent an Average Year)



Deliverable Fuel Consumption (Propane)

The site's only propane use is for the back-up generator which is exercised regularly to maintain its proper operating condition. There is one 120-gallon propane tank that was last filled with 94 gallons in April of 2022, per the MEI reported usage data available. It should be further determined how much fuel is actually used on an annual basis to run the propane generator. Given that there were no reported tank fill ups in 2023, it can be inferred that the (96) gallons reported in 2022 may have been the usage over more than one calendar year. Further calculations show (and noted in the CEI discussion below) that if the site used just (33) less gallons of propane per year (with respect to the 2022 reported usage), on-site fossil fuel consumption would comply with the 2030 target.

Energy Usage & Carbon Emissions Benchmarking

Energy Usage Intensity (EUI)

Energy Usage Intensity measures how much energy a facility uses with respect to its size. Based on the noted square footage and the available utility consumption data, the Truro Beach Office had an EUI of approximately 45.0 kBtu/Sqft/yr in 2022 which is slightly above the national median reference value of 40.1 kBtu/Sqft/yr reported for "Other – Public Services" by Energy Star Portfolio Manager Data. Although this usage metric is above the average, it is important to note that the reported propane fill-up quantity significantly impacts this EUI. If the (96) gallons of propane were not counted toward the calculation, the EUI would be 36.1 kBtu/Sqft/yr which is below the median reference value for this building usage type.

https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf

Carbon Emissions Index (CEI)

Benchmarking the carbon emissions of any facility begins with identifying the quantity and types of the fuels used to operate a facility. Organizations such as local, state, and federal governments continue to implement regulatory compliance policies requiring carbon emissions of buildings to be calculated and benchmarked against ordinance defined emission limits.

For Climate Leader Communities in the state of Massachusetts, the carbon emissions index is a measure of Metric Tons (MT) of CO2e/sf/yr which accounts for the different carbon emissions values of each unit of fuel type considered. Based on the noted square footage of the facility and the quantities used of each fuel type, this facility has a CEI of .0006 MTCO2e/sf/yr. The only on-site fossil fuel at this site is propane for the backup generator. The target carbon emissions reduction percentage is based on the total emissions from on-site fossil fuels used in 2022.

EUI & CEI Benchmarking

The Climate Leader Communities program in Massachusetts requires the use of a greenhouse gas emission baseline in Metric Tons of CO2. This report utilizes DOER's MassEnergyInsight (MEI) data provided by Cape Light Compact. As noted in the table below, the decarbonization road map required by Climate Leaders lists that both emissions from onsite fossil fuels in buildings and the energy usage intensity must be reduced by the noted percentages in the noted years.

Suggested Emission Reduction Timeline

Targets	2027	2030	2040	2050
Reduce emissions from onsite fossil fuels in buildings	-20%	-35%	-60%	-100%
Zero emission vehicles (ZEVs) in light-duty fleet adoption	5%	20%	75%	100%
Zero emission vehicles (ZEVs) in medium-/heavy-duty fleet adoption	0%	20%	50%	100%
Energy Use Intensity reduction *(deep energy retrofits/retro commissioning)*	-20%	-25%	-25%	-30%
Total Emissions Reduction Goals (% of 2022 emissions)	**>15%**	**>35%**	**>65%**	**>95%**

https://www.mass.gov/doc/climate-leader-communities-municipal-decarbonization-roadmap/download#:~:text=The%202021%20Climate%20Law%2C%20statewide,reduction%20by%20calendar%20year%202030.

Beach Office - EUI				
Year	**Electricity Usage (kWh)**	**Propane Usage (Gal)**	**EUI (kBtu/sf/yr)**	**2030 EUI Compliance**
2022	10,594	96	45.0	-
2023	7,678	-	26.2	-
2030 (Projected)	2,566	63	14.6	Compliant

Table 7: EUI Benchmarking

Beach Office - CEI					
Year	**Propane CO2e (MT/yr)**	**Total CO2e (MT/yr)**	**CEI (MT/sf/yr)**	**2030 CEI Target - 35% Reduction (MT/sf/yr)**	**Compliance**
2022	0.55	0.55	0.0006	0.0004	-
2023	-	-	-		-
2030 (Projected)	0.36	0.36	0.0004		Compliant

Table 8: CEI Benchmarking (2030 Projected Emissions are Based on the Implementation of the Proposed Measures)

Decarbonization Overview

The process of decarbonizing a building involves implementing measures to reduce or eliminate carbon dioxide (CO_2) emissions associated with its operation. The goal is to make buildings more energy-efficient, use cleaner energy sources, and overall contribute to a lower carbon footprint. Here are key strategies for decarbonizing a building which includes Energy Efficiency (Foundational), Load Reduction, and Electrification measures.

The start to the decarbonization process takes a whole building approach similar to the energy efficiency process; the site is subject to an energy audit. Opportunities to upgrade the building envelope are identified and implemented. Here, envelope insulation and fenestration deficiencies are rectified to reduce heating and cooling loads. At this point, the site considers installing energy efficient equipment including but not limited to lighting, HVAC systems, appliances and any equipment specific to building use. The transition from fossil fuel-based heating systems to electric heat pumps for space heating and cooling needs to be considered at this part of the process. In concert, smart building technologies like controls based on occupancy or other parameters can be implemented to further reduce energy load.

Installing on-site renewable energy systems such as solar panels or wind turbines to generate clean, renewable electricity needs to be a part of the plan with the goals of electrification and decarbonization in mind. When the site's electric loads are reduced through energy efficiency and optimization, renewable energy systems like solar panels can be properly sized. Energy storage solutions to store excess energy generated by renewable sources, such as batteries, are part and parcel and will improve overall energy resilience.

Decarbonizing a building requires a holistic approach that considers both operational and embodied carbon, as well as the entire lifecycle of the structure. It often involves a combination of technological innovations, design considerations, and policy support to achieve meaningful reductions in carbon emissions.

Proposed Measures

Type	Measure Description	Implementation Difficulty	Cost Implication ($/$$/$$$)
Load Reduction Measure 1	Insulation (Crawlspace)	Low	$
Renewable Energy Generation	Solar PV	High	$$$

Table 9: Proposed Emissions Reduction Measures

Efficiency Measures	Load Reduction Measures	Electrification Measures	Renewables

Based on the on-site findings, this facility is electrified and operates efficiently during its minimal occupancy throughout the year. Although the building envelope is generally in good condition where the walls, ceiling, and fenestrations provide sufficient thermal resistance, it was noted that the crawlspace lacks insulation. Adding insulation to the crawlspace will reduce the HVAC load served by the mini-split heat pumps.

Furthermore, and based on the energy benchmarking performed, the only way for the site to reach the EUI and CEI reductions targets in the coming years will be to add solar to offset the utility electric consumption. Additionally, in order to completely remove propane usage, it would require the implementation of a battery storage system tied to the solar array to remove the need for the backup generator.

Efficiency & Load Reduction Measures:

Although no efficiency measures were identified during the site assessment, the noted load reduction strategy shown in the table above provides an opportunity that can be explored before the renewable energy generation and energy storage measures to immediately reduce the facility's consumption. Although some measures are more difficult to implement than others, any of these measures will reduce the consumption to operate the facility (i.e. Insulation) and will support the facility with meeting its energy usage and carbon emission requirements.

Crawlspace Insulation:

Insulating a building effectively incorporates the creation of a thermal barrier on all sides, roof, and the basement area. Adding spray foam insulation on the walls and a vapor barrier on the floor of the crawlspace creates an effective building envelope reducing thermal losses and in turn reducing the cost and usage of conditioning the space.

Electrification Measures:

This facility has already had its HVAC system electrified and utilizes an electric resistance domestic hot water heater. Although a Solar PV array combined with a battery storage system is not necessarily considered an electrification measure, it will be an ideal way to remove the reliance on the fossil-fuel powered backup generator.

Renewables

Solar Photovoltaic (PV) Array

Solar Photovoltaic (PV) systems harness sunlight to generate electricity, where semiconductor materials convert sunlight into direct current (DC) electricity. These systems consist of solar panels made up of interconnected solar cells, inverters to convert DC electricity into usable alternating current (AC), mounting structures, and often include energy storage solutions such as batteries for storing excess energy. Ideally in the northern hemisphere, solar panels are south facing to receive the most direct sunlight.

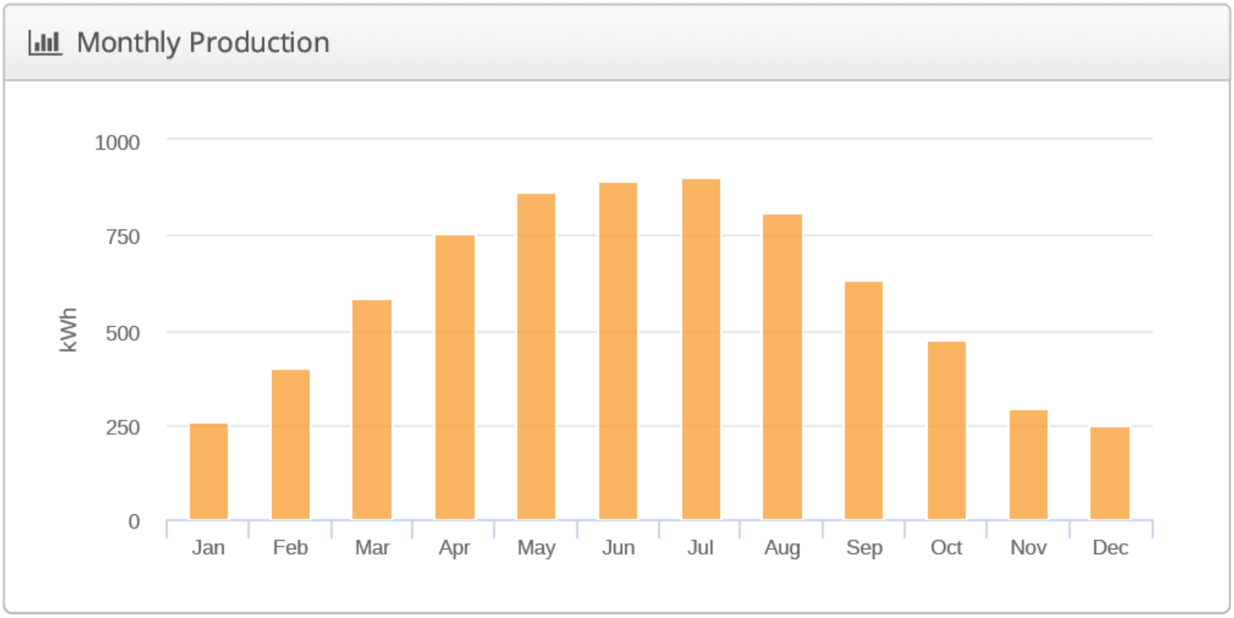
The main structure's roof has an east facing and a west facing section in addition to a rear structure with a north and south facing sloped roof. None of the roof facing are shaded by trees or other structures. Based on preliminary solar modeling, this facility has enough roof space to accommodate solar on the south and west facing roof sections. There is also space and no shading on the east facing roof. Although Solar PV modules in the north-east United States are most effective and receive the most solar irradiance when facing south-west, simulations show that adding solar to the east facing roof will not negatively impact the systems overall performance ratio. This facility also has enough space to consider the implementation of a car-port solar PV structure.

The usable roof space would not be sufficient to provide the building with most of its electrical needs. The potential car-port size that could be installed would produce enough electricity to offset almost all the Beach Office consumption. Nevertheless, the system was modeled, and a summary of results can be found below. It is important to note that the values in the table below are preliminary calculations that will likely change given the variability of installation costs, incentives, electricity rates, and any other factors that impact overall performance of the system and the associated economics.

PV System Summary	
Module DC Nameplate	6.44 kW
Total Estimated Annual Production	7,121 kWh
Performance Ratio	82.7%
Total Estimated Cost (Est. $3/Watt Installed)	$19,320
Total Tax Credits (Est. 30% Credit, 179d)	$5,796
Total Cost Savings (Est. $0.22/kWh)	$1,567
Payback (After Tax Credits)	8.6 years

Table 10: Proposed PV System Summary


HelioScope


Monthly Production
1000
750
500
250
0
kWh
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Resiliency

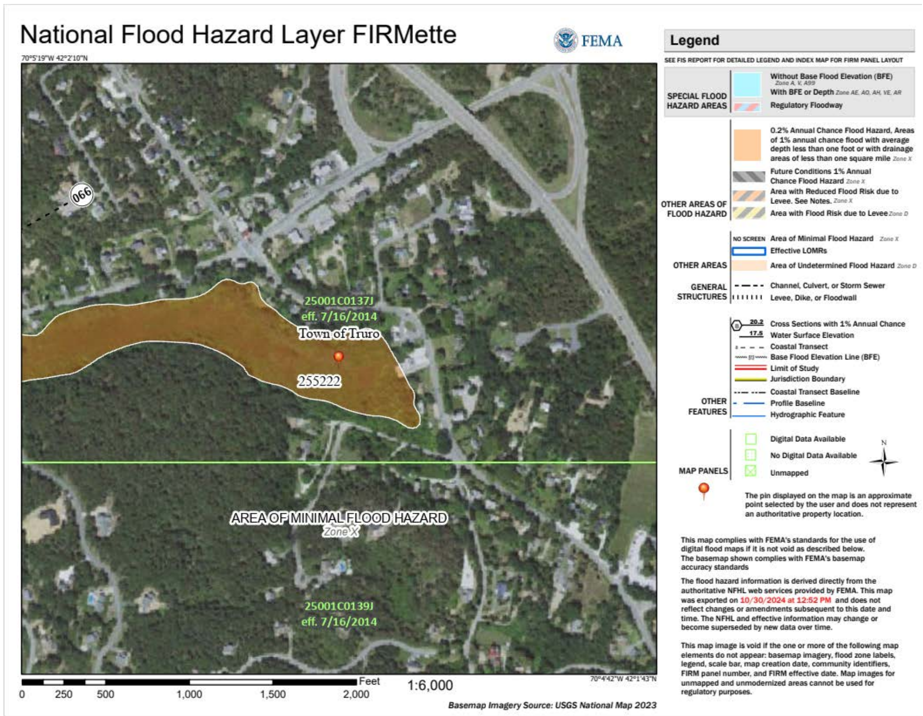
Backup Generator

A 14kW backup generator is currently utilized by the facility. This generator is a crucial component to enhance and maintain reliability, resilience, and energy availability. In the event of a power outage or service disruption, the backup generator can quickly and automatically kick in, allowing the facility to operate in brief outage periods. This ensures a continuous and reliable power supply to critical loads, even during emergencies or natural disasters.

The backup generator seems to be in good condition and sufficiently sized for the site. This existing backup generator, while helpful, is still a fossil-fuel consuming piece of equipment. Further studies and development of a Solar PV system in conjunction with a battery storage system would support the facility with phasing out of fossil fuel use.

Coastal Flooding

The following depicts the National Flood Hazard FIRMette for the site location. The image below shows localized flood hazard data derived from the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs), which can help stakeholders identify flood risk and facilitate informed decision-making to mitigate potential risks. Based on this data, the building is in an area within a 1% annual chance flood zone, often referred to as the “100-year flood zone.” Areas in the zone have 1% chance of flooding each year and may face significant flood risks. Incorporating flood-resistant designs and infrastructure ultimately safeguards lives and property and can reduce design costs when done in conjunction with designing for emission reduction measures.



Next Steps

It is recommended that you consider moving forward with the sustainable measures identified in this report. These measures represent a valuable opportunity to decarbonize the building while reducing energy usage and costs while leveraging available efficiency and sustainability incentives to decrease the overall implementation costs.

THREE EASY STEPS TO PARTICIPATE

- **Step #1:** Review your report with your Engineer and elect which measures to move forward with.
- **Step #2:** Sign proposal and schedule the installation of energy efficiency and microgrid improvements to ensure immediate meaningful energy savings and resiliency.
- **Step #3:** Recognize sustainable energy savings on a monthly basis!

Please be sure to contact Hossam Mahmoud, Sr. Energy Engineer at RISE engineering to take advantage of these opportunities today. I can be reached at hmahmoud@therisegroupinc.com or (774)-994-7269.