FINAL ENERGY AUDIT REPORT

JANUARY 8, 2024

Milton Town Hall
525 Canton Avenue
Milton, MA

Town of Milton (Milton)

Josh Eckart-Lee, Assistant Town Planner
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Report Prepared By:

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Purpose – (from April 2023 RFP):

> "The Town of Milton has been actively engaged in work to address climate change and its effects on municipal services, energy use, and utilities. This project, "Energy Resilience in Milton: Winter Valley Microgrid" envisions a district-level microgrid composed of the Winter Valley senior housing community, Milton Town Hall, and the Milton Police Department to protect our most vulnerable residents alongside our critical municipal services when we are faced by climate-driven disasters. The Town intends to connect these three locations through a microgrid system that will allow for continued power in times of need through a system that is sustainable and locally controlled. This feasibility study will explore the current demand load of the proposed project area, as well as the timelines for installing the necessary energy generation, storage, and grid operations infrastructure, grid maintenance and ownership structure, and potential for expansion or replication throughout other areas of the town."

Site Inspection and Data Collection

CESI performed a site inspection at the Milton Town Hall on May 15, 2023. During the visit, CESI was accompanied by Josh Eckart-Lee and noted existing conditions throughout the building. Subsequently, Milton has provided CESI with the necessary additional information required to issue this report (equipment specifications, energy billing data, site drawings, and responses to a CESI questionnaire).

Summary of Recommendations and Draft Proforma

To date, our efforts have not revealed the need for any significant energy efficiency (EE) improvements.

An exception may be select installations of air-source heat pumps (ASHPs) in certain areas. Given the very generous subsidies and tax credits available in the federal IRA legislation, the capital expenditure would be substantially discounted. Detailed engineering and financial analysis are recommended early in the Design Phase.

As the feasibility analysis evolves, we may recommend other energy and/or water efficiency improvements such as new windows, replacement toilets and aerators in all rest rooms, and the conversion of the remaining stairwell fluorescent lighting to LEDs. These and other possibilities are listed under "Other Potential Recommended ECMs" at the end of this draft report. Although they are unlikely to have short paybacks, they may be advisable for other reasons.

Our primary recommendation is to install a "battery energy storage system" (BESS), sized to meet the current monthly electricity demand of the Town Hall (as historically recorded on the master electric meter).

We have also considered the installation of ground-mount, parking lot solar PV canopies to complement the existing roof-mounted array and have determined that an 89 kW parking lot array would be feasible in the lot to the northwest of the newly constructed fire department headquarters.

As hopefully part of a virtual MG configuration and to take advantage of available revenue streams, we may recommend the installation of new controls to facilitate the operation of the combined PV/BESS system.

<u>Rationale for sizing Solar PV and BESS installations:</u>

We generally start by maximizing the amount of solar PV that will fit at each facility. The rooftop potential has already been achieved at the Town Hall. Our current analysis indicates that the existing rooftop PV is providing on average about 16% of the building's annual kWh requirements. With the inclusion of the parking lot array, the annual PV production is slightly greater than the total annual current kWh consumption.

To size the BESS power rating (kW), we generally try to serve the full peak electrical load of the facility, or at least it's important circuits. To size the BESS energy capacity (kWh), we start by recommending four hours of resilience at the predicted coincident

average demand for each building. In the rare case where grid power is lost for more than four hours and the solar energy is unable to keep the BESS charged, the backup generator would automatically assume the load. The kWh capacity of the BESS is the principal cost driver. We have used the most recent bid prices for mid-size systems in similar installations as a starting point for cost estimates, to be conservative.

The table below displays the estimated 10-year Cash Flow resulting from the installation of the recommended solar PV parking lot array, BESS, and new controls. The installation would cost approximately $403,000, of which a loan of $214,500 (net of the 30% investment tax credit) would be amortized with savings/revenues over a 10-year period. First year savings/revenues would be approximately $57,000 against expenses of $34,900. A funding shortfall (or Resiliency Gap) of $96,800 would have to be filled with grant or other financial sources.

Table 1 - Town Hall Parametric Model ProForma Cash Flow

Total Investment Estimate:	Output value	Units	Questions?
Total investment estimate in EE	$0	Dollars ($)	
Total investment estimate in BESS and microgrid controller	$178,200	Dollars ($)	
Total investment estimate in Solar	$225,000	Dollars ($)	
Total investment	$403,200	Dollars ($)	
Investment Tax Credit available in IRA	30%	Percent (%)	
Upfront or Imputed Present Value of Annual Resilience Gap or Cash Flow Shortfall	$96,768	Dollars ($)	

Annual Emissions Reduction Calculation	Output value	Units
EE savings, electric	0	kWh per year
Emission reduction from electric EE	0	metric tons per year
Solar savings, electric	108,000	kWh
Emission reduction from solar displ.	57	metric tons per year

MILTON TOWN HALL

	Annual Energy Savings from EE Improvements	Annual energy savings from solar energy produ...	T&D Demand Savings	Connected Solutions "Active Demand" Response Savings	ICAP Savings	Clean Peak Standard Certificate (CPS) Revenue [...	SMART Revenue PV + BESS	Less: Annual System Maintenance (2% est.)	Less: Curtailment Service Provider (CSP) charge	Less: Debt Service	Annual Cash Flow [2]	Cumulative Cash Flow	Carbon reduction (metric tons/year)
									Total investment:		$ (214,502)	$ (214,502)	
Year 1	$ -	$ 14,040	$ 14,208	$ 12,150	$ 2,187	$ 1,535	$ 12,960	$ (4,290)	$ (4,106)	$ (26,446)	$ 22,239	$ (192,264)	57
Year 2	$ -	$ 14,321	$ 14,493	$ 11,786	$ 2,187	$ 1,489	$ 12,571	$ (4,376)	$ (3,982)	$ (26,446)	$ 22,042	$ (170,222)	57
Year 3	$ -	$ 14,607	$ 14,783	$ 11,432	$ 2,187	$ 1,444	$ 12,194	$ (4,463)	$ (3,863)	$ (26,446)	$ 21,875	$ (148,347)	57
Year 4	$ -	$ 14,899	$ 15,078	$ 11,089	$ 2,187	$ 1,401	$ 11,828	$ (4,553)	$ (3,747)	$ (26,446)	$ 21,737	$ (126,610)	57
Year 5	$ -	$ 15,197	$ 15,380	$ 10,756	$ 2,187	$ 1,359	$ 11,473	$ (4,644)	$ (3,635)	$ (26,446)	$ 21,628	$ (104,982)	57
Year 6	$ -	$ 15,501	$ 15,687	$ 10,434	$ 2,187	$ 1,318	$ 11,129	$ (4,737)	$ (3,526)	$ (26,446)	$ 21,548	$ (83,434)	57
Year 7	$ -	$ 15,811	$ 16,001	$ 10,121	$ 2,187	$ 1,279	$ 10,795	$ (4,831)	$ (3,420)	$ (26,446)	$ 21,497	$ (61,937)	57
Year 8	$ -	$ 16,128	$ 16,321	$ 9,817	$ 2,187	$ 1,240	$ 10,471	$ (4,928)	$ (3,317)	$ (26,446)	$ 21,473	$ (40,464)	57
Year 9	$ -	$ 16,450	$ 16,647	$ 9,522	$ 2,187	$ 1,203	$ 10,157	$ (5,026)	$ (3,218)	$ (26,446)	$ 21,477	$ (18,987)	57
Year 10	$ -	$ 16,779	$ 16,980	$ 9,237	$ 2,187	$ 1,167	$ 9,853	$ (5,127)	$ (3,121)	$ (26,446)	$ 21,509	$ 2,522	57
Total	$ -	$ 153,734	$ 155,579	$ 106,343	$ 21,870	$ 13,436	$ 113,433	$ (46,975)	$ (35,934)	$ (264,462)	$ 217,024		572

Results	Output value	Units
Total Savings Year 11 (no debt payment)	$ 48,914	Dollars ($)
Approximate total years to $0 cumulative cash flow	9.9	Years
Cumulative cash flow over 15 years	$ 461,594	Dollars ($)

Existing Conditions

The Milton Town Hall is located at 525 Canton Avenue. It is a two-story building with 18,900 square feet of conditioned space including the basement level. It contains multiple town offices, two conference rooms and a full kitchen in the basement. The second floor has cathedral ceiling areas along either side of the buildings length that extend to the underside of the exposed roof structure. There is a central attic area that contains mechanical equipment.

Current building use patterns:

Approximately 58 staff occupy the building each week. About 50 of them are full-time from 8a.m. to 5p.m Monday through Thursday and to 1:30p.m. on Friday. Regular evening meetings occur from 7 to 10 pm, averaging three meetings each evening. Virtual meetings have had effect the evening use. Weekend use is negligible.

Building Shell / Exterior

The building has a concrete foundation, walls and floor slabs and concrete block interior structural walls in stairwells.

Roof

The roof is wood framed, pitched with a 14-year-old solar PV array on the southeast slope. The asphalt shingles were replaced four years ago. The PV system was removed and replaced at the time of roof replacement. Insulation levels are undetermined.

Windows

The original aluminum framed window system is still in place. Windows are a mix of infill wall system with fixed and casement styles. U-value is undetermined, but likely low by today's efficiency/code standards.

HVAC Systems

Heating

Two six-year-old Lochinvar FTX 500N (500 Mbh input / 489 output) condensing gas-fired boilers provide space heating (and domestic hot water). Heated water is pumped throughout the building by two redundant five horsepower motors to baseboard heaters in the hallways, fan coil units (FCUs) in the stairwells, and recessed wall registers in the offices. The system is controlled by a Lochinvar "Smart System" boiler reset (Photo 1515) that modulates the primary heating loop temperature, and the response to a demand for domestic hot water.

Each heated space (office or meeting room) has either a Honeywell AUBE digital thermostat or one of a variety of older model thermostats (see photos).
There is a night-time setback set on some of the Honeywell thermostats.
There are also ceiling fans throughout the building. (Photo 1411)

Air Conditioning

The same hydronic loop that provides water for space heating provides chilled water during the cooling season. Water is chilled with a YORK Model YCAL0028EE17XEBSTDXA Air Cooled Scroll Chiller (Serial: 82012L27640430) that was installed in November 2022. The BMS system enables the air conditioning off at dusk and on at dawn.

There is also at least one Carrier split system, single zone, air conditioner Model # 38MAQB24 (Serial: 4714V13525) serving some of the conditioned space. The model is capable of also providing space heating (ASHP) but it is unclear if it is being used in that manner.

Domestic Hot Water

The Lochinvar boilers described in the HVAC section also provide domestic hot water to the entire building. The boiler water is circulated through a heat exchanger in an 82 gallon Lochinvar Squire storage tank. Hot water is not recirculated through the building.

Ventilation

The building has an active mechanical corridor ventilation system of undetermined type and volume.

Bathroom air is mechanically exhausted through the central attic area to the outside. A building management system (BMS) turns on the exhaust only during occupied hours and days.

Emergency Electricity Generation

The building has an OnSite Energy / MTU 60kW diesel generator (Photo 1529) located along the exterior of the east wall. Its age is undetermined. Three TSC80e automatic transfer switches (Photos 1505-07) direct the generator output to emergency loads throughout the building.

Lighting

All interior lighting has been converted to LED, with the exception of a number of stairwell fixtures that remain with fluorescent bulbs.

There are 6 pole lights in street/driveway areas that are on from dusk to dawn controlled by photosensors. Office lighting is controlled by a mix of motion sensors and switches.

See Appendix B for detailed list of fixture types and wattages.

Potable Water

There are a total of seven bathrooms (men's and women's), 2 in the basement, 3 on first floor and 2 on second floor. Each bathroom has either one or two gravity flush 1.6 gallon per flush toilets and one sink. There are no showers.

Solar PV

The Town Hall has a 136 panel, 28.3-kilowatt (kW) rooftop solar PV array. The solar panels started to produce usable power in November of 2009. The system was originally designed to produce an estimated 25% of the building's annual electricity needs. A Sun Bug Solar June 2023 statement of total lifetime kWh indicates that 324.72 MWh have been produced, or an annual average of approximately 25,400 kWh. That is roughly 16% of the total kWh used in the baseline period of April 2022 through March 2023 (see below energy use section). However, the building's energy requirements may have also increased since 2009.

Three Solar Edge non-grid tied inverters (Photo 1493) convert the DC power to AC. Current maintenance practices and annual costs of the system are undetermined as well as the age of the existing inverters since they may have needed replacement since the original installation. At least a portion of building's roof was replaced four years ago but it is unclear if the work included the roof area occupied by the solar panels, and if so, how that installation was accomplished.

Energy and Water Historic Use

Electricity, natural gas, and water/sewer consumptions at the Town Hall are each recorded on a single master meter and billed on a single account/tariff. Following are the recorded usages and costs for the proposed baseline period of April 2022 through March 2023.

Electricity (not annualized for cooling degree days)

	Eversource						Costs as of April 2023:		
Tariff	Rate B2/G1 Small General Service DMD						Supply	$ 0.08999	/kWh
Acct.#	2673-772-1006						Dist. Dmd.	$ 18.25	/kW over 10
Meter #	2464968						Trans. Dmd.	$ 17.63	/kW over 11
	Town Hall / Offices						Other	$ 0.0429	/kWh
	From	To	Days	kWh	actual kW	billed kW	kWh	kW	Total
	2/28/22	3/28/22	28	9,440	30.4	20.4	$ 1,254	$ 732	$ 1,986
	3/28/22	4/28/22	31	8,480	25.6	15.6	$ 1,127	$ 560	$ 1,686
	4/28/22	5/28/22	30	8,800	41.6	31.6	$ 1,169	$ 1,134	$ 2,303
	5/28/22	6/28/22	31	11,040	39.2	29.2	$ 1,467	$ 1,048	$ 2,515
	6/28/22	7/28/22	30	16,960	52.8	42.8	$ 2,253	$ 1,536	$ 3,789
	7/28/22	8/28/22	31	18,480	56.0	46.0	$ 2,455	$ 1,650	$ 4,106
	8/28/22	9/28/22	31	12,640	48.8	38.8	$ 1,679	$ 1,392	$ 3,072
	9/28/22	10/28/22	30	9,040	40.8	30.8	$ 1,201	$ 1,105	$ 2,306
	10/28/22	11/28/22	31	8,000	24.0	14.0	$ 1,063	$ 502	$ 1,565
	11/28/22	12/28/22	30	10,400	27.2	17.2	$ 1,382	$ 617	$ 1,999
	12/28/22	1/28/23	31	11,360	28.0	18.0	$ 1,509	$ 646	$ 2,155
	1/28/23	2/28/23	31	9,760	26.4	16.4	$ 1,297	$ 588	$ 1,885
	2/28/23	3/28/23	28	7,840	27.2	17.2	$ 1,042	$ 617	$ 1,659
	3/28/23		365	132,800		318	$ 17,645	$ 11,395	$ 29,041
				36,500	annual solar PV kWh production all estimated to be used on site				
				169,300	total kWh consumed				

Natural Gas (not annualized for heating degree days)

	National Grid		Costs as of March 2023:		
Tariff	G43T Commerical Heat		Supply	$ 0.69940	/therm
Acct.#	52418-18760		Dist.	$ 0.5159	/therm
Meter #	2011068		Dist. Adj.	$ 0.2038	/therm
	Town Hall / Offices		Other	$ -	/therm
	From	To	Days	Therms	Total Cost
A	2/23/22	3/24/22	29	754	$ 1,070
A	3/24/22	4/26/22	33	519	$ 737
A	4/26/22	5/25/22	29	206	$ 292
A	5/25/22	6/24/22	30	23	$ 33
-	6/24/22	7/28/22	34	28	$ 40
A	7/28/22	8/25/22	28	28	$ 40
A	8/25/22	9/23/22	29	29	$ 41
A	9/23/22	10/25/22	32	177	$ 251
E	10/25/22	11/22/22	28	456	$ 647
A	11/22/22	12/23/22	31	899	$ 1,276
A	12/23/22	1/25/23	33	1,139	$ 1,616
E	1/25/23	2/27/23	33	1,072	$ 1,521
A	2/27/23	3/27/23	28	791	$ 1,123
	3/27/23		368	5,367	$ 7,616
				Per Therm:	$ 1.42

Water/Sewer

Water and Sewer Baseline					
Town Hall / Offices			Current Meter Number:		61040183
From:	To:	CFs	Total Cost	Cost per HCF	Gallons
2/3/22	5/2/22	2,660	$ 521.32	26.60	19,897
5/2/22	8/1/22	2,720	$ 542.77	27.20	20,346
8/1/22	11/1/22	3,250	$ 663.16	32.50	24,310
11/1/22	2/2/23	3,730	$ 777.74	37.30	27,900
		12,360	$ 2,504.99	123.60	92,453

Other Potential Recommended ECMs

- EE – Building Management System (BMS), select ASHPs, Window replacements, Water efficiency.
- Modify Existing Public MG Display in Building (Sun Bug already has a PV display)
- BESS energy storage battery**,** utility's electric service and main switchgear? Potential to add to current critical loads served in grid outage.
- Resilience- Communications. Evaluate microwave, satellite, LTE, etc.

Phase 2 Recommendations:

- Town Hall is adjacent to the existing/new Fire Station, the Milton Council on Aging and two churches. Is also on the opposite side of Canton Ave. from the Police Department. Explore potential for physical inclusion in MG.
- Investigate opportunities at other town facilities

Considered but not Currently Recommended:

Home Energy Efficiency Team's (HEET) Geothermal Design

CESI has been following the progress of HEET closely. The technology is sound; the efficiency is very high (Coefficient of Performance [COP] is as high as 6); the environmental improvement over gas lines is undeniable. However, the cost and disruption of Town and private property, however, prevents us from recommending it. It requires drilling a series of boreholes and laying new pipes along the street in front of participating properties, trenching into their facilities, and modifying their heating & cooling systems. Eversource is investing a lot of money (federal and state grants, ratepayer support) into a pilot project in Framingham, required by a DPU ruling. When that is evaluated, it's possible that the state will mandate utility investment in the infrastructure (where geology and user concentrations are suitable), after which individual properties could afford to subscribe.

A geothermal well field, however, could be a different project, staying on private property and not requiring utility approval or street trenching. Feasibility would depend on the site geology, the trenching required, and the design of existing HVAC system that it would supply or displace in each building. It could be included as an option to be explored in greater detail by responders to Milton's request for MG proposals.

Next Steps

1. Consult Eversource engineers regarding potential changes to electric service.
2. Inspect front-end electric service for BESS integration.
3. Consider sharing DERs among adjacent town facilities.
4. Develop costs, savings, and recommendations regarding "Other Potential Recommended ECMs."

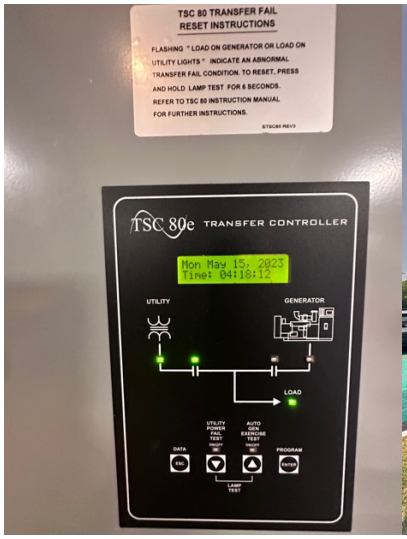
Appendices:

Appendix A

Facility Photos

1515 1411

1505 1529 1493



Appendix B

List of Existing LED Lighting Fixtures by Office and Common Areas

Common Areas:

Stairwells – 67 – mixture of LED and fluorescent 1x2 and 102 - 2x4s

Hallways – 24 - 13-inch round, 11-W; 14 - 6-inch recess, 9W
Cafeteria – 4- 2x4 LED indirect drop in style with motion sensors
Boiler room – 4 - 1x3 LED retrofit lamps – 13W
Front Entry – 2 - A Lamps 13W

Floor 1:

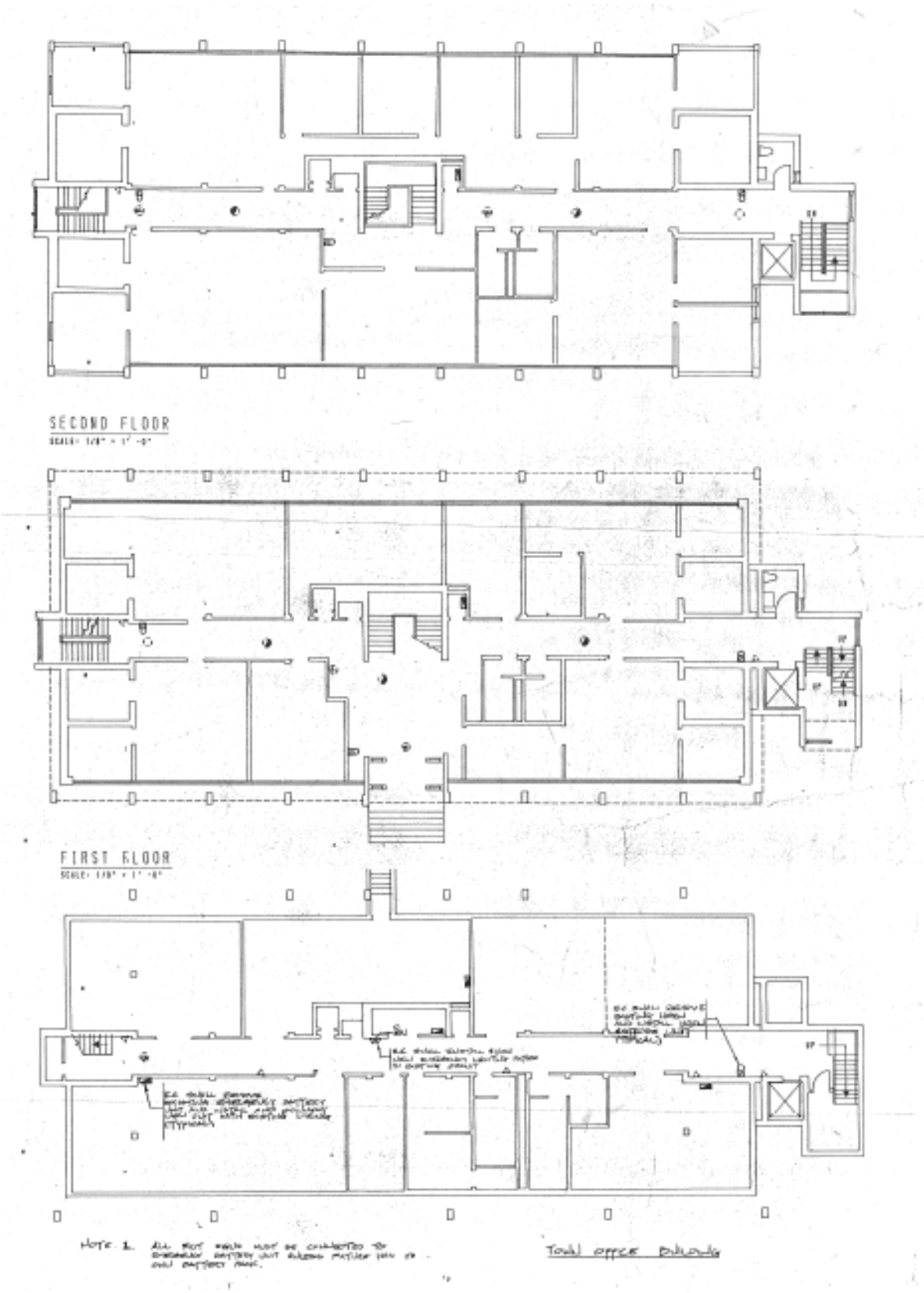
Park and Rec – 12 - 2x4 drop-in, indirect on switches and motion
Hallway – 13 – 13-inch round 11W sensors
Assessors – 11 - 2x4 drop in indirect LED on switch
Treasurers – 18 - 2x4 drop in indirect LED on switch
Technology – 8 - 2x4 drop in indirect LED on switch or sensor.
Men's room – 1 - 13W round LEDs; 1 - 2-ft. LED strip; 1 - 6 -inch LED recessed retrofit
Women's – 1 - 13 W round and 1 - 2ft strip
Town Clerk – 20 - 2x4 drop in indirect LED on switch/sensor
Health Dept. 20 - 2x4 drop in indirect LED on switch/sensor

Floor 2:

Stairway – 6 - 13inch round, 11W on motion/dual
Personnel – 20 - 1x2 4 ft retrofits and 4 - 2x4 drop in indirect on auto
Engineering – 23 - 1x2 4ft retrofits with 2 lamps each on switch
Env. Room – 10 - 2x2 4ft 4-lamp on switch
Stair center –4 - high bay 8-inch 90W PAR on switch
Hallway – 13 - 13-inch round 11W sensors
Accounting - 23 - 1x2 4ft retrofits with 2 lamps on switch
Inspectional Services - 14 - 1x2 4ft retro with 2 lamps on switch and 8 - 2x4 drop in 2 lamp on switch
Men's and women's – each have 1 - 13W round LEDs; 1 - 2-ft. LED strip; 1 - 6 -inch LED recessed retrofit

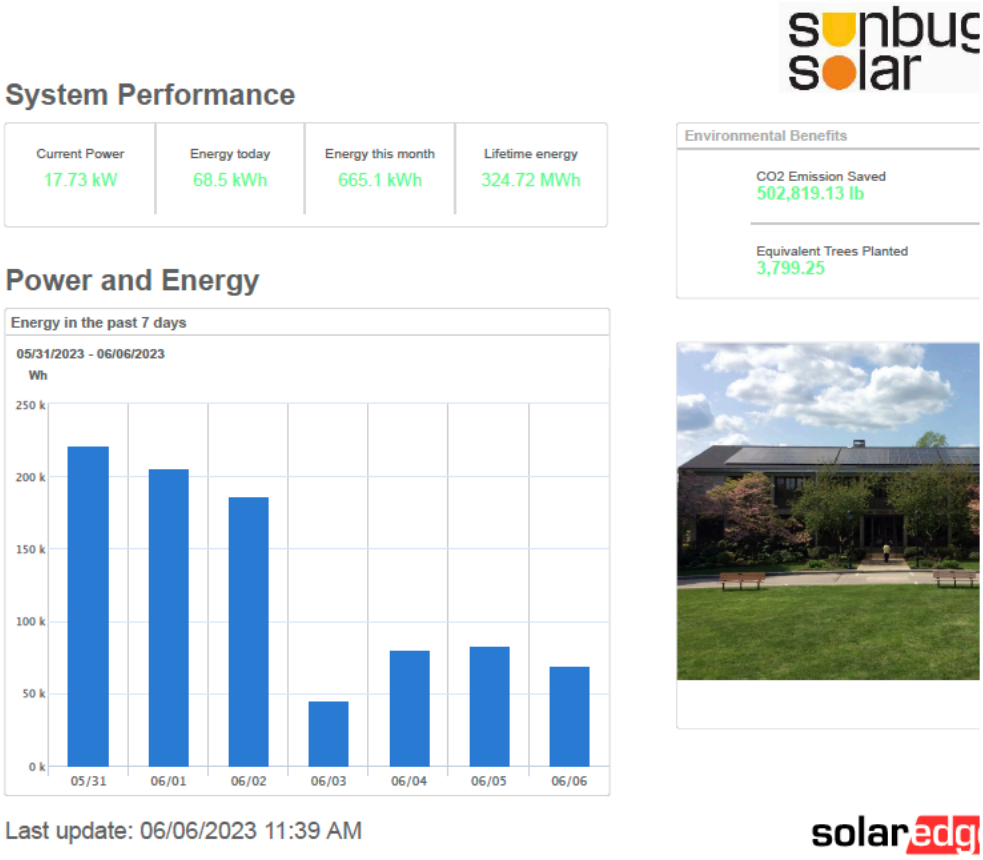
Appendix C

Town Hall Floor Plans


SECOND FLOOR
FIRST FLOOR
Town office Building

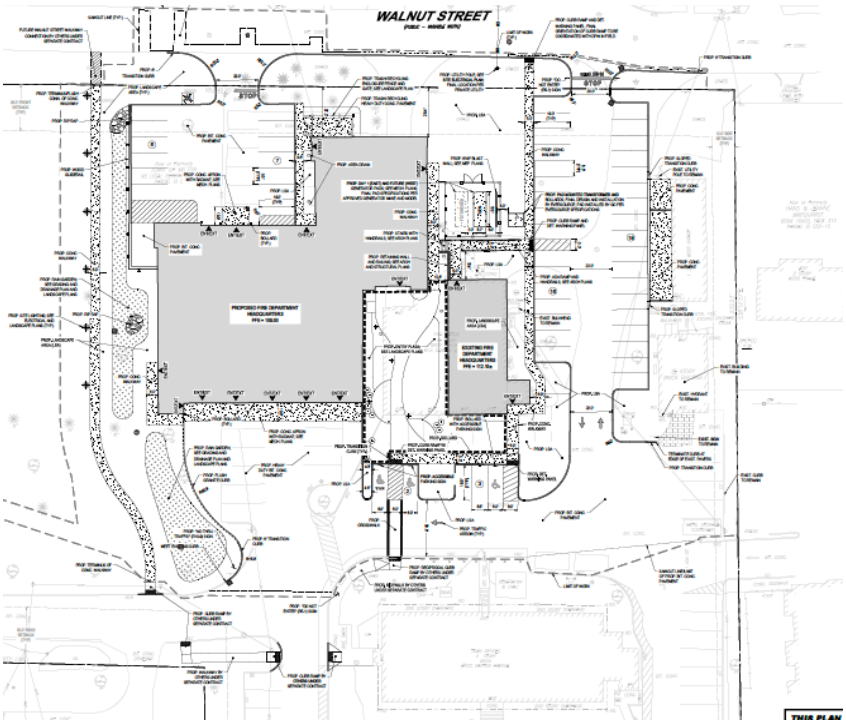
Appendix D

Sun Bug Solar June 5, 2023 existing rooftop PV system production printout:



Appendix E

New Fire Department Headquarters Site Plan


WALNUT STREET
STOP
STOP