Eversource Waterford Service Center – SCOPING STUDY

Utility/Site Contacts

[redacted]
Consultant, Energy Efficiency Services
Eversource Energy
[redacted]

[redacted]
Supervisor, Eastern CT Region Facilities Management
Eversource Energy
[redacted]

Justin Marmaras
Principal
QGM Consulting
860-515-6331
m@qgmconsulting.com

Padraic Hagan
Senior Energy Advisor
QGM Consulting
860-634-6298
phagan@QGMconsulting.com

Austin Malik
Associate Energy Advisor
QGM Consulting
austin.malik@qgmconsulting.com

Executive Summary

QGM Consulting (Padraic Hagan) conducted an energy efficiency scoping study at Eversource located at 63R Myrock Ave, Waterford CT on Wednesday, March 19th, 2025. QGM analyzed the site's electric and natural gas usage as well as associated Greenhouse Gas emissions. Objectives were to identify and quantify potential Energy Efficiency Measures (EEMs) for site energy reduction, site/Eversource incentive consideration, and estimated Greenhouse Gas reductions for any corporate initiatives or targets.

Included in this report is a list of potential EEMs with savings and implementation cost estimates. Please note that the values presented in this report are meant to provide an order of magnitude estimate and are not final values or guarantees for the determination of incentives. A measure summary is provided in the table below. These are the measures identified during the brief initial walk through; additional measures may be possible with more time on site. Simple paybacks do not include potential incentives or any non-energy benefits which may include maintenance savings, labor savings, water savings, etc. unless otherwise indicated.

QGM - Eversource Waterford CT- Scoping Study Measure Summary								
EEM#	Energy Efficiency Measure (EEM)	Estimated Annual Cost Savings	Estimated Annual Energy and GHG Savings			Potential GHG Reduction	Estimated Project Cost	Simple Payback
#	Description	$	kWh	CCF	GHG (MT CO2e)	% Site GHG	$	years
1	Control Conference Rooms by Occupancy	$828	5,800		1.7	1%	$10,000	12.1
2	New Building Management System - Adaptive/Optimal Start/Stop	$1,884	11,600	200	4.5	2%	$20,000	10.6
3	Consider Dry-Bulb Economizers on RTUs	$1,328	9,300		2.7	1%	$16,000	12.0
5	Consider Demand Control Ventilation	$15,358	84,800	2,850	40.2	20%	$24,000	1.6
4	Zero Loss CAIR Drains	$171	1,200		0.3	0%	$1,500	8.8
6	Building Shell Remediation	$4,168	23,600	700	10.7	5%	$50,000	12.0
TOTAL		$23,739	136,300	3,750	60.1	30%	$121,500	5.1
Electrification Measures								
7	Electrification - Natural Gas RTUs to ASHPs	-$297	(65,946)	8,000	24.4	12%	$89,000	n/a
TOTAL with electrification		$23,442	70,354	11,750	84	42%	$210,500	9.0

Measure **EEM #07 – Electrification – Natural Gas RTUs to ASHPs** is included as an electrification measure. The measure would be cost-flow negative, but would include MMBTU energy savings via the increased heating efficiency of the proposed heat pumps as well as a reduction in site GHG emissions. This measure is best considered via a "$/MT CO_2e reduction" metric.

General Facility Description

The site has 51,220 square feet of total space in a single three-story building. Original construction is dated to 1928 with renovations in 1995 and 2007 and ongoing refits taking place at the time of this study.

The facility includes offices/administration, conference rooms, equipment storage, and garages/service bays, and houses a typical staff of ~120 people working a standard in-office schedule, operating 6:30 AM – 3:30 PM Monday through Friday, with some additional personnel on site until 5 – 6 PM. Occasional weekend and 24-hour usage takes place during storm or other outage activities. Annual occupancy is estimated at ~3,100 hours/year.

HVAC System Description
Primary HVAC to site spaces is through packaged rooftop units (RTUs), including:

- (2) natural-gas fired RTUs with (1) additional planned as part of an ongoing project
- (4) heat pump RTUs
- Electric resistance baseboard providing perimeter heating at windows throughout the building
- Spot heating with natural gas and electric unit heaters (UHs) in service bay/garage and warehouse areas, and electric cabinet unit heaters (CUHs) in lobby and stairway areas
- Additional heating and cooling with split-system units

Site Lighting Description
Site lighting was retrofitted with LEDs and controls utilizing motion/occupancy and task-tuning in 2021.

Site Compressed Air Equipment Description
The site utilizes a compressed air system set at 125 psig, comprised of:

- (1) Air Compressor – 5 HP Atlas Copco, KT5V803 Load/Unload Style Compressor
- (1) CAIR Dryer – Styl Air, SRD-4507 Refrigerated Compressed Air Dryer
- (1) CAIR Storage Tank, ~600 gallons

Site Process Equipment Description

The site utilizes compressed air driven fluid pumps, electric and pneumatic lifts, and a variety of electric and compressed air hand tools for vehicle and equipment servicing. Monitoring or data logging of equipment would allow better understanding of process equipment energy use, efficiencies, and possible.

Monthly Billing Analysis

Historical electrical and natural gas information from the past (3) years was received from the site. The electrical data was provided in the form of a table with the monthly total electrical use and monthly average billed demand. Natural gas was provided as a table of annual use for 2022 through 2024 – monthly use is estimated via local historical weather factors. Natural gas costs were not included in these tables and were estimated with

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typical averages for the area and type of building. 0.1428/kWh was used as an electric rate based upon Eversource Facilities' third-party electric supply costs for similar type facilities.

Data from the 12 most recent months are summarized below:

Existing Building Electrical Baseline Most Recent 12 Month Total						
Energy Usage and Costs	Costs		Energy		Unit Costs ($/kWh, $/CCF)	CO2 Emitted (Metric Tons)
	Amount - $	% of Total	Amount - kWh, CCF	% of Total		
Natural Gas (CCF)	$ 5,953	7%	5,222	21%	$1.14	28
Electric Energy (kWh)	$ 83,921	93%	587,680	79%	$0.14	217
TOTAL	**$89,874**	**100%**		**100%**		**245**

Note that emergency generator use of natural gas is not included in these figures or tables.

A monthly summary of electric and thermal use is shown below:

Most Recent 12 Month Billing Summary									
Month	CDD (Balance Point: 65°F)	Billed Demand (kW)	Billed Energy (kWh)	Total Electric Cost	$/kWh	HDD (Balance Point: °F)	Estimated Energy (CCF)	Estimated Total Cost	$/CCF
Jan-24	0	151	64,960	$ 9,276	$ 0.14	977	1,027	$ 1,171	$ 1.14
Feb-24	0	166	68,320	$ 9,756	$ 0.14	867	912	$ 1,039	$ 1.14
Mar-24	0	150	68,800	$ 9,825	$ 0.14	656	690	$ 786	$ 1.14
Apr-24	0	138	61,440	$ 8,774	$ 0.14	498	524	$ 597	$ 1.14
May-24	15	112	48,640	$ 6,946	$ 0.14	186	196	$ 223	$ 1.14
Jun-24	154	85	36,800	$ 5,255	$ 0.14	7	7	$ 8	$ 1.14
Jul-24	309	96	40,800	$ 5,826	$ 0.14	0	0	$ -	$ -
Aug-24	193	113	40,960	$ 5,849	$ 0.14	7	7	$ 8	$ 1.14
Sep-24	38	98	40,000	$ 5,712	$ 0.14	47	49	$ 56	$ 1.14
Oct-24	0	97	32,960	$ 4,707	$ 0.14	280	294	$ 336	$ 1.14
Nov-24	2	90	35,840	$ 5,118	$ 0.14	507	533	$ 608	$ 1.14
Dec-24	0	103	48,160	$ 6,877	$ 0.14	935	983	$ 1,121	$ 1.14
TOTAL		**117**	**587,680**	**$ 83,921**	**$ 0.14**	**TOTAL**	**5,222**	**$ 5,953**	**$ 1.14**

The energy use intensity (EUI) is an indicator of building performance in terms of energy usage per building square foot (kbtu/SF), as shown below:

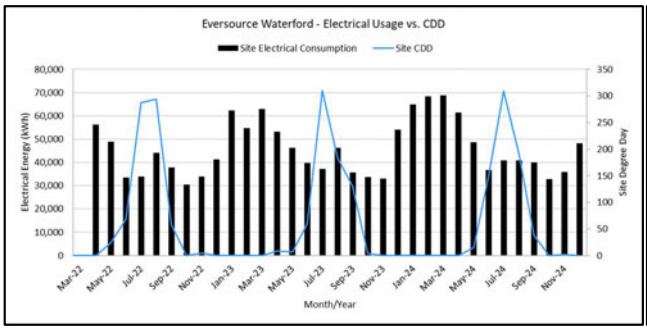
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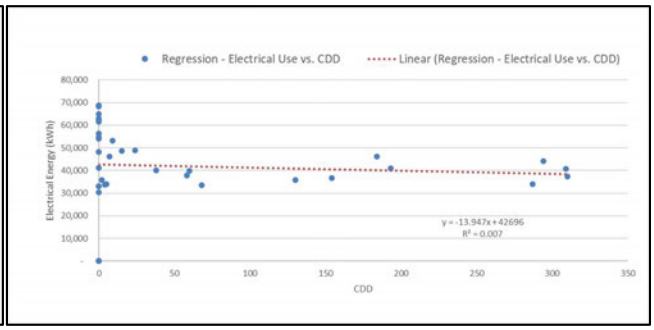
Building Energy Use Intensity (EUI)			
Utility	**Site EUI**	**Source EUI**	**Unit**
Natural Gas	10	11	kbtu/sf
Electricity	40	112	kbtu/sf
TOTAL	**51**	**123**	**kbtu/sf**

Source-site ratio per national average, source:
https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf

The EUI metric can be used to baseline existing energy use for future comparison or to compare this building to similar buildings. It should be noted that EUI does not consider production levels – service bay/garage activity preclude comparison of this building to similar size buildings housing only offices.

Weather and energy data was analyzed to understand the impact of weather on the site energy use. Below are graphs showing the relationship between the whole building's electrical use and cooling degree days:

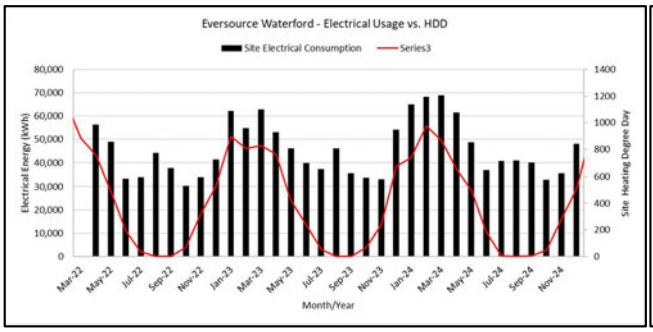


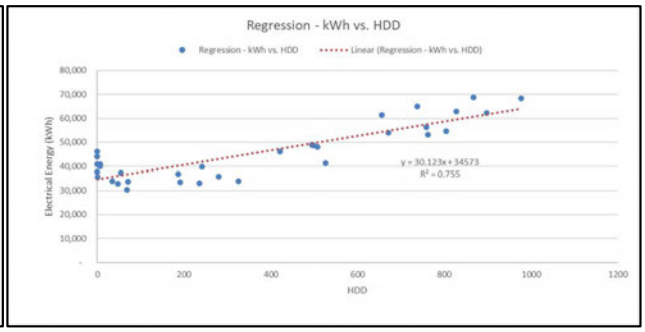


The first graph indicates there is no significant visual relationship between site cooling needs and overall electrical use, and the regression of building electric usage vs. CDD displays no statistical relationship, with an R^2 value of 0.13 and a slightly negative slope. A value of 1 indicates a perfect relationship. Peaking during winter months in the first graph suggests that electrical heating acts as a statistical confounder, and minimal peaking during summer months indicates that other uses such as service bay process use and office area plug loads contribute strongly to overall site electrical use.

Electrical use was also compared against heating degree days, as seen below:

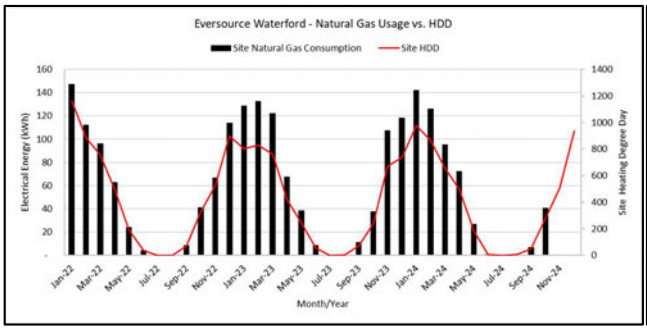
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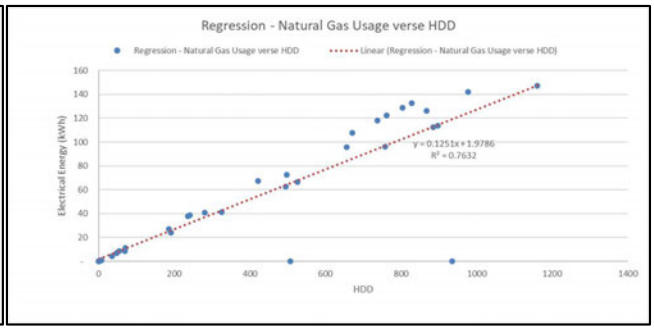




From the first graph, electrical use can be visually observed to follow HDD, suggesting that winter weather is a driver of electrical use. The regression further shows that whole building electrical displays a statistically significant relationship to HDD, with an R^2 value of 0.755. The Department of Energy Superior Energy Performance (SEP) program qualifies that a statistical relationship exists between the two variables with an R^2 value of > 0.5, and a strong relationship with an R^2 value of > 0.75. This site therefore shows a strong relationship between the electrical use and HDD, consistent with the use of heat pump RTUs and electric baseboard heating throughout the building.

Similar analysis was performed with estimated monthly natural gas use and HDD. It should be noted that the monthly natural gas profile was estimated via the use of HDD, therefore the visual matchup will be naturally be close:

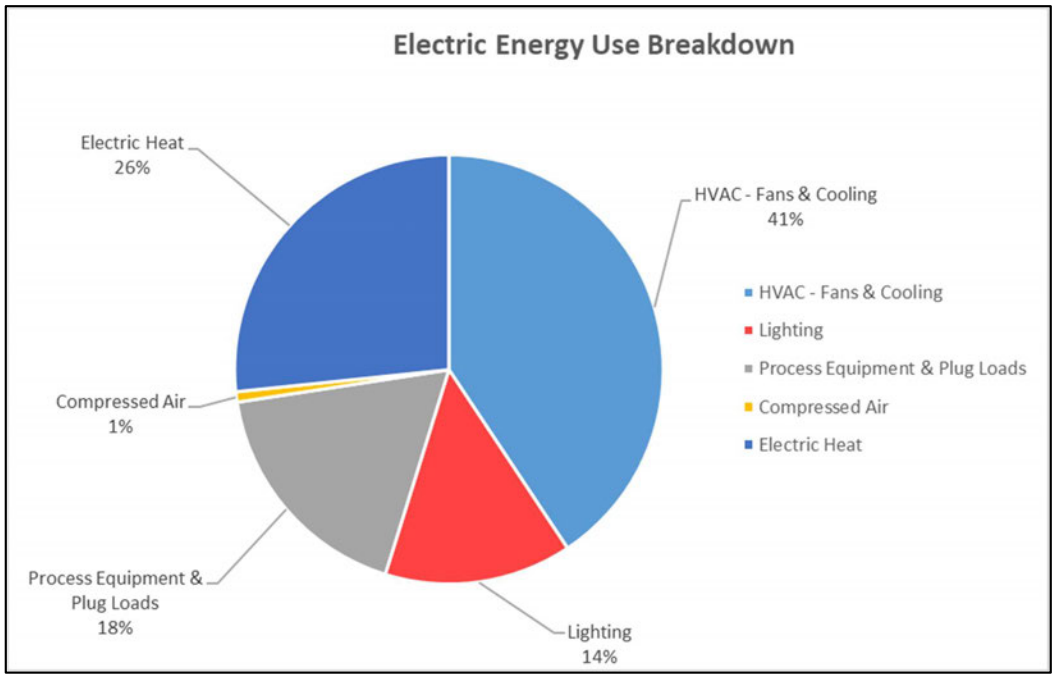




Mechanical System Energy Use Breakdown

Electric Use

Based on observations from the initial walk-through, the following electric energy use breakdown was developed. These results should be considered high level and were developed from motor nameplates, typical load factors and estimated operational hours. Actual data logging would be required to confirm these assumptions.

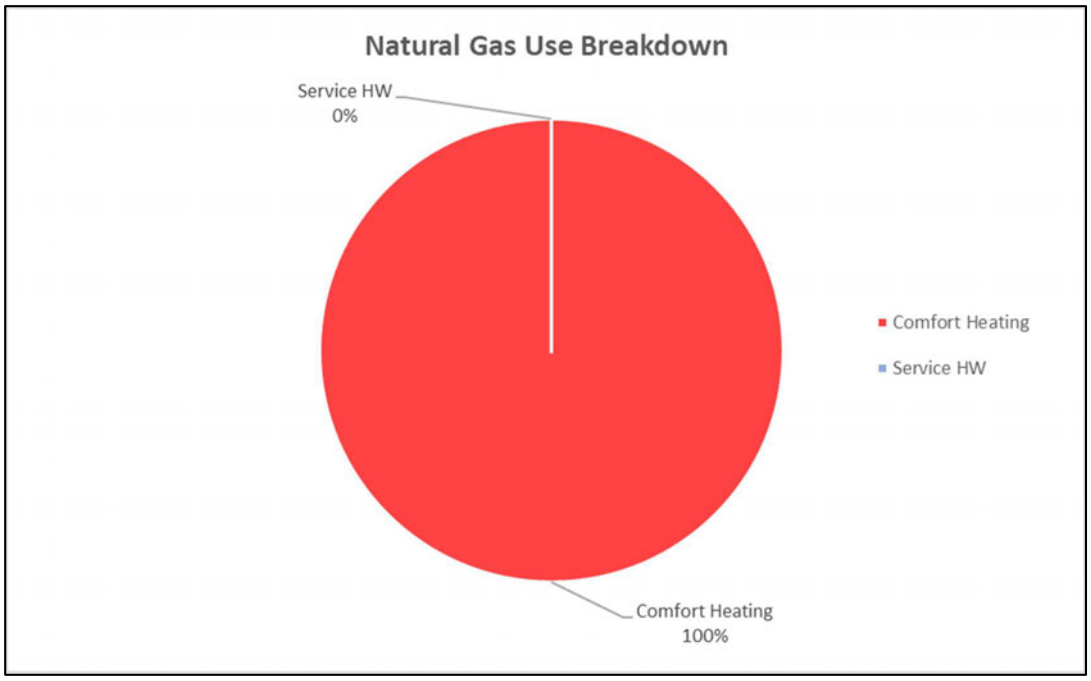


Estimated End Use Breakdown - Electricity	
Electric End Use	**Energy Use (kWh)**
HVAC - Cooling, heat pumps, & fans	242,237
Lighting	84,206
Process Equipment & Plug Loads	105,886
Compressed Air	4,663
Electric Heat	158,689
TOTAL	**595,680**

Natural Gas Use

Based on the initial walk-through, the following site natural gas use breakdown was developed. Site service hot water was observed to be heated electrically, thus 100% of natural gas use is believed to be associated with comfort heating:

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Natural Gas Use Breakdown
Service HW
0%
Comfort Heating
100%
Comfort Heating
Service HW

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Equipment Inventory:

Eversource 63R Myrock Ave - Equipment Inventory									
Type	Quantity	Tag	Make	Model	Heating (MBH)	Cooling (Tons)	Pump / Fan hp	Nominal CFM	Notes
HVAC									
RTU	1	RTU 1	Carrier	48HJE012	184	10.0	3.7 (bhp)	4,000	Natural gas fired
RTU	1	RTU 2	Carrier	48HJE012	184	10.0	3.7 (bhp)	4,000	Natural gas fired
Heat Pump RTU	1	RTU 3	Carrier						Nameplate illegible
Heat Pump RTU	1	RTU 4	Carrier	50TFQ008	86	7.5	2.4 (bhp)	3,200	
Heat Pump RTU	1	RTU 5	Carrier	50TFQ008	86	7.5	2.4 (bhp)	3,200	
Heat Pump RTU	1	RTU 7	Carrier	50TFQ012	105	10	2.4 (bhp)	4,100	
Heat Pump RTU	1	RTU 8	Carrier	50TFQ006	57	5	1.2 (bhp)	2,000	
Heat Pump RTU	1	RTU 9	Carrier	50SZ-024		2	0.75	800	Cooling only
Heat Pump RTU	1	RTU 10	Carrier	50TFQ008	86	7.5	2.4 (bhp)	3,200	
A/C	1	A/C Unit 6	Carrier		24	2			Nameplate illegible
Split System	1	Condensing Unit	Mitsubishi	PUY-A24NHA7					
Split System	1	AHU 5	Mitsubishi	PUZ-A12NKA7	18	1			
Split System	1	AHU 1	Mitsubishi						Nameplate illegible
Split System	1	(No Tag)	Carrier	38CKC018	18	1.5			
Split System	1	(No Tag)	Carrier						
Split System	1	(No Tag)	Mitsubishi	PUZ-A12NKA7	18	1			No site tag
Split System	1	(No Tag)	Carrier						
Fan	1	Exhaust Fan 1	Green Heck	GW-95-DGEX-QD			0.10	1,000	
Fan	1	Exhaust Fan 2	Green Heck	GWB-24-5			0.5	2,100	
Fan	1	Exhaust Fan 3	Green Heck	GWB-24-WMD			0.5	2,100	
Fan	1	Exhaust Fan 5	Green Heck	GWB-18-10			1	2,000	
Fan	1	Exhaust Fan 6	Green Heck	GWB-14-3			0.33	1,400	
Fan	1	Exhaust Fan 7	Green Heck	GWB-14-7			0.75	1,175	
Fan	1	Exhaust Fan 8	Green Heck	GWB-14-5			0.5	1,200	
Fan	1	Exhaust Fan 10	Green Heck	GB-260-10			1	4,800	
Unit Heater	1	UH-12	Qmark		25				
Unit Heater	1		Qmark		25				
Unit Heater	1		Modine		25				
Unit Heater	1				25				
Cabinet Unit Heater	1	CUH-1	Qmark		25				
Cabinet Unit Heater	1	CUH-3	Qmark		25				
Cabinet Unit Heater	1		Qmark		25				
Cabinet Unit Heater	1	CUH-5	Qmark		25				
Cabinet Unit Heater	1	CUH-7	Qmark		25				
Hot Water Heater	2		Ariston Thermo USA	EVC115C3W135					
Process Equipment									
Pressure Washer	1		Whitco Cleaning System	3020 ENG					
Air Compressor	1		Atlas Copco	KT5V803			5	18	
Air Dryer	1		Styl Air	SRD-4507				45	
CAIR Driven Pump	1		Graco	Fire-Ball 425					
CAIR Driven Pump	1		Graco	President 205-647					
CAIR Driven Pump	1	Oil Pump 3	Graco						
CAIR Driven Pump	1		Graco	Fire-Ball 300					

Best Practices

During the assessment walkthrough the facility was found to be observing the following energy Best Practices:

- Use of LED lighting and motion/occupancy controls in most/all areas
- Scheduled nighttime/weekend temperature setback in most/all areas via programmable thermostats
- Cog belts used on AHU fans

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Recent Energy Efficiency Projects Overview

The site has multiple recently completed or planned energy efficient projects in recent years. Listed below are some of the various energy projects recently completed:

- Upgrade to LED Lighting and advanced lighting controls
- Window caulking
- Planned Building Management System installation
- Upgrades to energy-savings equipment on replacement

With the projects described above, QGM Consulting was challenged to find additional energy efficiency measures (EEMs) and sustainability projects during the time of the survey. QGM outlined some potential recommendations below that may require some additional analysis and monitoring.

Site Energy Efficiency Measures/Recommendations

EEM – 01 – Consider Occupancy Control for Conference Rooms

An innovative control strategy noted in use at the Berlin campus is the control of site main Auditorium HVAC equipment based on an occupancy schedule. This space sees highly variable occupancy, particularly post-COVID. Setting this large space to unoccupied setpoints for significant periods of non-use (much as many sites already do with lighting) reduces the associated energy expenditure, while allowing a quick recovery for occupancy.

Areas of potential opportunity at this site include (2) conference rooms. The example below summarizes a potential before and after schedule – assuming average consistent use in the 10 AM – 2 PM period of weekdays. This model is likely conservative; it is likely that additional spaces are experiencing less or more infrequent occupancy and could remain in unoccupied mode for more of the operating schedule.

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HVAC Schedule - Existing and Proposed with Occupancy Control																			
Existing Schedule - No Scheduling								Proposed Schedule - Monday through Half-Day Saturday Schedule											
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
12:00 AM								12:00 AM							
1:00 AM								1:00 AM							
2:00 AM								2:00 AM							
3:00 AM								3:00 AM							
4:00 AM								4:00 AM							
5:00 AM								5:00 AM							
6:00 AM								6:00 AM							
7:00 AM		X	X	X	X	X		7:00 AM							
8:00 AM		X	X	X	X	X		8:00 AM							
9:00 AM		X	X	X	X	X		9:00 AM							
10:00 AM		X	X	X	X	X		10:00 AM		X	X	X	X	X	
11:00 AM		X	X	X	X	X		11:00 AM		X	X	X	X	X	
12:00 PM		X	X	X	X	X		12:00 PM		X	X	X	X	X	
1:00 PM		X	X	X	X	X		1:00 PM		X	X	X	X	X	
2:00 PM		X	X	X	X	X		2:00 PM		X	X	X	X	X	
3:00 PM		X	X	X	X	X		3:00 PM							
4:00 PM		X	X	X	X	X		4:00 PM							
5:00 PM		X	X	X	X	X		5:00 PM							
6:00 PM								6:00 PM							
7:00 PM								7:00 PM							
8:00 PM								8:00 PM							
9:00 PM								9:00 PM							
10:00 PM								10:00 PM							
11:00 PM								11:00 PM							
Occ Hrs	0	11	11	11	11	11	0	Occ Hrs	0	5	5	5	5	5	0
UnOcc Hrs	24	13	13	13	13	13	24	UnOcc Hrs	24	19	19	19	19	19	24

Implementation of this strategy may be possible with the installation of new thermostats including occupancy sensors or as a facet of the planned Building Management system (BMS) installation. The table below shows estimated costs and savings from the implementation of this type of control:

Control Conference Rooms by Occupancy			
Description	**Number**	**Unit**	**Notes**
Estimated Annual Cooling Savings	1,100	kWh	
Estimated Annual Heating Savings	4,700	kWh	
Annual Cost Savings	**$ 828**	**$**	**@ $0.1428/kWh**
Estimated Annual GHG Reduction	1.7	MT CO2e	@0.000291/MT CO2e
Estimated Cost to Upgrade	$ 10,000	$	Programming/occupancy sensors
Simple Payback	**12.1**	**Yrs**	
Estimated $/Lifetime MT CO2e	**$ 592**	**$**	**estimated 10 yr measure lifetime**

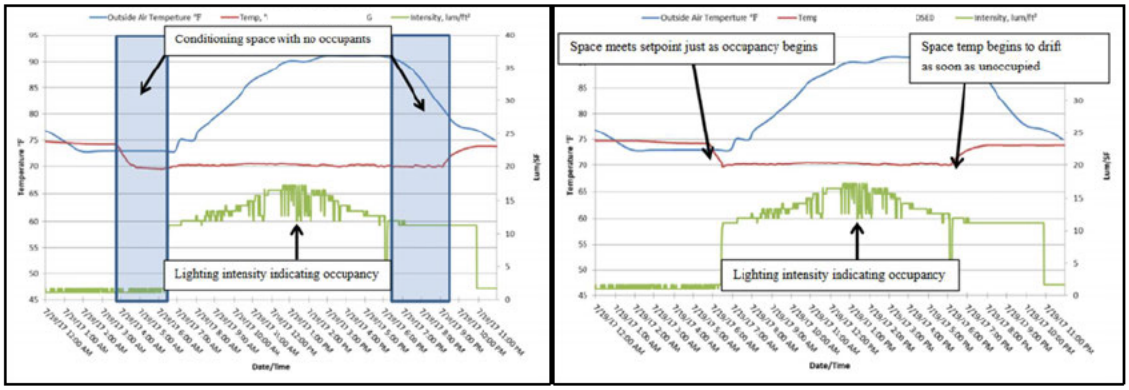
Recommended next steps for this project involve working with controls vendor to develop a scope of work and cost quotation – QGM can assist.

EEM – 02 – New Building Management System - Adaptive/Optimal Start/Stop

The site currently uses programmable thermostats to control heating and cooling equipment and schedules, with a near-future Building Management System (BMS) installation planned. Adaptive/Optimal Start/Stop (AOSS) is a control sequence available within modern Building Management Systems that allows the control system to iteratively "learn" the most optimal times to start up heating or cooling equipment so that the space is conditioned just as it becomes occupied.

The example below is real historical data from an example building, with the blue curve representing outdoor air temperature, the red curve, space temperature, and the green series lighting intensity (indicating occupancy).

The blue rectangles highlight the unnecessary long equipment ramp up and cool down periods in the "before" graph, while in the "after" graph with AOSS enabled, the equipment enables precisely and only when needed to meet setpoint once occupancy begins:



Implementation of AOSS should be possible as an option or additional control software modules with the planned BMS. The table below shows estimated cost and savings from the implementation of AOSS:

New Building Management System - Adaptive/Optimal Start/Stop			
Description	**Number**	**Unit**	**Notes**
Estimated Annual Cooling Savings	5,500	kWh	
Estimated Annual Electric Heating Savings	6,100	kWh	
Estimated Annual NG Heating Savings	200	CCF	
Annual Cost Savings	**$ 1,884**	**$**	**@ $0.1428/kWh & $1.14/CCF**
Estimated Annual GHG Reduction	4.5	MT CO2e	@0.000291/MT CO2e & 0.0055/CCF
Estimated Cost to Upgrade	$ 20,000	$	Pro-rated cost
Simple Payback	**10.6**	**Yrs**	
Estimated $/Lifetime MT CO2e	**$ 448**	**$**	**estimated 10 yr measure lifetime**

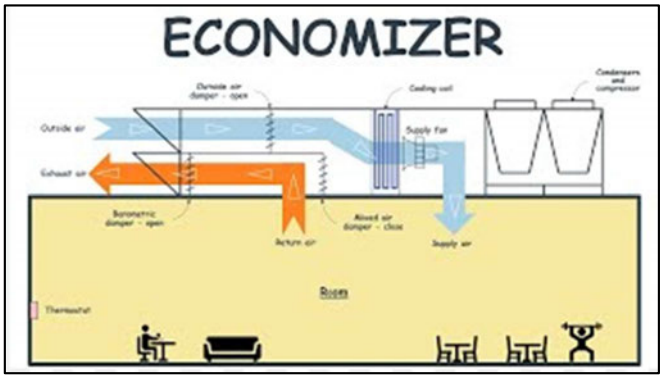
Recommended next steps for this project involve working with controls vendor to develop a scope of work and cost quotation. QGM can assist with recommendations or development of scope of work.

EEM – 03 – Install Dry-Bulb Economizers on RTUs

Discussion with site personnel indicates that most or all of the RTUs have bypassed or disabled economizers. It is recommended that the site consider the installation of new dry-bulb economizers on all RTUs – either as a factory option on planned RTU replacements or via a retrofit of existing units that will remain.

Dry-bulb economizer is a strategy that utilizes outdoor airstream temperature to determine the most advantageous times to be in economizer (introduction of untempered outdoor air) for reduced HVAC energy use

for space cooling. The graphic below illustrates economizer operation: the introduction of 100% (or modulated amounts in some cases) of outdoor air:



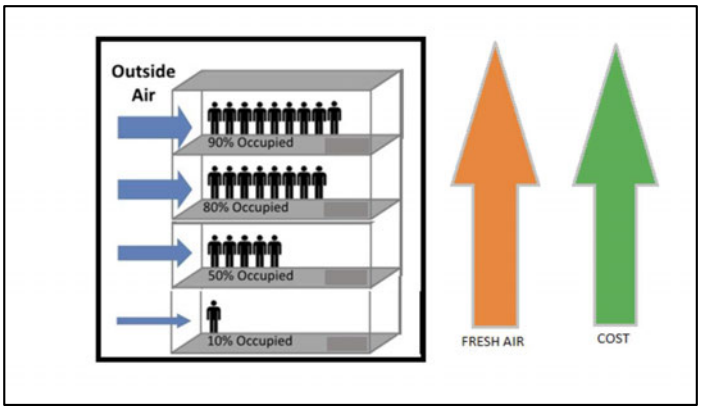
The table below shows estimated cost and savings from the introduction of new economizer sensors and controls:

Consider Dry-Bulb Economizers on RTUs			
Description	**Number**	**Unit**	**Notes**
Estimated Annual Cooling Savings	9,300	kWh	
Annual Cost Savings	**$ 1,328**	**$**	**@ $0.1428/kWh & $1.14/CCF**
Estimated Annual GHG Reduction	2.7	MT CO2e	@0.000291/MT CO2e & 0.0055/CCF
Estimated Cost to Upgrade	$ 16,000	$	Factory RTU option OR BMS add-on
Simple Payback	**12.0**	**Yrs**	
Estimated $/Lifetime MT CO2e	**$ 591**	**$**	**estimated 10 yr measure lifetime**

Recommended next steps for this project involve working with controls vendor to develop a scope of work and cost quotation. QGM can assist with recommendations for equipment or vendors if desired.

EEM – 04 – Demand Control Ventilation

The site is not currently able to control the introduction of outside air with existing HVAC controls. It is recommended that the site considers Demand Controlled Ventilation (DCV) as part of the BMS upgrade/installation. DCV works by modulating the outdoor air intake to only what is needed to satisfy the space occupancy. As the graphic below illustrates, a higher occupant load requires more outdoor air and higher HVAC costs, while lower (or no) occupant load requires less (or even no) outdoor air:



Demand Control Ventilation (DCV) uses CO_2 sensors in the space and/or return airstream to monitor the level of CO_2 in the space and modulate RTU outdoor air dampers to introduce only as much outdoor air as needed. Sites are commonly found to be introducing significant excess outdoor air, well beyond any occupant requirements – outdoor air dampers often come from the factory set at 20 – 50% without any ability to modulate.

The table below shows estimated cost and savings from the installation of DCV controls on all RTUs:

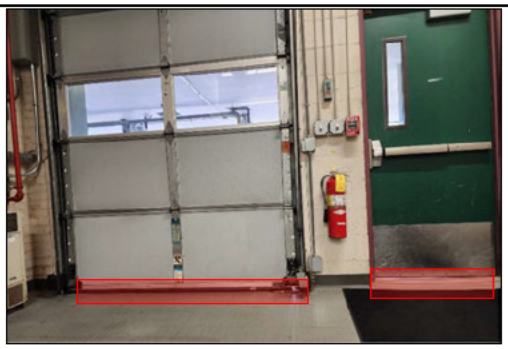
Consider Demand Control Ventilation			
Description	**Number**	**Unit**	**Notes**
Estimated Annual Cooling Savings	13,600	kWh	
Estimated Annual Electric Heating Savings	71,200	kWh	
Estimated Annual NG Heating Savings	2,850	CCF	
Annual Cost Savings	**$ 15,358**	**$**	**@ $0.1428/kWh & $1.14/CCF**
Estimated Annual GHG Reduction	40.2	MT CO2e	@0.000291/MT CO2e & 0.0055/CCF
Estimated Cost to Upgrade	$ 24,000	$	Factory RTU option OR BMS add-on
Simple Payback	**1.6**	**years**	
Estimated $/Lifetime MT CO2e	**$ 60**	**Yrs**	**estimated 10 yr measure lifetime**

Recommended next steps for this project involve working with a local vendor to develop a controls scope of work and cost quotations, moving to implement this measure either as a facet of the planned BMS installation or as a factory option for the planned RTU replacements and retrofit or any remaining units.

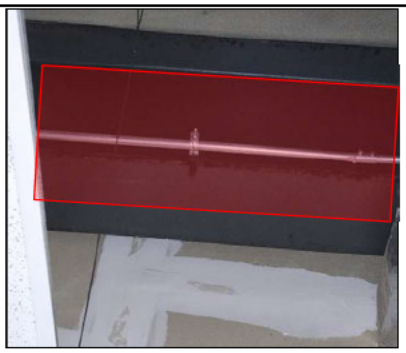
EEM – 05 – Building Shell Gap Remediation

During the walkthrough of the site, gaps were noted in the building envelope, as seen in the photos below:

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Visible daylight along bay doors and man doors indicating poor seal



Roof/wall intersection seals are often missing or degraded due to age and exposure to moisture

Gaps at door and window seals, as well as roof/wall intersections along 2nd and 3rd Floor exterior wall/roof transitions are likely allowing the infiltration/exfiltration of untempered air. It is recommended that the site perform a comprehensive building and thermal shell survey and remediate any identified gaps.

The table below details the estimated cost and savings for remediating gaps in the building shell, including estimated survey costs:

Remediate Building Shell Gaps			
Description	**Value**	**Unit**	**Notes**
Estimated Building Shell Remediation Savings (Electric)	23,600	kWh	
Estimated Building Shell Remediation Savings (Natural Gas)	700	CCF	
Annual Cost Savings	**$ 4,168**	**$**	**@ $0.1428/kWh & $1.14/CCF**
Estimated Annual GHG Reduction	10.7	MT CO2e	@0.000291/MT CO2e & 0.0055/CCF
Estimated Install Cost	$ 50,000	$	Including survey cost
Simple Payback	**12.0**	**Yrs**	
Estimated $/Lifetime MT CO2e	**$ 312**	**$**	**estimated 15 yr measure lifetime**

It is recommended to work with a vendor specializing in building shell remediation to conduct a survey and implement recommendations, as well as to work with local utility representatives to determine incentive eligibility.

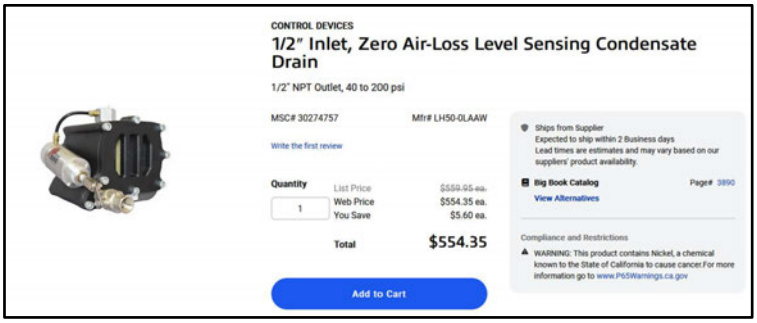
EEM – 06 – Replace Timed CAIR Drains with Zero Loss Drains

Service bays and garage areas at the site utilize a compressed air system as described in an earlier section, including dryer and storage tank drains. Compressed air drains are necessary when generating compressed air, as the natural moisture present in ambient air does not compress and must be removed from the system to prevent buildup and subsequent loss of efficiency or equipment operation.



Current Timer Drain

Typical timed drains use compressed air to purge the unneeded moisture, thus increasing the load on the compressor for the periods they are running. Zero loss drains are designed to evacuate the unneeded moisture without also venting air. Examples of zero loss drains sourced from online research are shown below:



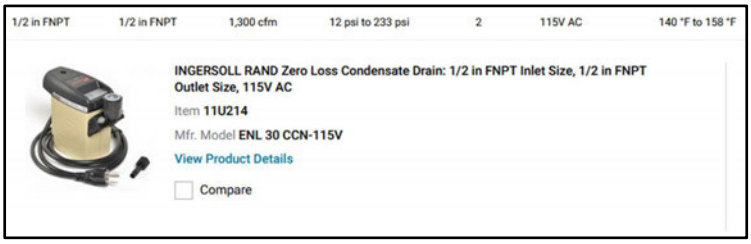


Table below details estimated savings associated with this measure:

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Replace Timer Condensate Drains with Zero Loss			
Description	**Value**	**Unit**	**Note**
Estimated Annual Energy Savings	**1,200**	**kWh**	
Estimated Annual Cost Savings	**$ 171**	**$**	**@ $0.1428/kWh**
Estimated Annual GHG Savings	0.3	MT CO2e	@ 0.0054 MT CO2e/CCF, 0.000291 MT CO2/kWh
Estimated Installation Cost	$ 1,500	$	High level estimate
Simple Payback	**8.8**	**Yrs**	
Estimated $/Lifetime MT CO2e	**$ 286**	**$**	**estimated 15 yr measure lifetime**

The site is encouraged to investigate zero loss drains with their compressed air vendor, or QGM can provide a list of products and/or vendors if desired.

EEM – 07 – Electrification - Consider Additional Heat Pumps to Replace Existing Natural Gas Heating

The site was observed to heat primarily via electric heating or heat pump AHUs, with (2) existing natural gas fired units and (1) planned near-term future natural gas unit to serve the 24-hour service area renovation currently taking place.

The site could consider replacement of existing natural gas fired heating systems with additional Air Source Heat Pump (ASHP) units. Challenges to this approach include HVAC redesign and cost, and an increase in overall site electrical use.

Associated GHG emissions reductions were calculated from estimated natural gas heating load and proposed ASHP heating. Existing natural gas heating is assumed to be replaced entirely by high efficiency (COP) heating equipment for a reduction in pure heating energy and GHG emissions.

The table below details estimated costs, savings, and GHG reductions from this measure. Note that with existing utility costs, this measure is slightly cash-flow negative. This measure should be considered with a Greenhouse Gas Emissions focus.

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Convert Natural Gas RTUs to Air Source Heat Pumps			
Description	**Value**	**Unit**	**Notes**
Estimated Annual Natural Gas Heating Usage	8,000	CCF	Projected use with planned 3rd NG RTU
Estimated Annual Natural Heating Gas Cost	$ 9,120	$	@ $1.14/CCF
Annual Associated GHG Emissions	**43.6**	**MT CO2e**	**@ 0.0054/CCF**
Proposed Annual Heating Energy	65,946	kWh	
Proposed Area Heating Cost	$ 9,417	$	@ $0.1428/kWh
Proposed Associated GHG Emissions	**19.2**	**MT CO2e**	**@ 0.000291/kWh**
Estimated Annual Natural Gas Savings	8,000	CCF	
Estimated Annual Electrical Savings	(65,946)	kWh	
Estimated Annual Cost Savings	**$ (297)**	**$**	
Estimated Change Cost - ASHPs Installed	**$ 89,000**	**$**	**Cost includes new EUHs**
Simple Payback - no incentives	**n/a**	**yrs**	
GHG Emissions Reduction	**24.4**	**MT CO2e**	
Lifetime Cost per MT CO2e	**$ 183**	**$/MT**	**Assumed 20 year measure life**

Next steps for this measure are to discuss possible air source heat pump installation with design engineers and a reputable local mechanical vendor – QGM can assist with a list of vendors if desired. Costs as presented are high-level estimates and would require engineering to develop more precise costs.

HVAC Setpoints

Discussion with personnel indicates that site or corporate SOPs for heating and cooling setpoints have relaxed from standards set in the past. Corporate SOPs for heating and cooling setpoints can vary, but frequently observed occupied standards fall between 70°F - 74°F for heating, and 68°F - 72°F for cooling.

SOP standards recommended for most sites are:

- Heating: 70°F occupied, 62°F unoccupied
- Cooling: 72°F occupied, 80°F unoccupied

Recommended setpoints such as these should balance occupant comfort with site energy usage. Periodic audits are recommended to identify and correct local overrides – often put in place for a temporary condition but not reset to SOP.

Idle Building Loads/Plug Loads

Current post pandemic hybrid workspaces present some open questions with regard to plug load. While in many cases overall office attendance is significantly reduced from pre-pandemic levels, the time gap between office occupancy has increased, suggesting increased opportunity for devices to remain idle and not in use.

Post pandemic idle loads are still not well understood and might benefit from additional study to better understand and define the nuances of total device count/demand, actual hours of opportunity, and economics of plug load management.

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Sustainability Considerations

Background

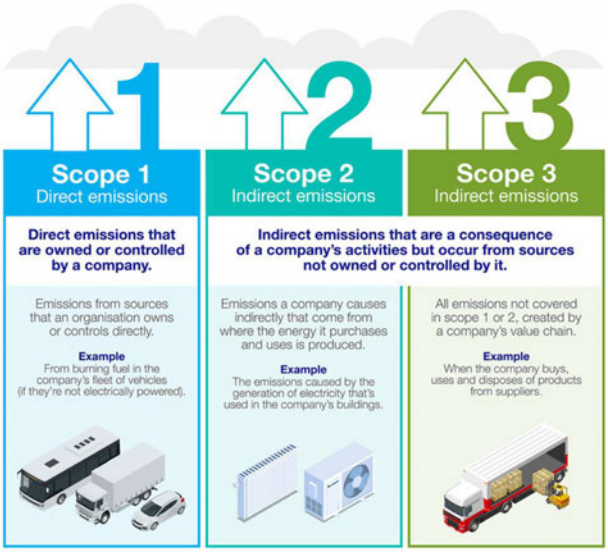
Site and portfolio sustainability is best guided by the framework and methodology set forth in ASHRAE Standard 228-2023 *Standard Method of Evaluating Zero Net Energy and Zero Net Carbon Building Performance* (available for purchase here: https://www.ashrae.org/technical-resources/bookstore/ansi-ashrae-standard-228-standard-method-of-evaluating-zero-net-energy-and-zero-net-carbon-building-performance). The site is not known to have a present net-zero strategy; however, the ASHRAE standard presents a strong method to:

- Assess current building energy usage and carbon emissions
- Establish a baseline
- Develop milestones
- Develop a plan to reach milestones

The data and information shown below are intended to help develop an understanding of where current portfolio sustainability goal aligns with current position.

Emissions Scopes

Emissions reporting is generally addressed across three Emissions Scopes, as seen below:



An important aspect of developing a sustainability plan is the determination of which emissions scopes will be targeted for reduction. The majority of sustainability planning at the time of this report is focused on Scopes 1 and 2, although large corporations with significant supply and delivery chains have begun to address Scope 3 as well. The focus of the sustainability plan in this report is on Scope 1 and 2 emissions.

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ASHRAE Standard 228-2023 *Standard Method of Evaluating Zero Net Energy and Zero Net Carbon Building Performance*

ASHRAE 228-2023 includes the following diagram illustrating energy flows into, from, and out of a site:

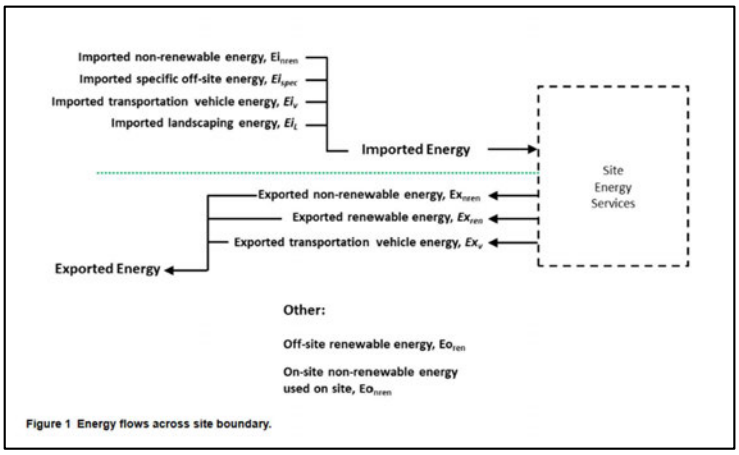


Figure 1 Energy flows across site boundary.

The difference between energy flow into a site, and energy flow out, is site net energy. The primary goal of sustainability is to reduce this net energy, and therefore, net carbon emissions associated with the site and its operation.

ASHRAE 228-2023 – examples of data gathering and forms

ASHRAE 228-2023 recommends site conduct an all-energy and associated carbon emissions accounting as seen in the tables shown below. Note that generator natural gas use, while not considered for efficiency measures, must be accounted for.

Form 1
General Building and Site Description

ID:	Waterford Service Center	Measurement Start Date:	3/19/2025
Address:	63R Myrock Ave		
City, State, Country, ZIP Code:	Waterford, CT 06385, USA		
Primary Year of Construction:		Secondary:	

Gross Floor Area (GFA):	51,220
Physical site area, SF:	49,228
Non-green-roof building footprint area:	26,700
Other Physical site area not requiring landscape care:	
Landscape area (LA):	

On-site renewable energy system type:	n/a	On-site renewable energy system design max output, kW:	

Compliance Type

Portion of building:	100%
Building:	Main
Part of a Community? If "Yes," Community Name?	

REDACTED

Form 2

Annual Site Energy Conversion Calculation

	Energy Form	Energy Use Numerical Value	Units	Conversion Factor to kWh	Annual site Energy, kWh/yr
1a	Imported grid electricity	595,680	kWh	1	595,680
1b	Imported specific electricity				
2a	Imported grid natural gas	32,343	CCF	30.2	975,409
2b	Imported renewable natural gas				
3	Imported steam				
4	Imported hot water				
5	Imported chilled water				
6a	Imported grid fuel oil				
6b	Imported renewable fuel oil				
7a	Imported grid propane				
7b	Imported renewable propane				
8	Imported coal or other				
9	Imported biomass				
10	On-site nonrenewable energy				
11	Imported transportation vehicle energy				
12	Imported landscape energy				
13	Exported nonrenewable electricity				
14	Exported renewable electricity				
15	Exported steam				
16	Exported hot water				
17	Exported chilled water				
18	Exported other				
19	Exported transportation vehicle energy				

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Form 3

Annual Site Energy Conversion Calculation

	Energy Form	Energy Use Numerical Value	Source Energy Conversion Factor	Annual Source Energy, kWh/yr
1a	Imported grid electricity	595,680	1	595,680
1b	Imported specific electricity			
2a	Imported grid natural gas	975,409	1.0	975,409
2b	Imported renewable natural gas			
3	Imported steam			
4	Imported hot water			
5	Imported chilled water			
6a	Imported grid fuel oil			
6b	Imported renewable fuel oil			
7a	Imported grid propane			
7b	Imported renewable propane			
8	Imported coal or other			
9	Imported biomass			
10	On-site nonrenewable energy			
11	Imported transportation vehicle energy			
12	Imported landscape energy			
13	Exported nonrenewable electricity			
14	Exported renewable electricity			
15	Exported steam			
16	Exported hot water			
17	Exported chilled water			
18	Exported other			
19	Exported transportation vehicle energy			
20	Qualified off-site renewable energy			

**Source energy factors typically available from local utilities*

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Form 4

Annual Greenhouse Gas Emissions (GHG) Net Calculation

	Energy Form	Annual Site Energy, kWh/yr	GHG Emissions Factor, kg CO2e/kWh	Annual GHG Emissions, kg CO2e/yr
1a	Imported grid electricity	595,680	0.58	346,686
1b	Imported specific electricity			
2a	Imported grid natural gas	975,409	0.18	176,089
2b	Imported renewable natural gas			
3	Imported steam			
4	Imported hot water			
5	Imported chilled water			
6a	Imported grid fuel oil			
6b	Imported renewable fuel oil			
7a	Imported grid propane			
7b	Imported renewable propane			
8	Imported coal or other			
9	Imported biomass			
10	On-site nonrenewable energy			
11	Imported transportation vehicle energy			
12	Imported landscape energy			
13	Exported nonrenewable electricity			
14	Exported renewable electricity			
15	Exported steam			
16	Exported hot water			
17	Exported chilled water			
18	Exported other			
19	Exported transportation vehicle energy			
20	Qualified off-site renewable energy			
21	Refrigeration Loss (Form 4A)			

Annual GHG Net Emissions	522,775	**Annual GHG Net Emissions, kg CO2e**	522,775
Previous Measurement Period	none	**Previous GHG Net Emissions, kg CO2e**	none
Sum, Two-Year GHG Net Emissions	522,775	**Sum, Two-Year GHG Net Emissions kg CO2e**	522,775

**Refrigerant loss form not included as not relevant at site.*

Site sustainability team or personnel are encouraged to determine and enter applicable values. As seen above, these tables and final conversions result in an annual carbon baseline for the site.

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The next step is the determination of the carbon reduction goal and the timeframe to reach it. Carbon emissions are suggested to be tracked monthly and annually along with energy usage to assess the impact of reduction efforts.

Sustainability Plan

With a carbon baseline established and a goal and timeframe put in place, the next step is to develop a sustainability plan to reduce site net energy and carbon. A four-step plan, as outlined in an article from CBRE (Decarbonizing Commercial Real Estate | CBRE) and shown in the chart below, is recommended:



The table below details the four-step plan with narrative descriptions and progress to date for the target site. Note that the process is by nature to be repeated for continuous improvement and consideration of new technologies:

Eversource CT 63R Myrock Ave Sustainability Plan			
Step	Description	Progress	Notes
1	Efficiency/Conservation	50%	In process, identifying and determining measures
2	Electrify Remaining Loads	50%	Identify and electrify remaining energy loads
3	Renewable Energy Offset	0%	Onsite or purchased renewable electricity
4	Offset Remaining Loads	0%	Purchase RECs on open market, consider portfolio offsets

Step 1: Efficiency and Conservation

Identify possible efficiency and conservation measures at the target site to reduce energy usage and associated carbon. This step is in progress at this site – this study has identified several possible measures for the reduction of energy usage. These measures should be considered for implementation.

Step 2: Electrify Remaining Loads

Site net energy loads not able to be reduced should be considered for electrification. Site has addressed this step via the installation of heat pump RTUs, split system heating, and electric HW Heaters.

Step 3: Renewable Energy Offset

Offset of site electrical energy usage via renewable energy: either generated onsite or through purchasing of renewable energy from sources such as community solar or solar farms as well as energy brokerage.

Step 4: Offset Remaining Loads

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Lastly, the site may consider RECs and/or purchased carbon offsets to meet the remaining site net carbon. ASHRAE 228-2023 rigorously defines each of these categories and is strongly recommended as a guideline for these efforts and associated accounting.

Repeat: Steps 1 – 4

A sustainability plan should be viewed as a process of continuous improvement. The site is encouraged to consider additional opportunities and technologies as they become available and more economical.

Next Steps:

- Site to review suggestions in report (and calculation assumptions) and discuss internally if any interest to move forward with any of the recommended opportunities (and work closely with vendors on potential quotes and SOWs).
- Virtual report out to discuss this report. The goal of the meeting is to determine which, if any, of the suggested ECMs are to be acted upon in the near to intermediate future.
- For those ECMs that require input from designers, site is suggested to initiate the process sooner than later. Site is encouraged to get contractors/vendors to site to review and provide budgetary costs.