The Daylight Savings Company

Energy Audit For:
Town of Stanford
26 Town Hall Rd
Stanfordville, NY, 12581

Prepared by:
Daylight Savings Company
48 N Church St, Goshen, NY, 10924
1-800-337-2192

Date: 2/17/2022
(Revised 2/17/2022)

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Cost Estimation

In general at this level of reporting the pricing for certain measures is fairly stable and can be predicted accurately (e.g. lighting) but even then the variation of pricing between manufacturers and accessories will yield contradictions as the project moves forward to implementation. Pricing for other items such as windows varies wildly even though the estimating process makes a best effort to incorporate field conditions, customer market segment and other influencing factors such as architectural districts. In all cases the pricing shown in this report evolved from actual pricing acquired by Daylight Savings through decades of working in the energy efficiency field. Data from other resources such as RSMeans are included as appropriate. Whenever possible we incorporate customers' actual contractor quotes because they represent the most accurate assessment of a project budget.

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Executive Summary

The recommendations made in this report highlight opportunities you can take advantage of to lower your energy bills and improve your energy efficiency.

Your Energy Audit can be used to help make informed energy decisions, and to apply for both incentives and financing.

This report presents the findings of an energy assessment conducted on October 13, 2021 by Jon Buyl for:

Town of Stanfordville
26 Town Hall Rd
Stanfordville, NY, 12581
845-453-0737

Facility contact person: Frank Pepe

The table below, Table 1: Energy Consumption Summary, presents annual energy costs at this facility (the "Total Cost" also includes monthly basic charges):

Table 1: Energy Consumption Summary

Energy Consumption Summary by Fuel Type								
Fuel Type	**Consumption**		**$/unit energy**	**Energy Cost**	**Average Monthly Demand**	**$/unit demand**	**Demand Cost**	**Total Cost**
Electricity	70,869	kWh	$0.15	$10,630	26.3 kW	-	-	$10,630
Diesel	760	gal	$3.00	$2,280	-	-	-	$2,280
Fuel Oil (No. 2)	3,159	gal	$2.50	7897.5	-	-	-	$7,898
Propane	3,329	gal	$1.93	$6,425	-	-	-	$6,425
All Fuels	**1,088**	**MMBtu**	**$25.0**	**$27,233**			**$0**	**$27,233**

EXECUTIVE SUMMARY

Process Overview

This energy assessment was conducted based on the procedures described as a Level 2 Energy Survey and Analysis in the ASHRAE *Procedures for Commercial Building Energy Audits*, 2011 edition. All energy consuming systems were inventoried, utility energy consumption bills were gathered and analyzed, and models were developed to describe the energy consumption as a function of the key parameters. Opportunities for reducing energy consumption were identified and evaluated, and suggestions for implementation are presented in this report. The assessment has several distinct features, goals, and limitations.

- This is a snapshot assessment of the facility. It is not an exhaustive (and more costly and time consuming) systems engineering approach where extensive data logging is carried-out to determine precise equipment operating parameters and efficiencies.
- Energy savings estimates contained in this assessment report are generally based on calculation methodologies that comply with the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs ("NY Tech Manual"), prepared for the New York Department of Public Service.
- No contractor quotes were obtained for this assessment. Separate statements of work for each project would be developed to determine the final project cost and savings.

The potential annual energy cost savings are shown on the next page in Table 2: Energy Cost Reduction Opportunities (ECRO's). A discussion of the existing conditions and the recommended improvements are included in the discussion in the executive summary.

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Table 2: Energy Cost Reduction Opportunities (ECRO's)

Master List of Measures

Description	Measure ID	Measure Status	Annual Savings							Installed Cost $	Useful Life of Measure	Simple Payback	SIR	Life Cycle Savings	% of Annual Utility Costs Saved
			kW	kWh Electricity	gal Diesel	gal Fuel Oil (No. 2)	gal Propane	GHG Emissions Reduction (Metric Tons CO2e)	$ Total						
Install a Geothermal Heat Pump for the Town Hall	ECRO_1	R	-	-9,727	-	3,159	-	25.7	$6,438	$111,100	25	17.3 years	1.0	$1,012	23.6%
Install a Geothermal Heat Pump for the DPW Building	ECRO_2	NR	-	-9,974	-	-	3,329	12.5	$4,929	$138,800	25	28.2 years	0.6	-$52,973	18.1%
Install WiFi Thermostats	ECRO_3	R	-	1,531	-	714	-	8.4	$2,016	$6,600	11	3.3 years	2.8	$12,049	7.4%
Purchase a Battery-Operated Zero-Turn Mower	ECRO_4	R	-	-9,612	760	-	-	1.1	$1,538	$21,000	18	13.6 years	1.0	$160	5.6%
Install a Variable Speed Drive to Control the DPW Garage Ventilation	ECRO_5	R	-	2,814	-	-	-	2.0	$422	$2,380	10	5.6 years	1.5	$1,221	1.6%
Replace Select Motors with Brushless DC Motors	ECRO_6	R	-	1,543	-	-	-	1.1	$231	$1,170	15	5.1 years	2.4	$1,593	<1%
Install a Timer on the DPW Air Compressor	ECRO_7	R	-	913	-	-	-	0.6	$137	$240	12	1.8 years	5.7	$1,123	<1%
Replace the DPW Refrigerator with an ENERGY STAR Unit	ECRO_8	R	-	705	-	-	-	0.5	$106	$770	12	7.3 years	1.4	$283	<1%
Upgrade the Lighting to LED Lighting	ECRO_9	R	8.9	14,320	-	-	-	10.1	$2,148	$12,112	15	5.6 years	2.1	$13,531	7.9%
Install Photovoltaic Solar Cells	ECRO_10	R	-	65,347	-	-	-	45.9	$8,789	$147,000	25	16.7 years	1.0	$6,036	32.3%
			8.9	**67,833**	**760**	**3,873**	**-**	**95.4**	**$21,825**	**$302,372**	**-**	**13.9**	**-**	**$37,008**	**80.1%**

EXECUTIVE SUMMARY

The following notes relate to the table on the previous page:

- "R" means a measure is recommended for immediate implementation because it has a positive lifecycle cost. "NR" means a measure has a negative lifecycle cost. NR items are included in this table because they are sensible when included with the recommended measures and because the overall project represented in the "Total" line has a positive lifecycle cost. NR items typically have additional, non-energy benefits such as comfort, health, and safety.

- Energy saving values that are negative represent a fuel switching measure and the new fuel use is a "negative savings".

- Simple payback is the cost divided by the estimated annual savings. It represents the amount of time it will take for a project to pay for itself. Life cycle savings is the present value of the annual energy savings over the life of the measure (e.g. twelve years for temperature control) at the FEMP discount rate of 3.0% less the implementation cost. Salvage values are zero for the purposes of this illustration.

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The estimated demand and energy savings are shown below in Table 3: Estimated Energy Savings. The information in this table corresponds to the measures in Table 2: Energy Cost Reduction Opportunities (ECRO's). The DPW geothermal shows no values because it is not recommended for implementation.

Table 3: Estimated Energy Savings

Energy Cost Reduction Opportunities	Total kW Reduction	Total Annual kWh Reduction	Total Annual Gallons of Diesel Reduced	Total Annual Gallons of Oil Reduced
Install a Geothermal Heat Pump for the Town Hall	-	-9,727	-	3,159
Install a Geothermal Heat Pump for the DPW Building	-	-	-	-
Install WiFi Thermostats	-	1,531	-	714
Purchase a Battery-Operated Zero-Turn Mower	-	-9,612	760	-
Install a Variable Speed Drive to Control the DPW Garage Ventilation	-	2,814	-	-
Replace Select Motors with Brushless DC Motors	-	1,543	-	-
Install a Timer on the DPW Air Compressor	-	913	-	-
Replace the DPW Refrigerator with an ENERGY STAR Unit	-	705	-	-
Upgrade the Lighting to LED Lighting	8.9	14,320	-	-
Install Photovoltaic Solar Cells	-	65,347	-	-
Total	**8.9**	**67,833**	**760**	**3,873**

EXECUTIVE SUMMARY

Executive Summary Discussion

Facility and Applicant Description

The site's intent through this energy audit is to receive guidance regarding the reduction of energy costs and the overall improvement of operations.

Operations and Maintenance Related Observations and Recommendations

There are several small electricity accounts with little to no usage. There is a monthly cost to keep these accounts open. It is suggested to explore the idea of installing a local plug and then distributing power through generators or battery packs for the few times that power might be needed.

The DPW air compressor was observed at 140 psi. This should be set to no higher than 100 psi since most equipment can be operated at less than 100 psi. This will save 15-20% of the compressor energy. This report suggests the implementation of a timer to reduce the operating time of the air compressor. The reduced pressure would result in additional energy savings.

The two on-site generators (~30 kW total) may qualify for participation in Central Hudson's Commercial System Relief Program and could potentially yield annual revenue of around $500. These programs pay to reduce electric usage when the utility electrical distribution system needs help. Participants are called one day ahead of a forecasted peak-shaving need. These calls for electric load reductions typically occur on the hottest days when the electrical system may exceed acceptable performance levels. Reducing overall energy demand during these events decreases the need for costly infrastructure upgrades and minimizes carbon emissions. The following are incentive payments for planned events: $1.23/kW/month for the reservation payment + $0.11/kWh for the performance payment. Applications and any questions can be submitted via CH.DLM@cenhud.com. The generator may also be eligible to participate in NYISO Programs. There are environmental rules regarding the allowed emissions from the generator that include limitations on the generator's age. These limitations may preclude the site from participating in Demand Response programs.

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The details of the following ECROS begin on page 12 with each ECRO occupying each consecutive page.

ECRO_1: Install a Geothermal Heat Pump for the Town Hall

It is recommended to install a new geothermal system to provide space heating and cooling. Please see the measure description in the next report section.

ECRO_2: Install a Geothermal Heat Pump for the DPW Building

See the prior measure.

ECRO_3: Install WiFi Thermostats

This measure involves installing WiFi thermostats such that they are set to maintain an unoccupied space temperature setpoint of 55°F during the heating season and to turn off the cooling equipment during the cooling season.

ECRO_4: Purchase a Battery-Operated Zero-Turn Mower

A diesel-engine mower is currently being used at the site. Electric motor efficiencies are significantly higher and therefore this measure involves buying a mower that is battery-operated.

ECRO_5: Install a Variable Speed Drive to Control the DPW Garage Ventilation

Due to electrical dynamics, motors operating at partial load waste a disproportionate amount of energy. Adjustable speed drives greatly reduce these losses by properly matching the motor speed to the required load.

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ECRO_6: Replace Select Motors with Brushless DC Motors

It is recommended to replace the selected motors with new DC motors. The energy efficiency of brushless DC (BLDC) motors can obtain a relatively high amount of mechanical power in return for the electrical power input. The energy used by AC motors to create the electromagnet decreases the efficiency of the AC motor in comparison to the DC motors.

ECRO_7: Install a Timer on the DPW Air Compressor

This measure involves installing a timer to control the operation of the DPW air compressor. The air compressors do not need to operate at night or during the day when they are not needed. The implementation of this measure would have a minimal impact on maintenance practices at the facility.

ECRO_8: Replace the DPW Refrigerator with an ENERGY STAR Unit

According to the Environmental Protection Agency (EPA) ENERGY STAR rated refrigerators and freezers are at least 30% more efficient than standard models.

ECRO_9: Upgrade the Lighting to LED Lighting

The lighting can be replaced/retrofitted with LED fixtures and/or lamps for a significant reduction in energy consumption. The implementation of this measure is recommended. See Appendix B for the details of this recommendation.

ECRO_10: Install Photovoltaic Solar Cells

The cost effectiveness of installing photovoltaic solar cells to produce electricity was investigated and found to be cost effective with available NYSERDA incentives and tax credits. It is recommended that the owner contacts local solar installers to get quotes for installing solar panels. Daylight Savings' can review the quotes.

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All conceivable measures were considered for this report including but not limited to insulation, weatherization, envelope, renewable energy, on-site generation, lighting upgrade, and HVAC equipment upgrade measures. The measures presented in detail in this report were found to be applicable and cost effective.

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For all sites we recommend to continue to shop around for an electricity supplier as the market is highly competitive and lower rates are sometimes available.

CONSUMER ADVISORY

- The Public Service Commission has been critical of certain Energy Services Companies, or ESCOs, particularly regarding prices. The Commission is considering whether the retail access market for energy commodity is working properly, or if it should be revised.
- The NY Power to Choose website allows consumers to compare the various ESCO products on a side-by-side basis, and against the local utility's supply costs. The website is not an endorsement of any ESCO or utility.
- The information offered on the website is self-reported by each ESCO and has not been audited for accuracy.
- Use caution in evaluating energy offers. The posted rates are guaranteed only for the specified period. The rate of a variable product is generally available for the first month, after which an ESCO could potentially increase the rate significantly.
- Careful shopping, and the use of the "historical pricing" feature, which graphically shows the ESCO's historic pricing patterns compared to the incumbent utility, can help to identify which ESCO, if any, are more likely to provide commodity supply price savings compared to your local utility.
- Please note that comparative historical pricing data is typically not available if the ESCO is offering "value-added products" such as furnace cleaning or "green products".
- For information on complaints taken by the Department of Public Service regarding ESCOs please visit the Department website at: www.dps.ny.gov
- To search for competitive rates using the cautionary methodology described above please visit http://documents.dps.ny.gov/PTC/home.

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Contact for information regarding potential USDA incentives:

Gary Pereira, USDA Rural Development
9025 River Road
Marcy, NY 13403
Tel: (315) 736-3316 Ext. 129
gary.pereira@ny.usda.gov
http://www.rd.usda.gov/ny

ENERGY COST REDUCTION OPPORTUNITIES

Energy Cost Reduction Opportunities

The recommended measures and opportunities are presented on the following pages. Note that economic metrics do not include available incentives.

See Appendix B: Methodology for detailed calculations and the lighting upgrade and equipment upgrade details (i.e. proposed fixture upgrades, etc.).

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_1: Install a Geothermal Heat Pump for the Town Hall

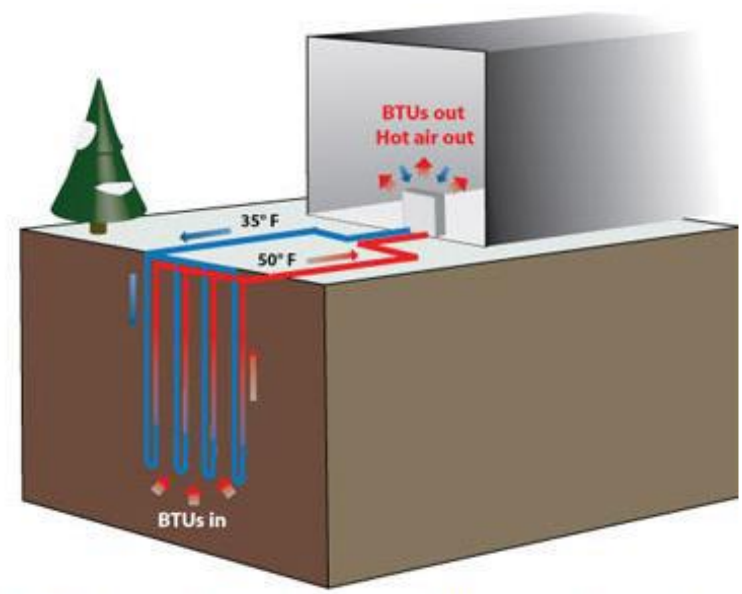
Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	-9,727	-	3,159	-	$6,438	$111,100	25	17.3 years	1.0	$1,012	5.8%	23.6%

Description

It is recommended to install a new geothermal system to provide space heating and cooling. Ground-source heat pump are also referred to as geothermal heat pumps. The technology uses an indoor heat pump unit and a heat exchanging ground loop buried underground (or underwater) to transfer thermal energy between and amongst the ground and the building. The variation in subsurface and/or groundwater temperatures remains constant across seasons—typically around 55°F, which allows ground-source heat pump systems to reach coefficients of performance of between 3 to 6. When operating in heating mode, GSHP systems transfer thermal energy from the ground (or groundwater) to the building; while when operating in cooling mode, the systems transfer thermal energy from the building to the ground (or groundwater). GSHP can provide heat to a hydronic system (aka hot water system) for the purposes of radiant heating. GSHP can have auxiliaries added to provide domestic hot water.



Vertical closed-loop system operating in heating mode.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_2: Install a Geothermal Heat Pump for the DPW Building

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	-9,974	-	-	3,329	$4,929	$138,800	25	28.2	0.6	-$52,973	3.6%	18.1%

Description

See the prior measure.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_3: Install WiFi Thermostats

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	1,531	-	714	-	$2,016	$6,600	11	3.3	2.8	$12,049	30.5%	7.4%

Description

Operation of the heating and/or cooling systems when the building is unoccupied leads to unnecessary and excess energy consumption. Especially since the highest heating loads occur overnight when the building is typically unoccupied, the energy lost during unoccupied heating is substantial.

It was noted that during unoccupied hours the space temperature setpoints can be modified for significant energy savings. During the heating season the unoccupied temperature setpoint can be set at 55°F and during the cooling season the cooling equipment can be turned off during unoccupied periods. If staff members discover that it is too cold when they arrive in the morning it is recommended that the heating system is started up earlier so that when occupants arrive the building is comfortable. See Appendices A and B for further details.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_4: Purchase a Battery-Operated Zero-Turn Mower

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	-9,612	760	-	-	$1,538	$21,000	18	13.6	1.0	$160	7.3%	5.6%

Description

The existing scenario is such that a diesel-engine zero-turn mower is currently being used at this site. Fuel engine efficiencies are low especially when the engine motor is operating at a low load. In addition, the overall efficiency is further degraded when standby idling losses are included. Electric motor efficiencies are significantly higher and there are no standby losses. Therefore, this measure involves buying a battery-operated zero-turn mower. The implementation of this measure will also reduce engine maintenance as well as improve working conditions because electric mowers have significantly less noise and zero emissions.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_5: Install a Variable Speed Drive to Control the DPW Garage Ventilation

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	2,814	-	-	-	$422	$2,380	10	5.6	1.5	$1,221	17.7%	1.6%

Description

Motors typically do not require their full capacity. There are times when full capacity may be needed, but the majority of the time they are only partially loaded. Due to electrical dynamics, motors operating at partial load waste a disproportionate amount of energy. Adjustable speed drives greatly reduce these losses by properly matching the motor speed to the required load. The drives are available for a wide range of applications and horsepower ratings. They are installed near the motor and use controls to determine the appropriate speed in order to meet the load.

For assistance, contact your local motor sales representative.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_6: Replace Select Motors with Brushless DC Motors

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	1,543	-	-	-	$231	$1,170	15	5.1	2.4	$1,593	19.8%	<1%

Description

It is recommended to replace the selected motors with new DC motors. At the end of a motor's useful life it is economically viable to replace failed standard efficiency motors with the highest efficiency motors available. The additional cost for buying the high efficiency option over a new standard motor will be paid back in a relatively short period of time. It may also be cost effective to replace standard efficiency motors that have not reached the end of their useful life with high efficiency (also referred to here as electrically commutated (EC) or brushless DC) motors. The economics depend on the current motor efficiency and the hours of operation. The more hours in which a motor operates the more cost effective it is to replace it with a motor with a higher efficiency. The efficiency of a system is defined as the amount of output received, as a percentage of what was input into the system. Therefore, the energy efficiency of brushless DC (BLDC) motors can obtain a relatively high amount of mechanical power in return for the electrical power input. Motors have power loss in the form of I-R losses. DC motors utilize permanent magnets so none of their energy needs to be used in the creation of an electromagnet as in AC motors. The energy used by AC motors to create the electromagnet decreases the efficiency of the AC motor in comparison to the DC motors. At the same time, BLDC motors are considered more energy efficient than brushed DC-motors. This means for the same input power, a BLDC motor will convert more electrical power into mechanical power than a brushed motor, mostly due to absence of friction of brushes. The enhanced efficiency is greatest in the no-load and low-load region of the motor's performance curve. A BLDC motor, for the same mechanical work output, will usually be smaller than a brushed DC motor, and always smaller than an AC induction motor. The BLDC motor is smaller because its body has less heat to dissipate. From that standpoint, BLDC motors use less raw material to build, and are better for the environment.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_7: Install a Timer on the DPW Air Compressor

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	913	-	-	-	$137	$240	12	1.8	5.7	$1,123	57.0%	<1%

Description

This measure involves installing a timer to control the operation of the DPW air compressor. The air compressors do not need to operate at night or during the day when they are not needed. The timer can be a wind-up type or a digital type, but the settings should shut the air compressor "off" after a certain number of reasonable hours, such as two hours. The implementation of this measure would have a minimal impact on maintenance practices at the facility.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_8: Replace the DPW Refrigerator with an ENERGY STAR Unit

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	705	-	-	-	$106	$770	12	7.3	1.4	$283	13.7%	<1%

Description

Refrigerator and freezer energy usage is affected by the heat gain through the freezer walls, infiltration through door seals, the efficiency of the evaporator fan motors and lighting, and by operational inefficiencies due to dirty heat exchangers.

Modern ENERGY STAR rated refrigerators and freezers include increased insulation levels, improved controls, and improved fan, lighting and coil technologies to minimize the energy loss and consumption. According to the Environmental Protection Agency (EPA) ENERGY STAR rated refrigerators and freezers are at least 30% more efficient than standard models. It is recommended that the older refrigerators and freezers be replaced with ENERGY STAR units.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_9: Upgrade the Lighting to LED Lighting

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
8.9	14,320	-	-	-	$2,148	$12,112	15	5.6	2.1	$13,531	17.7%	7.9%

Description

LED stands for light emitting diode. LED fixtures are available in a variety of shapes and sizes to accommodate many applications. The benefits of LED are twofold. First, you are installing a light source that may last 20-30 years without maintenance. Secondly, LEDs use a fraction of the energy. LEDs are still a developing technology, so it is recommended that you install samples prior to full implementation. This will confirm that they are compatible with your particular application. Fixtures/lamps that are listed by the Design Lights Consortium or that are ENERGY STAR rated are recommended. For more details on LEDs listed by the Design Lights Consortium visit: http://www.designlights.org/solidstate.about.php.

Please see Appendix B for detailed recommendations.

ENERGY COST REDUCTION OPPORTUNITIES

ECRO_10: Install Photovoltaic Solar Cells

Summary

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $	Useful Life of Measure	Simple Payback (years)	SIR	Lifecycle Savings	Annual Return on Investment	% of annual utility costs
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $							
-	65,347	-	-	-	$8,789	$147,000	25	16.7	1.0	$6,036	6.0%	32.3%

Description

A solar PV system should be investigated for your facility. A photovoltaic cell (PV cell) is a specialized semiconductor diode that converts visible light into direct current (DC). Photovoltaic cells are an integral part of solar-electric energy systems, which are becoming increasingly important as alternative sources of utility power. There are significant incentives and tax credits available making the payback for the implementation of this measure relatively attractive, which would be available through a lease-purchase agreement. The project developer should contact solar installers to get quotes for installing solar panels. This PV evaluation uses a system size of 50 kW. This size took into consideration the overall electricity usage and the related impacts from the electricity conserving measures in this report. A correctly sized PV system should produce roughly 80%-90% of the electricity needs of the site and should take into consideration future use changes. Annual excess electricity is bought back by the utility at a much lower rate so the PV sizing should not exceed the site’s future needs. An optimized system sizing is provided as part of the solar proposal process. Solar PV would be beneficial in terms of resiliency and sustainability as well as to the electric grid so if the Town is interested then it is strongly advised to obtain reputable proposals.

ENERGY COST REDUCTION OPPORTUNITIES

Additional Opportunities

Note that when equipment reaches the end of its useful life (i.e. any HVAC equipment, motors, etc.) the facility should consider replacing the existing equipment with premium efficiency equipment, and seek out any available improved controls. The incremental costs associated with high-efficiency equipment and improved controls are typically recovered quickly due to the resultant significant energy savings. This also includes computers, televisions, washing machines, etc.

HISTORICAL ENERGY USAGE AND COSTS

Historical Energy Usage and Costs

Table 5: Electricity Billing Data and Figure 1: Electricity Usage Profile represents the electrical energy usage for the surveyed building from Jan-21 to Dec-21; these can be found on the following page. Central Hudson provides electricity to the facility under Rate SC2. This electric rate has a component for consumption that is measured in kilowatt-hours (kWh). It is measured by multiplying the wattage of the equipment times the hours that it operates. For example, a 1,000-Watt lamp operating for 5 hours would measure 5,000 Watt-hours. Since one kilowatt is equal to 1,000 Watts, the measured consumption would be 5 kWh. Rates used in this report reflect the most current rate structure available. Table 4: Rate Structure shows the blended, annualized rate structure:

Table 4: Rate Structure

Rate Structure for SC2

Description	Summer	Winter	Average
Energy Charge	$0.1500/kWh	$0.1500/kWh	$0.1500/kWh

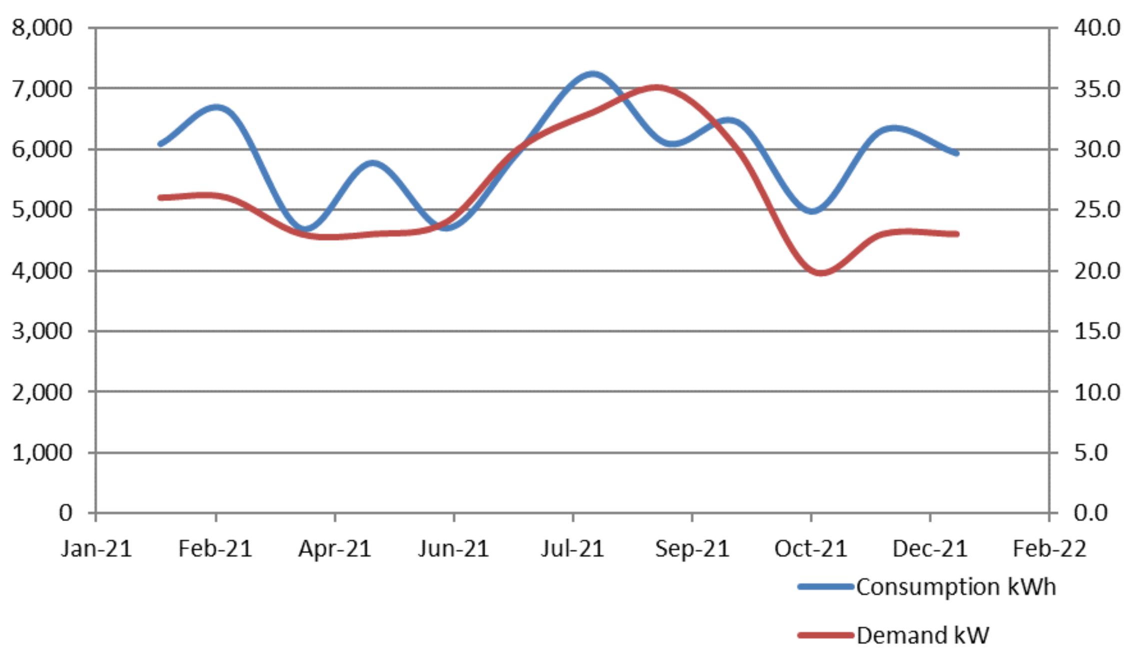
Figure 2: Electricity End Use is a pie chart reflecting the electrical end-uses and their contribution to the total electricity usage. Table 6: Electricity End Use is the electrical end-use in data format. This figure and table can be found on the following pages.

HISTORICAL ENERGY USAGE AND COSTS

Table 5: Electricity Billing Data

Summary of Annual Energy Consumption - Electricity						
Start Date	**End Date**	**Days**	**Electricity Use (kWh)**	**Electricity Peak (kW)**	**Electricity Cost ($)**	**Electricity Load Factor**
1/1/2021	1/31/2021	30	6,089	26.0	$ 913	33%
2/1/2021	2/28/2021	27	6,647	26.0	$ 997	39%
3/1/2021	3/31/2021	30	4,687	23.0	$ 703	28%
4/1/2021	4/30/2021	29	5,776	23.0	$ 866	36%
5/1/2021	5/31/2021	30	4,690	24.0	$ 704	27%
6/1/2021	6/30/2021	29	5,949	30.0	$ 892	28%
7/1/2021	7/31/2021	30	7,253	33.0	$ 1,088	31%
8/1/2021	8/31/2021	30	6,102	35.0	$ 915	24%
9/1/2021	9/30/2021	29	6,454	30.0	$ 968	31%
10/1/2021	10/31/2021	30	4,970	20.0	$ 746	35%
11/1/2021	11/30/2021	29	6,318	23.0	$ 948	39%
12/1/2021	12/31/2021	30	5,934	23.0	$ 890	36%
	Annual Total	353	70,869	35.0	$ 10,630	

Figure 1: Electricity Usage Profile

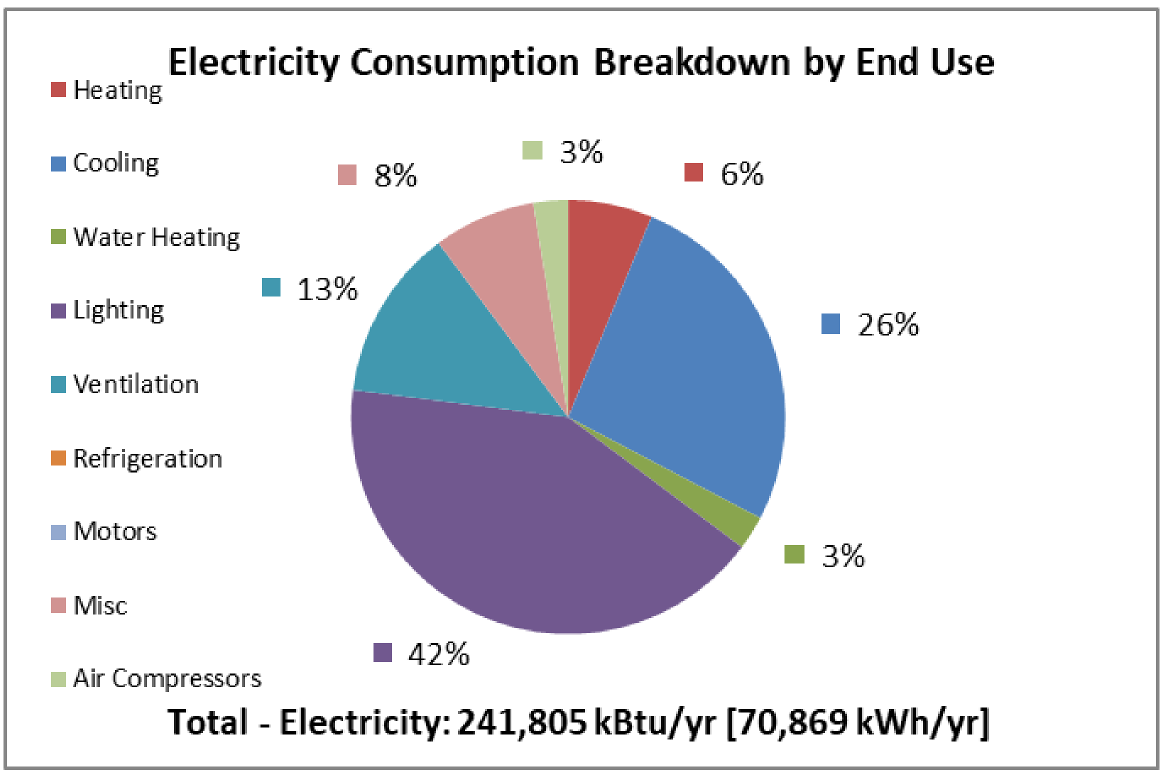


HISTORICAL ENERGY USAGE AND COSTS

Table 6: Electricity End Use

Electricity	
EndUse	**Percent of Total**
Heating	6.3%
Cooling	26.4%
Water Heating	2.5%
Lighting	41.8%
Ventilation	12.8%
Misc	7.6%
Air Compressors	2.6%

Figure 2: Electricity End Use



HISTORICAL ENERGY USAGE AND COSTS

Fuel Oil (No. 2) is provided by a local delivery company. It is delivered at various times throughout the year. An annual delivery summary is shown in the following table:

Fuel Oil (No. 2) Billing Data		
Annual Fuel Oil (No. 2) Delivery Total	**Total Annual Fuel Oil (No. 2) Cost**	**Average Fuel Oil (No. 2) Cost**
3,159.0 gal	$7,898	$2.50 /unit

Propane is provided by a local delivery company. It is delivered at various times throughout the year. An annual delivery summary is shown in the following table:

Propane Billing Data		
Annual Propane Delivery Total	**Total Annual Propane Cost**	**Average Propane Cost**
3,329.0 gal	$6,425	$1.93 /unit

Diesel is provided by a local delivery company. It is delivered at various times throughout the year. An estimated annual delivery summary for the high use zero turn mower is shown in the following table:

Diesel Billing Data		
Annual Diesel Delivery Total	**Total Annual Diesel Cost**	**Average Diesel Cost**
760.0 gal	$2,280	$3.00 /unit

APPENDICES

APPENDIX DATA

Appendix A: Equipment Inventory

Appendix B: Methodology

Appendix C: Glossary of Terms

APPENDIX A: EQUIPMENT INVENTORY

Appendix A: Equipment Inventory

General

Facility Name:	Town of Stanfordville
Building Location:	26 Town Hall Rd, Stanfordville, NY, 12581
Total Square Footage:	36,787
Farm Size:	0
Farm Type:	Government Office

Building Construction							
Construction Description	**Age (yrs)**	**Wall Type**	**Wall Insulation**	**Roof Type**	**Roof Insulation**	**Window Type**	**Number of Stories**
Town Hall	12	Wood	Fiberglass	Sloped Asphalt Shingles	Fiberglass	Double Pane	1
DPW	7	Block	Foam Board	Sloped Metal	Fiberglass	Double Pane	1

The existing heating and cooling load requirements were estimated for each zone in the building using a thermal module. The thermal module accounts for temperature setpoint and occupancy schedules, internal gains, solar gains, building envelope characteristics, and infiltration rates and is based on a modified ASHRAE bin analysis. To ensure the accuracy of the model components are adjusted based on site specific conditions and the model is balanced such that the results match the actual utility data. Below are the model inputs and temperature setpoint schedules and an explanation of variables.

Input	Units	Explanation	Typical Range
Heating system efficiency	**-**	**The system efficiency of the heating system.**	0 - 1
Cooling system efficiency (COP)	**COP**	**The system efficiency of the coolingsystem.**	0 - 8.8
Building gross square footage	**sf**	**The gross square footage of the zone.**	N/A
Number of stories	**-**	**The number of stories associated with the zone.**	N/A
A	**ft^2**	**The surface area of the zone.**	N/A
U	**Btu/ft^2-°F-hr**	**The overall heat transfer coefficient for the zone.**	0.2 - 0.02
UA	**Btu/°F-hr**	**= U*A**	N/A
CFM_{occ}	**cfm**	**The infiltration rate of the zone during occupied periods.**	N/A
CFM_{unocc}	**cfm**	**The infiltration rate of the zone during unoccupied periods.**	N/A
Solar gains	**Btu/hr**	**The heat gain from the sun's radiation during daylight hours.**	35-525/btu/ft^2/day
Occupant gains (people)	**Btu/hr**	**The heat gain due to the body heat of occupants.**	330 Btu/hr/person
Lighting gains	**Btu/hr**	**The heat gain due to lighting.**	0.1 - 2.0 W/sf
Equipment gain occupied	**Btu/hr**	**The heat gain due to equipment in the zone during occupied periods.**	0.05 - 0.65 W/sf
Equipment gains unoccupied	**Btu/hr**	**The heat gain due to equipment in the zone during unoccupied periods.**	0.05 - 0.2 W/sf
Sensible heat ratio	**-**	**SHR accounts for the latent cooling load**	0.6 - 0.9
Total occupied gains	**Btu/hr**	**The sum of above gain during occupied periods.**	N/A
Total unoccupied gains	**Btu/hr**	**The sum of above gain during unoccupied periods.**	N/A

APPENDIX A: EQUIPMENT INVENTORY

Occupancy and temperature schedules by zone and model input parameters:

Zone - 1

Occupancy Schedules and Setpoints - Zone - Town Hall - Square Footage = 10,803							
Season: Winter Schedule	Winter Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	9:00	17:00	5	70	65	72	74
1 Proposed	9:00	17:00	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							
Season: Summer Schedule	Summer Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	9:00	17:00	5	70	65	72	74
1 Proposed	9:00	17:00	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							
Season: Shoulder Schedule	Shoulder Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	9:00	17:00	5	70	65	72	74
1 Proposed	9:00	17:00	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							

Heating system efficiency	68.4%
Cooling system efficiency (COP)	2
Building gross square footage	10,803
Number of stories	1
A	25,763
U	0.06
UA	1,431
CFM_{occ}	2,611
CFM_{unocc}	653
Solar gains	24,252
Occupant gains (people)	9,900
Lighting gains	19,167
Equipment gain occupied	14,744
Equipment gains unoccupied	3,686
Sensible heat ratio	0.8
Total occupied gains	43,811
Total unoccupied gains	3,686

APPENDIX A: EQUIPMENT INVENTORY

Model Outputs:			
Heating	kBtu output	existing:	297,626
Heating	kBtu input	existing:	435,444
Heating	kBtu output	proposed:	241,518
Heating	kBtu input	proposed:	353,355
Heating	kBtu output	% change:	18.9%
Heating	kBtu input	% change:	18.9%
Cooling	kBtu output	existing:	88,629
Cooling	kBtu input	existing:	44,314
Cooling	kBtu output	proposed:	79,685
Cooling	kBtu input	proposed:	39,843
Cooling	kBtu output	% change:	10.1%
Cooling	kBtu input	% change:	10.1%

APPENDIX A: EQUIPMENT INVENTORY

Zone - 2

Occupancy Schedules and Setpoints - Zone - DPW - Square Footage = 13,353							
Season: Winter Schedule	Winter Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	6:30	15:30	5	70	65	72	74
1 Proposed	6:30	15:30	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							
Season: Summer Schedule	Summer Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	6:30	15:30	5	70	65	72	74
1 Proposed	6:30	15:30	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							
Season: Shoulder Schedule	Shoulder Occupied: Use 24 Hour Time			Heating Temperatures		Cooling Temperatures	
Day Type	From:	To:	# days per week	Occupied	Unoccupied	Occupied	Unoccupied
1 Existing	6:30	15:30	5	70	65	72	74
1 Proposed	6:30	15:30	5	70	55	72	88
2 Existing			2		65		74
2 Proposed			2		55		88
3 Existing							
3 Proposed							

Heating system efficiency	80.0%
Cooling system efficiency (COP)	2.4
Building gross square footage	13,353
Number of stories	1
A	0
U	0.05
UA	0
CFM_{occ}	4,006
CFM_{unocc}	1,001
Solar gains	0
Occupant gains (people)	9,900
Lighting gains	23,691
Equipment gain occupied	9,112
Equipment gains unoccupied	4,556
Sensible heat ratio	0.8
Total occupied gains	42,704
Total unoccupied gains	4,556

APPENDIX A: EQUIPMENT INVENTORY

Model Outputs:			
Heating	kBtu output	existing:	238,963
Heating	kBtu input	existing:	298,704
Heating	kBtu output	proposed:	225,370
Heating	kBtu input	proposed:	281,713
Heating	kBtu output	% change:	5.7%
Heating	kBtu input	% change:	5.7%
Cooling	kBtu output	existing:	45,551
Cooling	kBtu input	existing:	18,979
Cooling	kBtu output	proposed:	43,749
Cooling	kBtu input	proposed:	18,229
Cooling	kBtu output	% change:	4.0%
Cooling	kBtu input	% change:	4.0%

APPENDIX A: EQUIPMENT INVENTORY

In the tables below, an asterisk indicates estimated equipment ratings due to equipment inaccessibility or a lack of legible nameplates. (MBH = thousand British Thermal Units per hour, kW = kilowatts, AHU = air handling unit, HP = horsepower.)

Heating

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Estimated Efficiency	Age, years
Town Hall Exterior Mini-Split Heat	Fujitsu/ AOU24RLB	1	24	MBH	Electricity	2.3	2008
Town Hall Exterior Mini-Split #2 Heat	Fujitsu/ AOU30RLX	1	32	MBH	Electricity	2.3	2008
Town Hall Boiler	Weil-McLain/ BL-776-SW	1	480	MBH	Fuel Oil (No. 2)	0.7	1987
DPW Boiler for Floor Radiant Heat	Elite/ EL-220N	1	220	MBH	Propane	0.9	2011
DPW Bay #2-7 Infrared Heater	Detroit Radiant Prod/ HL3-20-75P	1	60	MBH	Propane	0.8	2011
DPW Bay #2-7 Infrared Heater #2	Detroit Radiant Prod/ HL3-50-200P	5	157	MBH	Propane	0.8	2011

Ventilation

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Hours/ Wk	Estimated Load Factor	Estimated Efficiency
Town Hall Supply Fan (located in the ceiling)	First Co/ 60HBXB-HW	1	1	HP	Electricity	45	0.8	0.55
DPW Air Handler in Mech Room	Trane/ GAM5A0C	1	0.75	HP	Electricity	45	0.8	0.65
DPW Bays Ventilation	Pennbarry	1	7.5	HP	Electricity	18	0.8	0.85

Motors

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Hours/ Wk	Estimated Load Factor	Estimated Efficiency
Zero Turn Mower	Kubota/ ZD331	1	31.0	HP	Diesel	12	0.6	0.3

APPENDIX A: EQUIPMENT INVENTORY

Cooling

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Estimated Efficiency	Age, years
Town Hall Exterior Mini-Split Cool	Fujitsu/ AOU24RLB	1	2	Ton	Electricity	2.7	2008
Town Hall Exterior Mini-Split #2 Cool	Fujitsu/ AOU30RLX	1	3	Ton	Electricity	2.7	2008
Town Hall Exterior Ac Unit	Heil/ N4A360GkB200	1	3	Ton	Electricity	1.9	2008
Town Hall Exterior Ac Unit Fan	Heil/ N4A360GkB200	1	0.25	HP	Electricity	0.5	2008
Town Clerk Ac Unit	Carrier/ 253-187	1	2	Ton	Electricity	1.4	1990
Assessor Office LG AC*	No NP	1	2	Ton	Electricity	1.1	1990
Historian Office AC Unit	Comfort Aire	1	1	Ton	Electricity	1.4	2000
Old Court Room AC	GE/ AEH24DJH1	1	2	Ton	Electricity	1.9	2005
DPW Office/Shop Exterior Ac Units	Trane/ 4TTB4060E	1	5	Ton	Electricity	2.4	2011
DPW Office/Shop Exterior Ac Units #2	Trane/ 4TTB4048E	1	4	Ton	Electricity	2.4	2011

Domestic Hot Water

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Estimated Efficiency	Age, years
Town Hall DHW Heater	American/ E6N-40R	1	4.5	kW	Electricity	0.9	2018
DPW Office DHW*	No NP	1	4.5	kW	Electricity	0.9	2011

APPENDIX A: EQUIPMENT INVENTORY

Miscellaneous[1]

Description	Make/Model	Qty	Capacity	Units	Fuel Type	Hours/Wk	Estimated Load Factor	Estimated Efficiency
Town Hall Basement Dehumidifier	Aprilaire/ 1750A	1	0.88	kW	Electricity	5	0.7	0.9
Town Hall Kitchen Mini Fridge*	GE	1	0.15	Ton	Electricity	40	0.8	1.5
DPW Office Fridge	Kenmore/ 596.76063	1	0.3	Ton	Electricity	40	0.8	1.4
DPW Air Compressor	Dayton/ 3Z966 with AO Smith Motor/ 37344	1	5.0	HP	Electricity	10	0.8	0.9

[1] For refrigeration equipment the "Estimated Efficiency" is presented as the coefficient of performance.

APPENDIX A: EQUIPMENT INVENTORY

Lighting

Line Number	Building	Area	Technology	Qty.	Hr/Wk Usage
1	Town Hall	Exterior	13-Watt, LED fixtures	8	25
2	Town Hall	Exterior	34-Watt, LED fixtures	3	25
3	Town Hall	Exterior	75-Watt, incandescent lamps	1	25
4	Town Hall	Exterior	100-Watt, LED fixtures	1	25
5	Town Hall	Basement	2,4' LED fixures	16	15
6	Town Hall	Basement	2, 13-Watt, compact fluorescent, screw-in lamps	4	15
7	Town Hall	Basement	60-Watt, LED fixtures	2	15
8	Town Hall	Basement	2,4' LED fixures	5	15
9	Town Hall	Supervisor Office	2,4' LED fixures	4	15
10	Town Hall	Supervisor Office	45-Watt, LED fixtures	2	15
11	Town Hall	Hallway	45-Watt, LED fixtures	3	35
12	Town Hall	Courtroom	2,4' LED fixures	12	15
13	Town Hall	County Clerk Room	2,4' LED fixures	4	15
14	Town Hall	County Clerk Room	60-Watt, LED fixtures	2	15
15	Town Hall	Tax Collector	60-Watt, LED fixtures	1	15
16	Town Hall	Building Inspector	60-Watt, LED fixtures	4	15

APPENDIX A: EQUIPMENT INVENTORY

Line Number	Building	Area	Technology	Qty.	Hr/Wk Usage
17	Town Hall	Building Inspector	2,4' LED fixures	6	15
18	Town Hall	Men's Bathroom	2,4' LED fixures	1	15
19	Town Hall	Hallway	2,4' LED fixures	7	35
20	Town Hall	Hallway	2,4' LED fixures	2	35
21	Town Hall	Community Meeting Room	2,4' LED fixures	15	15
22	Town Hall	Town Clerk Office	2,4' LED fixures	6	15
23	Town Hall	Basement	23-Watt, compact fluorescent, screw-in lamps	2	15
24	Town Hall	Old Basement	2, 4' T8 lamps and electronic ballasts	6	15
25	Town Hall	Assessor Office	2,4' LED fixures	4	15
26	Town Hall	Historian Office	2,4' LED fixures	2	15
27	Town Hall	Kitchen	2,4' LED fixures	10	15
28	Town Hall	Girls Bathroom	2,4' LED fixures	1	15
29	Town Hall	Old Court Room	2,4' LED fixures	10	15
30	Town Hall	Exterior Pole Lights	165-Watt, LED fixtures	2	60
31	DPW	Exterior	150-Watt metal halide lamps	10	60
32	DPW	Office	2, 22-Watt T5 lamps and electronic ballasts	11	35

APPENDIX A: EQUIPMENT INVENTORY

Line Number	Building	Area	Technology	Qty.	Hr/Wk Usage
33	DPW	Mech room	3,4' T5 lamps and electronic ballasts	2	15
34	DPW	Bath	2, 22-Watt T5 lamps and electronic ballasts	2	15
35	DPW	Upstairs Offices	2, 4' T5 lamps and electronic ballasts	1	35
36	DPW	Upstairs Offices	2, 4' T8 lamps and electronic ballasts	3	35
37	DPW	Upstairs Offices	2, 4' "U" T8 lamps and electronic ballasts	2	35
38	DPW	Upstairs Offices	2,2' T8 lamps and electronic ballasts	3	35
39	DPW	Kitchen	2, 22-Watt T5 lamps and electronic ballasts	9	35
40	DPW	Hallway	2, 22-Watt T5 lamps and electronic ballasts	3	35
41	DPW	Bath	2, 22-Watt T5 lamps and electronic ballasts	2	15
42	DPW	Locker Room	2, 22-Watt T5 lamps and electronic ballasts	4	15
43	DPW	Hallway	2, 4' "U" T8 lamps and electronic ballasts	1	35
44	DPW	Bay #1	2, 4' T8 lamps and electronic ballasts	16	35
45	DPW	Bay #1	2,4' LED fixures	1	15
46	DPW	Bay #2-7	2, 4' T8 lamps and electronic ballasts	8	15
47	DPW	Bay#2-7	4, 4' T5 HO lamps and electronic ballasts	18	35
48	DPW	Side Bay	2, 4' T8 lamps and electronic ballasts	6	15

APPENDIX A: EQUIPMENT INVENTORY

Line Number	Building	Area	Technology	Qty.	Hr/Wk Usage
49	DPW	Exterior Pole Light	175-Watt metal halide lamps	1	60
50	DPW	Pole Barn	75-Watt, incandescent lamps	2	10
51	DPW	Pole Barn	2, 4' T8 lamps and electronic ballasts	8	10
52	DPW	Pole Barn	60-Watt, incandescent lamps	1	10
53	DPW	Pole Barn (observed as "on")	9.5-Watt, LED fixtures	10	10
54	DPW	Pole Barn (observed as "on")	100-Watt, incandescent lamps	1	10
55	Rec	Skate Park Exterior	150-Watt metal halide lamps	1	60
56	DPW	Sand/Salt Barn	250-Watt high pressure sodium lamps	4	10
57	DPW	Sand/Salt Barn	100-Watt, incandescent lamps	2	10
58	Rec	Pavilion	60-Watt, incandescent lamps	10	25
59	Rec	Pavilion	2,4' standard lamps and magnetic ballasts	8	25
60	Rec	Pavilion Bath and Storage	9.5-Watt, LED fixtures	5	25

APPENDIX B: METHODOLOGY

Appendix B: Energy Savings Calculations Methodologies

The first step in the energy analysis is the site survey. The auditor walks your entire site to inventory the building envelope (roof, windows, etc.), the heating, ventilation, and air conditioning equipment (HVAC), the lighting equipment, and all other significant equipment. The auditor also interviews site personnel to gain an understanding of facility operations.

The collected information is used to develop a computer-simulated building model. The model provides an end-use baseline for all of the fuels used at the facility. The baseline is used to calculate the energy savings for the recommended measures. The energy savings for the recommended measures are interactive. This provides a higher reliability for the energy savings predictions.

All algorithms, standards, processes, and methods are based on ASHRAE guidelines, FEMP best practices, industry best practices, and engineering principles. Implementation costs are based on actual cost data for similar projects, Means cost data, other available industry cost data, and local suppliers and trades.

The following formulae and variables were used to calculate the savings shown in this report:

Unit Conversions:

- kBtu to therms, divide by 100
- kBtu to kWh, divide by 3.412
- kBtu to gallons of fuel oil, divide by 138.6905
- kBtu to gallons of propane, divide by 91

APPENDIX B: METHODOLOGY

ECRO_1: Install a Geothermal Heat Pump for the Town Hall

The following equations were used to calculation energy savings:

Energy Savings = $[1-Eff_{BL}/Eff_{PR}]$ * Existing Applicable Heating Energy Usage

Proposed Energy Usage = Existing Applicable Heating Energy Usage - Energy Savings

The existing applicable heating energy usage was estimated by analyzing the utility data and disaggregated the usage for each end-use . The disaggregation method utilizes a simplified energy use model which assumes that space heating during the heating season is correlated to heating degree-days, and space cooling during the cooling season is correlated to cooling degree-days.

Energy Cost Savings =

= (Existing Applicable Heating Energy Usage/Con_{F1} * \$/$Unit_{F1}$) - (Proposed Energy Usage/Con_{F2} * \$/$Unit_{F2}$)

Where:

Con_{F1} = Existing fuel conversion factor from kBtu to fuel unit of measure

Con_{F2} = Proposed fuel conversion factor from kBtu to fuel unit of measure (if no fuel change, $Con_{F1} = Con_{F2}$)

$Unit_{F1}$ = unit of measure of existing fuel type

$Unit_{F2}$ = unit of measure of proposed fuel type ($Unit_{F2} = Unit_{F1}$ if no fuel change)

Cost Estimates are based on upon RS Means data, internal experience with similar projects, and research data.

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing all of the air conditioning.

Description of Variable	Symbol	Value	Units
The baseline efficiency	Eff_{BL}	189%	%
The proposed efficiency	Eff_{PR}	809%	%
Existing applicable energy usage	N/A	44,708	kBtu
Existing applicable energy usage	N/A	13,103	kWh
Units of the existing fueltype	$Unit_{F1}$	kWh	-
Units of the proposed fueltype	$Unit_{F2}$	kWh	-
Cost per unit of the existing fueltype	$\$/Unit_{F1}$	$0.15	$/Unit
Cost per unit of the proposed fueltype	$\$/Unit_{F2}$	$0.15	$/Unit
Proposed energy usage	-	10,427	kBtu
Conversion factor for existing fueltype	Con_{F1}	3	kBtu/Unit
Conversion factor for proposed fueltype	Con_{F2}	3	kBtu/Unit
Energy savings	-	34,281	kBtu
Energy cost savings	-	$1,507	$

	Old	New
Unit Eff:	205.0%	879.0%
Distribution Losses:	8.0%	8.0%
Standby Losses:	0.0%	0.0%
	188.6%	808.7%

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing the main boiler.

Description of Variable	Symbol	Value	Units
The baseline efficiency	Eff_{BL}	64%	%
The proposed efficiency	Eff_{PR}	414%	%
Existing applicable energy usage	N/A	438,123	kBtu
Existing applicable energy usage	N/A	3,159	gal
Units of the existing fueltype	$Unit_{F1}$	gal	-
Units of the proposed fueltype	$Unit_{F2}$	kWh	-
Cost per unit of the existing fueltype	$\$/Unit_{F1}$	$2.50	$/Unit
Cost per unit of the proposed fueltype	$\$/Unit_{F2}$	$0.15	$/Unit
Proposed energy usage	-	67,471	kBtu
Conversion factor for existing fueltype	Con_{F1}	139	kBtu/Unit
Conversion factor for proposed fueltype	Con_{F2}	3	kBtu/Unit
Energy savings	-	370,652	kBtu
Energy cost savings	-	$4,931	$

	Old	New
Combustion Eff:	77.0%	450.0%
Distribution Losses:	8.0%	8.0%
Standby Losses:	10.0%	0.0%
	63.8%	414.0%

APPENDIX B: METHODOLOGY

Measure Cost Summary

Component	Materials	Labor	Total
Geothermal heat pump, 20 Ton.	$47,760	$31,840	$79,600
Excavation and loop installation.	$18,000	$12,000	$30,000
Miscellaneous components.	$1,500	$0	$1,500

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	-9,727	-	3,159	-	$6,438	$111,100

APPENDIX B: METHODOLOGY

ECRO_2: Install a Geothermal Heat Pump for the DPW Building

The following equations were used to calculation energy savings:

Energy Savings = [1-Eff_{BL}/Eff_{PR}] * Existing Applicable Heating Energy Usage

Proposed Energy Usage = Existing Applicable Heating Energy Usage - Energy Savings

The existing applicable heating energy usage was estimated by analyzing the utility data and disaggregated the usage for each end-use . The disaggregation method utilizes a simplified energy use model which assumes that space heating during the heating season is correlated to heating degree-days, and space cooling during the cooling season is correlated to cooling degree-days.

Energy Cost Savings =

= (Existing Applicable Heating Energy Usage/Con_{F1} * \$/$Unit_{F1}$) - (Proposed Energy Usage/Con_{F2} * \$/$Unit_{F2}$)

Where:

Con_{F1} = Existing fuel conversion factor from kBtu to fuel unit of measure

Con_{F2} = Proposed fuel conversion factor from kBtu to fuel unit of measure (if no fuel change, Con_{F1} = Con_{F2})

$Unit_{F1}$ = unit of measure of existing fuel type

$Unit_{F2}$ = unit of measure of proposed fuel type ($Unit_{F2}$ = $Unit_{F1}$ if no fuel change)

Cost Estimates are based on upon RS Means data, internal experience with similar projects, and research data.

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing the air conditioning equipment.			
Description of Variable	**Symbol**	**Value**	**Units**
The baseline efficiency	Eff_{BL}	202%	%
The proposed efficiency	Eff_{PR}	809%	%
Existing applicable energy usage	N/A	19,160	kBtu
Existing applicable energy usage	N/A	5,616	kWh
Units of the existing fueltype	$Unit_{F1}$	kWh	-
Units of the proposed fueltype	$Unit_{F2}$	kWh	-
Cost per unit of the existing fueltype	$\$/Unit_{F1}$	$0.15	$/Unit
Cost per unit of the proposed fueltype	$\$/Unit_{F2}$	$0.15	$/Unit
Proposed energy usage	-	4,796	kBtu
Conversion factor for existing fueltype	Con_{F1}	3	kBtu/Unit
Conversion factor for proposed fueltype	Con_{F2}	3	kBtu/Unit
Energy savings	-	14,365	kBtu
Energy cost savings	-	$632	$

	Old	New
Unit Eff:	220.0%	879.0%
Distribution Losses:	8.0%	8.0%
Standby Losses:	0.0%	0.0%
	202.4%	808.7%

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing the propane heating equipment.

Description of Variable	Symbol	Value	Units
The baseline efficiency	Eff_{BL}	68%	%
The proposed efficiency	Eff_{PR}	428%	%
Existing applicable energy usage	N/A	302,939	kBtu
Existing applicable energy usage	N/A	3,329	gal
Units of the existing fueltype	$Unit_{F1}$	gal	-
Units of the proposed fueltype	$Unit_{F2}$	kWh	-
Cost per unit of the existing fueltype	$\$/Unit_{F1}$	$1.93	$/Unit
Cost per unit of the proposed fueltype	$\$/Unit_{F2}$	$0.15	$/Unit
Proposed energy usage	-	48,396	kBtu
Conversion factor for existing fueltype	Con_{F1}	91	kBtu/Unit
Conversion factor for proposed fueltype	Con_{F2}	3	kBtu/Unit
Energy savings	-	254,543	kBtu
Energy cost savings	-	$4,297	$

	Old	New
Combustion Eff:	79.0%	450.0%
Distribution Losses:	5.0%	5.0%
Standby Losses:	9.0%	0.0%
	68.3%	427.5%

APPENDIX B: METHODOLOGY

Measure Cost Summary

Component	Materials	Labor	Total
Geothermal heat pump, 25 Ton.	$59,700	$39,800	$99,500
Excavation and loop installation.	$22,500	$15,000	$37,500
Miscellaneous components.	$1,800	$0	$1,800

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	-9,974	-	-	3,329	$4,929	$138,800

APPENDIX B: METHODOLOGY

ECRO_3: Install WiFi Thermostats

The existing heating and cooling load requirements were estimated for each zone in the building using a thermal module. The thermal module accounts for temperature setpoint and occupancy schedules, internal gains, solar gains, building envelope characteristics, and infiltration rates and is based on a modified ASHRAE bin analysis. To ensure the accuracy of the model components are adjusted based on site specific conditions and the model is balanced such that the results match the actual utility data.

To calculate energy savings due to temperature setpoint modification all that had to be changed within the model were the temperature setpoint schedules. See the "Equipment Inventory" for existing and proposed temperature setpoint schedules.

Cost Estimates are based on the list price of thermostats and local labor rates for installation. If this measure only requires thermostat adjustment then the estimated cost is the labor required for an employee to take the time to adjust the thermostat(s).

Measure Cost Summary

Component	Materials	Labor	Total
Wi-fi thermostats	$3,000	$3,600	$6,600

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	1,531	-	714	-	$2,016	$6,600

APPENDIX B: METHODOLOGY

ECRO_4: Purchase a Battery-Operated Zero-Turn Mower

The energy savings estimate for this measure were calculated using the following methodology:

Method for Calculating Summer Peak Demand and Energy Savings:

$kBtu_{ex}$ = Qty * Cap_{ex} * LFex * DFex * (1/η_{ex}) * Hrs_{ex} * 0.746*3.412^{++}

$kBtu_{pr}$ = Qty * Cap_{pr} * LFpr * DFpr * (1/η_{pr}) * Hrs_{pr} * 0.746*3.412^{++}

ΔkBtu = $kBtu_{ex}$ - $kBtu_{pr}$

ΔkW = (Qty *Cap_{ex}* (1/η_{ex}) * DFs * CFs * 0.746^{++})-(Qty *Cap_{pr}* (1/η_{pr}) * DFs * CFs * 0.746^{++}) (If applicable)

$^{++}$Note that conversion factors vary depending upon the units of capacity

Where:

ΔkW = gross coincident demand savings

ΔkBtu = gross annual energy savings

QTY = number of units

η_{ex} = efficiency of existing equipment

η_{pr} = efficiency of proposed scenario

$Cap_{ex/pr}$ = Capacity of equipment existing/proposed

LF = load factor

DF = diversity factor

$Hrs_{ex/pr}$ = hours of operation existing/proposed

DFs = demand diversity factor

CFs = coincidence factor

0.746 = conversion factor (kW/hp)

3.412 = kWh to kBtu conversion factor

Energy cost savings = ΔkBtu * Unit/kBtu Conversion Factor * $/Unit

Demand cost savings = ΔkW * # of months applicable (If applicable)

Cost estimates are based on experience with similar concepts.

APPENDIX B: METHODOLOGY

Calculation Inputs for the Zero Turn Mower

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Existing capacity of each	Cap_{ex}	31.00	HP/Diesel
Proposed capacity of each	Cap_{pr}	31.00	HP/Diesel
Units/Fueltype	-	HP/Diesel	-
Existing efficiency	$\eta_{existing}$	0.28	-
Load factor existing/proposed	LFex/LFpr	0.6/0.6	-
Diversity factor existing/proposed	DFex/DFpr	1.0/1.0	-
Existing hours per week	Hrs_{ex}	12	Hours
Proposed hours per week	Hrs_{pr}	0	Hours
Existing energy consumption	$kBtu_{ex}$	105,421	kBtu
Demand diversity factor (DF)	DFs	0.00	-
Coincidence factor (CF)	CFs	0.00	-
Demand savings, kW	ΔkW	0.0	kW
Number of months applicable	-	0	Months
Proposed efficiency, enter as example, .81	$\eta_{proposed}$	0.28	-
Energy savings %	-	100.0%	%
Proposed energy consumption	$kBtu_{pr}$	0	kBtu
Energy Savings, kBtu =	-	105,421	kBtu

Calculation Inputs for the Zero Turn Mower (proposed)

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Existing capacity of each	Cap_{ex}	31.00	HP/Electricity
Proposed capacity of each	Cap_{pr}	31.00	HP/Electricity
Units/Fueltype	-	HP/Electricity	-
Existing efficiency	$\eta_{existing}$	0.90	-
Load factor existing/proposed	LFex/LFpr	0.6/0.6	-
Diversity factor existing/proposed	DFex/DFpr	1.0/1.0	-
Existing hours per week	Hrs_{ex}	0	Hours
Proposed hours per week	Hrs_{pr}	12	Hours
Existing energy consumption	$kBtu_{ex}$	0	kBtu
Demand diversity factor (DF)	DFs	0.00	-
Coincidence factor (CF)	CFs	0.00	-
Demand savings, kW	ΔkW	0.0	kW
Number of months applicable	-	0	Months
Proposed efficiency, enter as example, .81	$\eta_{proposed}$	0.90	-
Energy savings %	-	-	%
Proposed energy consumption	$kBtu_{pr}$	32,798	kBtu
Energy Savings, kBtu =	-	-32,798	kBtu

APPENDIX B: METHODOLOGY

Measure Cost Summary

Component	Materials	Labor	Total
Battery operated zero turn mower	$29,000	$0	$29,000
Salvage value existing zero-turn mower.	-$8,000	$0	-$8,000

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	-9,612	760	-	-	$1,538	$21,000

APPENDIX B: METHODOLOGY

ECRO_5: Install a Variable Speed Drive to Control the DPW Garage Ventilation

A bin analysis was carried-out to estimate the energy savings for this measure. Each bin includes the number of hours that the motors operate at a particular speed or load (in the case of the constant speed existing motor). The following equations were used for each bin to calculate energy savings.

Existing energy consumption, kWh = Σ {[Cap * 0.746 * (1/Eff)] * [Bin hoursex] * QTY * LF}, summed for each LF

Proposed energy consumption, kWh = Σ{[(% speed)^{X}* Cap * 0.746 * (1/Effspeed)] * [Bin hourspr] * QTY * LFpr}

Energy savings, kWh = Existing energy consumption - Proposed energy consumption

Where:

Cap = motor rated capacity, hp

Eff_{speed} = motor efficiency at speed = $Eff_{name\text{-}plate}$ * Efficiency Reduction Factor, Ref: "Electric Motor Efficiency under Variable Frequencies and Loads" by Charles M. Burt; Xianshu Piao; Franklin Gaudi; Bryan Busch; and N. F. N. Taufik.

X = affinity law exponent

QTY = quantity of affected motors

LF = the LF of the bin being analyzed

LFpr = the proposed load factor

Bin hoursex = the number of hours that the motor currently operates at speed
Bin hourspr = the proposed number of hours that the motor will operate at speed

Eff = motor efficiency

Cost estimates are based upon local labor rates.

Speed	Efficiency Reduction Factor
100%	0.97
90%	0.98
80%	1
70%	0.98
60%	0.95
50%	0.93
40%	0.9
30%	0.85
20%	0.78
10%	0.75
0%	0

APPENDIX B: METHODOLOGY

Calculation Inputs for Installing VSD(s) (DPW Bays Ventilation)

Description of Variable	Symbol	Value	Units
Quantity of motors	QTY	1	-
Capacity of each motor	Cap	7.5	-
Units of motor capacity	-	HP	-
Affinity law exponent	X	2.5	-
Motor rated efficiency	Eff	0.85	-

Hours per year: 936
Motor Efficiency: 85.0%
LF pr (if applicable): 100.0%
Motor hp: 7.5
Power law exponent: 2.5

% Speed/Load factor	Existing motor input (kW)	Proposed VSD controlled motor input (kW)	Existing hours/yr @ speed	Proposed hours/yr @ speed	Existing % of time at speed	Proposed % of time at speed	kWh existing	kWh proposed	kW Saved	Eff. at speed
100%	6.58	6.79	0	0	0.0%	0.0%	0	0	-	82.5%
90%	5.92	5.16	0	0	0.0%	0.0%	0	0	-	83.3%
80%	5.27	3.77	936	187	100.0%	20.0%	4,929	705	-	85.0%
70%	4.61	2.75	0	187	0.0%	20.0%	0	515	-	83.3%
60%	3.95	1.93	0	281	0.0%	30.0%	0	543	-	80.8%
50%	3.29	1.25	0	281	0.0%	30.0%	0	351	-	79.1%
40%	2.63	0.74	0	0	0.0%	0.0%	0	0	-	76.5%
30%	1.97	0.38	0	0	0.0%	0.0%	0	0	-	72.3%
0%	0	0.00	0	0	0.0%	0.0%	0	0	-	-
				Total:	100.0%	100.0%	4,929	2,115		

Measure Cost Summary

Component	Materials	Labor	Total
Install a 7.5 HP ventilation fan VFD.	$1,100	$1,280	$2,380

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	2,814	-	-	-	$422	$2,380

APPENDIX B: METHODOLOGY

ECRO_6: Replace Select Motors with Brushless DC Motors

The energy savings estimate for this measure is based on the methodology outlined in the manual entitled "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs".

Method for Calculating Summer Peak Demand and Energy Savings:

$\Delta kWh = Qty * .746 * Motorhp * LF * DF * (1 – \eta existing/\eta proposed) * Hours$

$\Delta kW = Qty * .746 * (1 – \eta existing/\eta proposed) * DFs * CFs$

Where:

ΔkW = gross coincident demand savings

ΔkWh = gross annual energy savings

Units = number of motors

$\eta existing$ = efficiency of base motor

$\eta proposed$ = efficiency of high-efficiency motor

Motorhp = horsepower of motor

LF = load factor

DF = diversity factor

Hours = hours of operation

DFs = demand diversity factor

CFs = coincidence factor

0.746 = conversion factor (kW/hp)

Cost estimates are based on RS Means Mechanical Cost Data and Motor Master+.

Calculation Inputs for Replacing DPW Air Handler in Mech Room

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Capacity of each	N/A	0.750	-
Units of motor capacity	N/A	HP	-
Existing efficiency	$\eta_{existing}$	0.65	-
Load factor	LF	0.80	-
Diversity factor	DF	1.00	-
Annual hours of operation	FLH	2,340	hours
Existing energy consumption, kWh	N/A	1,611	kWh
Demand diversity factor (DFs)	DFs	0.00	-
Coincidence factor (CFs)	CFs	0.00	-
Demand savings, kW	Δ_{kW}	0.0	kW
Number of months motor operates	N/A	0	months
Proposed efficiency	$\eta_{proposed}$	0.90	-

Calculation Inputs for Replacing Town Hall Exterior Ac Unit Fan

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Capacity of each	N/A	0.250	-
Units of motor capacity	N/A	HP	-
Existing efficiency	$\eta_{existing}$	0.45	-
Load factor	LF	1.00	-
Diversity factor	DF	1.00	-
Annual hours of operation	FLH	520	hours
Existing energy consumption, kWh	N/A	216	kWh
Demand diversity factor (DFs)	DFs	0.00	-
Coincidence factor (CFs)	CFs	0.00	-
Demand savings, kW	Δ_{kW}	0.0	kW
Number of months motor operates	N/A	0	months
Proposed efficiency	$\eta_{proposed}$	0.90	-

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing Town Hall Supply Fan (located in the ceiling)

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Capacity of each	N/A	1.000	-
Units of motor capacity	N/A	HP	-
Existing efficiency	$\eta_{existing}$	0.55	-
Load factor	LF	0.80	-
Diversity factor	DF	1.00	-
Annual hours of operation	FLH	2,340	hours
Existing energy consumption, kWh	N/A	2,539	kWh
Demand diversity factor (DFs)	DFs	0.00	-
Coincidence factor (CFs)	CFs	0.00	-
Demand savings, kW	Δkw	0.0	kW
Number of months motor operates	N/A	0	months
Proposed efficiency	$\eta_{proposed}$	0.90	-

Measure Cost Summary

Component	Materials	Labor	Total
BLDC motors, 1/4 HP to 1.0 HP. Qty: 3	$720	$450	$1,170

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	1,543	-	-	-	$231	$1,170

APPENDIX B: METHODOLOGY

ECRO_7: Install a Timer on the DPW Air Compressor

The energy savings estimate for this measure were calculated using the following methodology:

Method for Calculating Summer Peak Demand and Energy Savings:

$kWh_{ex} = Qty * Cap_{ex} * LFex * DFex * (1/\eta_{ex}) * Hrs_{ex} * 0.746^{++}$

$kWh_{pr} = Qty * Cap_{pr} * LFpr * DFpr * (1/\eta_{pr}) * Hrs_{pr} * 0.746^{++}$

$\Delta kWh = kWh_{ex} - kWh_{pr}$

$\Delta kW = (Qty * Cap_{ex} * (1/\eta_{ex}) * DFs * CFs * 0.746^{++}) - (Qty * Cap_{pr} * (1/\eta_{pr}) * DFs * CFs * 0.746^{++})$

$^{++}$Note that conversion factors vary depending upon the units of capacity

Where:

ΔkW = gross coincident demand savings

ΔkWh = gross annual energy savings

QTY = number of units

η_{ex} = efficiency of existing equipment

η_{pr} = efficiency of proposed scenario

$Cap_{ex/pr}$ = Capacity of equipment existing/proposed

LF = load factor

DF = diversity factor

$Hrs_{ex/pr}$ = hours of operation existing/proposed

DFs = demand diversity factor

CFs = coincidence factor

0.746 = conversion factor (kW/hp)

Energy cost savings = ΔkWh * $/kWh

Demand cost savings = ΔkW * # of months applicable

Cost estimates are based on experience with similar concepts.

APPENDIX B: METHODOLOGY

Calculation Inputs for the DPW Air Compressor

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Existing capacity of each	Cap_{ex}	5.00	HP
Proposed capacity of each	Cap_{pr}	5.00	HP
Units	-	HP	-
Existing efficiency	$\eta_{existing}$	0.85	-
Load factor existing/proposed	LFex/LFpr	0.8/0.8	-
Diversity factor existing/proposed	DFex/DFpr	1.0/1.0	-
Existing hours per week	Hrs_{ex}	10	Hours
Proposed hours per week	Hrs_{pr}	5	Hours
Existing energy consumption, kWh	kWh_{ex}	1,826	kWh
Demand diversity factor (DF)	DFs	0.00	-
Coincidence factor (CF)	CFs	0.00	-
Demand savings, kW	ΔkW	0.0	kW
Number of months applicable	-	0	Months
Proposed efficiency, enter as example, .81	$\eta_{proposed}$	0.85	-
Energy savings %	-	50.0%	%
Proposed energy consumption, kWh	kWh_{pr}	913	kWh
Energy Savings, kWh =	-	913	kWh

Measure Cost Summary

Component	Materials	Labor	Total
Wind up timer or digital timer with preset "off" time.	$144	$96	$240

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	913	-	-	-	$137	$240

APPENDIX B: METHODOLOGY

ECRO_8: Replace the DPW Refrigerator with an ENERGY STAR Unit

The energy savings estimate for this measure were calculated using the following methodology:

Method for Calculating Summer Peak Demand and Energy Savings:

$kWh_{ex} = Qty * Cap_{ex} * LF * DF * (1/\eta_{ex}) * Hrs_{ex} * 12 * (1/3.412)$

$kWh_{pr} = Qty * Cap_{pr} * LF * DF * (1/\eta_{pr}) * Hrs_{pr} * 12 * (1/3.412)$

$\Delta kWh = kWh_{ex} - kWh_{pr}$

$\Delta kW = (Qty *Cap_{ex}* (1/\eta_{ex}) * DFs * CFs * 12 * (1/3.412))-(Qty *Cap_{pr}* (1/\eta_{pr}) * DFs * CFs * 12 * (1/3.412))$

Where:

ΔkW = gross coincident demand savings

ΔkWh = gross annual energy savings

QTY = number of refrigerators

η_{ex} = efficiency of existing refrigerator

η_{pr} = efficiency of high-efficiency refrigerator

$Cap_{ex/pr}$ = Tons of refrigeration existing/proposed

LF = load factor

DF = diversity factor

$Hrs_{ex/pr}$ = hours of operation existing/proposed

DFs = demand diversity factor

CFs = coincidence factor

0.746 = conversion factor (kW/hp)

Energy cost savings = ΔkWh * $/kWh

Demand cost savings = ΔkW * # of months applicable

Cost estimates are based on the list price of commercial refrigerator equipment

APPENDIX B: METHODOLOGY

Calculation Inputs for Replacing DPW Office Fridge

Description of Variable	Symbol	Value	Units
Quantity	QTY	1	-
Existing capacity of each	Cap_{ex}	0.3	Ton
Proposed capacity of each	Cap_{pr}	0.3	Ton
Units	-	Ton	-
Existing efficiency	$\eta_{existing}$	1.40	-
Load factor	LF	0.80	-
Diversity factor	DF	1.00	-
Existing hours per week	Hrs_{ex}	40	Hours
Proposed hours per week	Hrs_{pr}	40	Hours
Existing energy consumption, kWh	kWh_{ex}	1,254	kWh
Demand diversity factor (DF)	DFs	0.00	-
Coincidence factor (CF)	CFs	0.00	-
Demand savings, kW	ΔkW	0.0	kW
Number of months applicable	-	0	Months
Proposed efficiency, enter as example, .81	$\eta_{proposed}$	3.20	-
Energy savings %	-	56.3%	%
Proposed energy consumption, kWh	kWh_{pr}	549	kWh
Energy Savings, kWh =	-	705	kWh

Measure Cost Summary

Component	Materials	Labor	Total
Purchase a new, household type, Energy Star rated unit.	$550	$220	$770

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	705	-	-	-	$106	$770

APPENDIX B: METHODOLOGY

ECRO_9: Upgrade the Lighting to LED Lighting

The following equation was used to calculate the energy savings due to upgrading the existing lighting with new more efficacious fixtures.

ΔkWh (energy savings lighting) = (kW_{base} - kW_{ee}) * Full Load Hours of Operation

ΔkW = (kWbase - kWee)

(applies if the lighting would not be operating during the peak demand period then no demand savings were included)

Heating penalty (kBtu) =

= (ΔkWh (lighting) * 3.412 * # of heating months * Interaction factor)/ (12 months * Heating efficiency)

Cooling benefit (kWh) =

= (ΔkWh (lighting) * # of cooling months * Interaction factor)/ (12 months * Cooling efficiency)

kW_{base}=total wattage of existing fixtures

kWs_{ee} =total wattage of new fixtures

Interaction factor is typically equal to one because the heat output of the lighting remains within the building envelope (IF = Interaction factor).

Cost savings, $ = (ΔkWh (lighting + cooling) * $/kWh) + (ΔkW * 12 months (unless otherwise specified) * $/kW) - (Heating penalty * $/unit)

See the following tables for inputs.

Cost estimates are based on RS Means data, internal project experience, and discussions with lighting venders and suppliers.

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	**Electricity, kWh**	**Diesel, gal**	**Fuel Oil (No. 2), gal**	**Propane, gal**	**Annual $**	
8.9	14,320	-	-	-	$2,148	$12,112

APPENDIX B: METHODOLOGY

Lighting Upgrade Cost Summary Table

Line #	Area	Existing Lighting	Action	Estimated Labor $	Estimated Materials $	Estimated Annual Total $ Savings	Payback Period (No Incentives Included)
3	Exterior	75-Watt, incandescent lamps with wall-mounted fixtures, Fixture QTY 1	replace lamps with 11W LED lamps., Fixture Qty 1	$5	$5	$12	0.8 years
6	Basement	2, 13-Watt, compact fluorescent, screw-in lamps with wall-mounted fixtures, Fixture QTY 4	install new 10-Watt, LED fixtures., Fixture Qty 4	$160	$300	$9	49.1 years
23	Basement	23-Watt, compact fluorescent, screw-in lamps with surface-mounted fixtures, Fixture QTY 2	replace lamps with 11W LED lamps., Fixture Qty 2	$10	$10	$3	6.6 years
24	Old Basement	2, 4' T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 6	replace lamps with 14-Watt LED lamps., Fixture Qty 6	$150	$120	$23	11.7 years
Total	-	-	-	$325	$435	$48	-

Lighting Upgrade Cost Summary Table

Line #	Area	Existing Lighting	Action	Estimated Labor $	Estimated Materials $	Estimated Annual Total $ Savings	Payback Period (No Incentives Included)
31	Exterior	150-Watt metal halide lamps with surface-mounted fixtures, Fixture QTY 10	install new 80-Watt, LED fixtures., Fixture Qty 10	$750	$1,100	$538	3.4 years
32	Office	2, 22-Watt T5 lamps and electronic ballasts with recessed fixtures, Fixture QTY 11	replace lamps with 9-Watt LED lamps., Fixture Qty 11	$275	$132	$78	5.2 years
33	Mech room	3,4' T5 lamps and electronic ballasts with recessed fixtures, Fixture QTY 2	replace lamps with 14-Watt LED lamps., Fixture Qty 2	$50	$60	$11	9.6 years
34	Bath	2, 22-Watt T5 lamps and electronic ballasts with recessed fixtures, Fixture QTY 2	replace lamps with 9-Watt LED lamps., Fixture Qty 2	$50	$24	$6	12.2 years
35	Upstairs Offices	2, 4' T5 lamps and electronic ballasts with recessed fixtures, Fixture QTY 1	replace lamps with 14-Watt LED lamps., Fixture Qty 1	$25	$20	$10	4.7 years
36	Upstairs Offices	2, 4' T8 lamps and electronic ballasts with recessed fixtures, Fixture QTY 3	replace lamps with 14-Watt LED lamps., Fixture Qty 3	$75	$60	$27	5.0 years
37	Upstairs Offices	2, 4' "U" T8 lamps and electronic ballasts with recessed fixtures, Fixture QTY 2	install new 30-Watt, LED fixtures., Fixture Qty 2	$90	$100	$17	11.2 years
38	Upstairs Offices	2,2' T8 lamps and electronic ballasts with recessed fixtures, Fixture QTY 3	replace lamps with 9-Watt LED lamps., Fixture Qty 3	$75	$36	$13	8.5 years
39	Kitchen	2, 22-Watt T5 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 9	replace lamps with 9-Watt LED lamps., Fixture Qty 9	$225	$108	$64	5.2 years
40	Hallway	2, 22-Watt T5 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 3	replace lamps with 9-Watt LED lamps., Fixture Qty 3	$75	$36	$21	5.2 years
41	Bath	2, 22-Watt T5 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 2	replace lamps with 9-Watt LED lamps., Fixture Qty 2	$50	$24	$6	12.2 years
42	Locker Room	2, 22-Watt T5 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 4	replace lamps with 9-Watt LED lamps., Fixture Qty 4	$100	$48	$12	12.2 years
43	Hallway	2, 4' "U" T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 1	install new 30-Watt, LED fixtures., Fixture Qty 1	$45	$50	$8	11.2 years
44	Bay #1	2, 4' T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 16	replace lamps with 14-Watt LED lamps., Fixture Qty 16	$400	$320	$144	5.0 years
46	Bay #2-7	2, 4' T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 8	replace lamps with 14-Watt LED lamps., Fixture Qty 8	$200	$160	$31	11.7 years
47	Bay#2-7	4, 4' T5 HO lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 18	install new 100-Watt, LED fixtures., Fixture Qty 18	$1,800	$2,520	$658	6.6 years
48	Side Bay	2, 4' T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 6	replace lamps with 14-Watt LED lamps., Fixture Qty 6	$150	$120	$23	11.7 years
49	Exterior Pole Light	175-Watt metal halide lamps with surface-mounted fixtures, Fixture QTY 1	install new 80-Watt, LED fixtures., Fixture Qty 1	$75	$110	$63	2.9 years
50	Pole Barn	75-Watt, incandescent lamps with wall-mounted fixtures, Fixture QTY 2	replace lamps with 11W LED lamps., Fixture Qty 2	$10	$10	$10	2.0 years
51	Pole Barn	2, 4' T8 lamps and electronic ballasts with surface-mounted fixtures, Fixture QTY 8	replace lamps with 14-Watt LED lamps., Fixture Qty 8	$200	$160	$21	17.5 years
52	Pole Barn	60-Watt, incandescent lamps with surface-mounted fixtures, Fixture QTY 1	replace lamps with 8W LED lamps., Fixture Qty 1	$5	$5	$4	2.5 years
54	Pole Barn (observed as "on")	100-Watt, incandescent lamps with surface-mounted fixtures, Fixture QTY 1	replace lamps with 13W LED lamps., Fixture Qty 1	$5	$8	$7	1.9 years
55	Skate Park Exterior	150-Watt metal halide lamps with surface-mounted fixtures, Fixture QTY 1	install new 80-Watt, LED fixtures., Fixture Qty 1	$75	$110	$54	3.4 years
56	Sand/Salt Barn	250-Watt high pressure sodium lamps with surface-mounted fixtures, Fixture QTY 4	install new 80-Watt, LED fixtures., Fixture Qty 4	$300	$440	$67	11.0 years
57	Sand/Salt Barn	100-Watt, incandescent lamps with surface-mounted fixtures, Fixture QTY 2	replace lamps with 13W LED lamps., Fixture Qty 2	$10	$16	$14	1.9 years
58	Pavilion	60-Watt, incandescent lamps with surface-mounted fixtures, Fixture QTY 10	replace lamps with 8W LED lamps., Fixture Qty 10	$50	$50	$101	1.0 years
59	Pavilion	2,4' standard lamps and magnetic ballasts with surface-mounted fixtures, Fixture QTY 8	replace lamps with 14-Watt LED lamps., Fixture Qty 8	$200	$160	$90	4.0 years
Total	-	-	-	$5,365	$5,987	$2,100	-

APPENDIX B: METHODOLOGY

LED Lighting Upgrade Calculation Inputs Summary Table

Line #	Ex. # Fix.	Ex. Hrs/wk	Ex. W/ Fixture	Pr. # Fix.	Pr. Hrs/wk	Pr. W/ Fixture	Lighting kWh Savings	Peak kW Savings	# of Mos. kW Applicable	kW $ Savings	kWh Lighting $ Savings	Estimated Labor $	Estimated Materials $	Estimated Annual Total $ Savings
3	1	25	75	1	25	11	83	0.06	-	-	$12	$5	$5	$12
6	4	15	30	4	15	10	62	0.08	-	-	$9	$160	$300	$9
23	2	15	24	2	15	11	20	0.03	-	-	$3	$10	$10	$3
24	6	15	61	6	15	28	154	0.20	-	-	$23	$150	$120	$23
Total	-	-	-	-	-	-	320	0.4	-	$0	$48	$325	$435	$48

APPENDIX B: METHODOLOGY

LED Lighting Upgrade Calculation Inputs Summary Table

Line #	Ex. # Fix.	Ex. Hrs/wk	Ex. W/ Fixture	Pr. # Fix.	Pr. Hrs/wk	Pr. W/ Fixture	Lighting kWh Savings	Peak kW Savings	# of Mos. kW Applicable	kW $ Savings	kWh Lighting $ Savings	Estimated Labor $	Estimated Materials $	Estimated Annual Total $ Savings
31	10	60	195	10	60	80	3,588	1.15	-	-	$538	$750	$1,100	$538
32	11	35	44	11	35	18	521	0.29	-	-	$78	$275	$132	$78
33	2	15	91	2	15	42	76	0.10	-	-	$11	$50	$60	$11
34	2	15	44	2	15	18	41	0.05	-	-	$6	$50	$24	$6
35	1	35	63	1	35	28	64	0.04	-	-	$10	$25	$20	$10
36	3	35	61	3	35	28	180	0.10	-	-	$27	$75	$60	$27
37	2	35	61	2	35	30	113	0.06	-	-	$17	$90	$100	$17
38	3	35	34	3	35	18	87	0.05	-	-	$13	$75	$36	$13
39	9	35	44	9	35	18	426	0.23	-	-	$64	$225	$108	$64
40	3	35	44	3	35	18	142	0.08	-	-	$21	$75	$36	$21
41	2	15	44	2	15	18	41	0.05	-	-	$6	$50	$24	$6
42	4	15	44	4	15	18	81	0.10	-	-	$12	$100	$48	$12
43	1	35	61	1	35	30	56	0.03	-	-	$8	$45	$50	$8
44	16	35	61	16	35	28	961	0.53	-	-	$144	$400	$320	$144
46	8	15	61	8	15	28	206	0.26	-	-	$31	$200	$160	$31
47	18	35	234	18	35	100	4,390	2.41	-	-	$658	$1,800	$2,520	$658
48	6	15	61	6	15	28	154	0.20	-	-	$23	$150	$120	$23
49	1	60	215	1	60	80	421	0.14	-	-	$63	$75	$110	$63
50	2	10	75	2	10	11	67	0.13	-	-	$10	$10	$10	$10
51	8	10	61	8	10	28	137	0.26	-	-	$21	$200	$160	$21
52	1	10	60	1	10	8	27	0.05	-	-	$4	$5	$5	$4
54	1	10	100	1	10	13	45	0.09	-	-	$7	$5	$8	$7
55	1	60	195	1	60	80	359	0.12	-	-	$54	$75	$110	$54
56	4	10	295	4	10	80	447	0.86	-	-	$67	$300	$440	$67
57	2	10	100	2	10	13	90	0.17	-	-	$14	$10	$16	$14
58	10	25	60	10	25	8	676	0.52	-	-	$101	$50	$50	$101
59	8	25	86	8	25	28	603	0.46	-	-	$90	$200	$160	$90
Total	-	-	-	-	-	-	14,000	8.5	-	$0	$2,100	$5,365	$5,987	$2,100

APPENDIX B: METHODOLOGY

ECRO_10: Install Photovoltaic Solar Cells

Energy savings and costs associated with this measure were estimated using NREL's PVWatts calculator tool. The National Renewable Energy Laboratory (NREL) created an online tool called "PVWatts Calculator" for estimating the performance of potential PV installations. Data from the following website was also incorporated into the analysis: https://nysolarmap.com/.

The websites provided an estimate of the annual kWh that would be produced by the solar cells, installed cost, and an estimate of the available incentives and tax credits.

It is assumed that the facility would use all of the kWh produced by the solar cells.

Cost savings = [$/kWh * Estimated annual kWh production] + [PV Capacity * DSF * $/kW]
Where:

Estimated annual kWh production is the estimated quantity of electricity that would be produced by the installation.

PV Capacity = the total kW capacity of the system

DSF = demand savings factor = the estimated percentage of the time that the PV system offsets the monthly peak demand (assumption: no demand savings).

Calculation Inputs for PV

Description of Variable	Symbol	Value	Units
PV system capacity	N/A	50.0	kW
Demand savings factor	DSF	0%	%
Estimated kWh produced	N/A	65,347	kWh

Measure Cost Summary

Component	Installed Cost	Incentives	Tax Incentives
50 kW system	$147,000	$0	$0

Summary of Measure Costs and Savings

Annual Savings						Installed Cost $
Peak kW Saved	Electricity, kWh	Diesel, gal	Fuel Oil (No. 2), gal	Propane, gal	Annual $	
-	65,347	-	-	-	$8,789	$147,000

APPENDIX B: METHODOLOGY

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

Disclaimer: The PVWatts® Model ("Model") is provided by the National Renewable Energy Laboratory ("NREL"), which is operated by the Alliance for Sustainable Energy, LLC ("Alliance") for the U.S. Department Of Energy ("DOE") and may be used for any purpose whatsoever.

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The energy output range is based on analysis of 30 years of historical weather data for nearby, and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

RESULTS

65,347 kWh/Year*

System output may range from 62,472 to 66,380 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	3.38	4,303	827
February	4.25	4,803	923
March	4.90	5,989	1,150
April	5.46	6,201	1,191
May	5.64	6,543	1,257
June	5.64	6,152	1,182
July	6.13	6,762	1,299
August	5.96	6,609	1,270
September	5.34	5,846	1,123
October	4.08	4,819	926
November	3.34	4,012	771
December	2.62	3,308	635
Annual	**4.73**	**65,347**	**$ 12,554**

Location and Station Identification

Requested Location	26 Town Hall Rd Stanfordville, NY, 12581
Weather Data Source	Lat, Lon: 41.85, -73.7 1.4 mi
Latitude	41.85° N
Longitude	73.70° W

PV System Specifications *(Residential)*

DC System Size	50 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	30°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	0.192 $/kWh

Performance Metrics

Capacity Factor	14.9%

The average electricity rate in the table above includes price escalation.

APPENDIX C: GLOSSARY OF TERMS

Appendix C: Glossary of Terms

Some terms and abbreviations used in this report are defined as follows:

AC: Air conditioning, or alternating current when used to describe smoke detectors and carbon monoxide detectors.

ACH: Air changes per hour.

AFUE: Annual Fuel Utilization Efficiency; applies to boilers and furnaces with a rated input less than 300 MBH.

AHU: air handling unit.

Btu: British thermal unit of energy.

CFL: Compact fluorescent lamp.

CFM: Cubic feet per minute.

CO: Carbon monoxide.

DHW: Domestic hot water.

DRP: Demand response program.

EC: Electronically commutated.

EUI: Energy Use Intensity; energy consumption per square foot.

HAF: Horizontal air flow.

HE: High-efficiency.

HVAC: Heating, Ventilation and Air Conditioning

kBtu: One thousand Btus.

kW: Kilowatts of electric power.

kWh: Kilowatt-hours of electric energy.

LED: Light-emitting diode.

APPENDIX C: GLOSSARY OF TERMS

Lifecycle cost: The net savings (saving minus costs) over the lifetime of a measure assuming a specific discount rate.

Lifetime: The estimated service life of an energy conservation reduction opportunities measure.

Low-e: Low-emissivity glass coating or film.

MBH: One thousand Btus per hour.

N/A: Not applicable.

NYSERDA: New York State Energy Research and Development Authority

ROI: Annual return on investment

RTU: Rooftop HVAC unit.

Simple Payback The number of years it will take for the annual energy cost savings to equal the installation cost. This is equal to the total installation cost divided by total energy cost savings.

SIR: Savings-to-Investment Ratio, equal to discounted energy cost savings over the analysis period divided by the estimated cost; discount rate is assumed to be 3.0 percent.

TC: Timeclock.

Thermal Efficiency: Ratio of boiler output to boiler input for boilers and furnaces with rated input greater than 300 MBH.

W: Watt of electric power