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Energy Efficiency Study

Town of Germantown
Germantown, NY

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For questions regarding this report or other programs offered by NYSERDA, please contact Joanna Moore at 866-697-3732 extension 3220 or by email at jml@nyserda.org.

We hope the findings of this report will assist you in making decisions about energy efficiency improvements in your facility. Thank you for your participation in this program.

NOTICE

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State of New York

Kathy Hochul, Governor

Executive Summary

Recommended Measure Summary				
Measure Name	Recommendation	Cost	Savings	Simple Payback (years)
1 - Envelope Sealing	R	$ 107,835.00	$ 8,451.15	12.8
2a - Town Hall - Insulation Replacement*	R – End of Life	$ 2,281.66	$ 76.34	30
5 - Activity Building - Occupancy Controls	R	$ 1,710.86	$ 154.95	11
6 - Garage - Install IR Heaters	R	$ 10,480.88	$ 2,919.21	3.6
7 - Garage - Install Heat Pump	RNE	$ 14,524.33	$ (204.71)	N/A
Total		**$ 136,832.73**	**$ 15,168.53**	**9.0**

**These ECMs use the incremental cost of upgrading*

Recommendation Type	Meaning
R	Recommended
R- End of Life	Recommended at End of Life
RNE	Recommended for Non-Energy Reasons

A more detailed summary of costs and energy savings for all measures can be found at the end of this report in Appendix A: Project Summary Sheet.

The purpose of this report is to identify and evaluate opportunities for energy conservation for the Town of Germantown. This report is the final product of an energy conservation study performed through the NYSERDA FlexTech Initiative.

The following is a brief description of all the Energy Conservation Measures (ECMs) identified and evaluated in this report, their estimated costs, their estimated savings, a simple payback for the measures, as well as C&S's recommendations, for more details see the Energy Conservation Measures section later in this report:

- 1 – Envelope Sealing – Green Building Solutions assesses the envelopes of the Town Hall, Highway Garage, and the Activity Buildings to locate sources of air leakage. The energy savings associated with sealing the envelopes and reductions in heating loads was determined. The report from Green Building Solutions can be found in Appendix B.

- 2a – Town Hall – Insulation Replacement – This measure investigates replacing the insulation in the roof of the Town Hall, in-kind, when the roof itself gets replaced in the near future.

- 2b – Town Hall – Insulation Replacement – This measure investigates replacing the insulation in the roof of the Town Hall, with foam board, when the roof itself gets replaced in the near future.

- 3 – Man-Sized Door Replacement – This measure investigates replacing the existing, aluminum man-sized doors with steel ones.

- 4 – Bay Door Replacement – This measure investigates replacing the bay doors in-kind.

- 5 – Activity Building - Occupancy Controls – This measure investigates the installation of occupancy controls on the HVAC systems at the Activity Building due to its sporadic usage.

- 6 – Garage – Install IR Heaters – This measure investigates the installation of infrared heaters in the storage bay of the Highway Garage.

- 7 – Garage – Install Heat Pump – This measure investigates the installation of a heat pump coil to HVAC system to provide cooling to a third of the garage, which includes the breakroom and office.

- 8 – Town Hall – Install Heat Pump – This measure investigates replacing the condenser with a heat pump coil that attaches to the furnace.

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Background

The following report is the result of multiple energy audits at the Town Hall, Kellner Activity Building, and Department of Public Works (DPW) Garage. These audits are in accordance with the NYSERDA FlexTech program. C&S Engineers Inc. is a NYSERDA approved FlexTech provider and performed many similar energy studies through the FlexTech program.

Overview

The Town of Germantown aims to advance further in the Climate Smart communities (CSC) Certification program. Part of this process involves a comprehensive energy audit of their facilities. As such, the Town wants to investigate ways to improve the energy efficiency of their Town Hall, Kellner Activity Building, and the Department of Public Works (DPW) Garage.

C&S Engineers, Inc. carried out energy audits, which estimated the costs, and potential energy savings that could be realized by implementing a number of energy conservation measures at each facility. A more detailed explanation can be found in the "Energy Conservation Measures" section below.

Facility Information

Town Hall

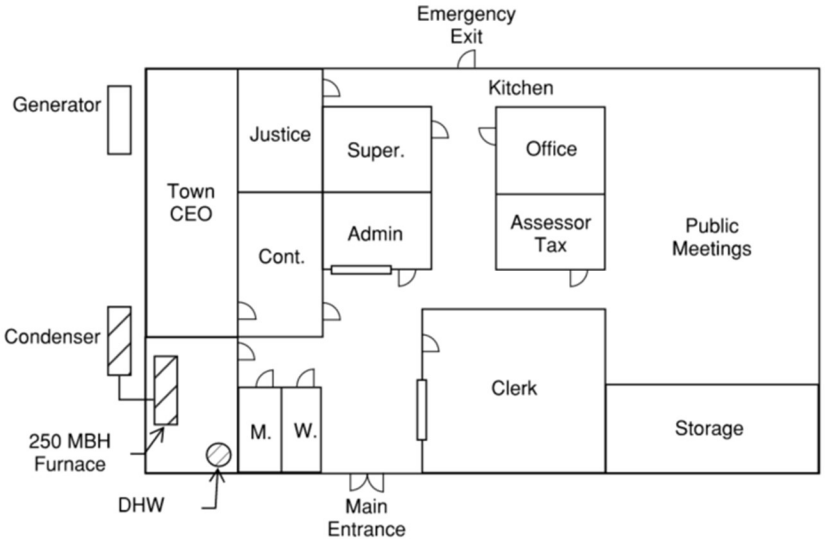


Figure 1 - Floorplan is not to scale

The Town Hall located at 50 Palatine Park Rd in Germantown, New York, was constructed in 1979 and is 3,200 square feet. The Town Hall is open and occupied Tuesday, Thursday, and Friday from 9:00a – 11:00a, Wednesday from 5:00p – 8:00p, and Saturday from 9:00a – 12:00p. It is closed on Monday and Sunday. Some staff such as the Sheriff and Town Judge will occupy the building intermittently on any day of the week. Additionally, there are town board and committee meetings that use the facility two to three times a week. The facility is heated by a 250 MBH propane-fired furnace, which supplies air through the ductwork in the plenum. A small, 4-ton split AC system also provides cooling with a DX cooling coil located in the ductwork. Approximately 1-2" gaps were purposely left below all facility doors to assist with circulation and occupant comfort, which is reportedly lacking. All the windows at the Town Hall are double paned. Below is a table listing the specifics of all the major equipment found at the Town Hall:

Equipment Type	Heating Capacity	Heating Efficiency	Cooling Capacity	Cooling Efficiency
Condenser	N/A	N/A	4 Tons	11 EER
Furnace	250 MBH	81%	N/A	N/A

Highway Garage

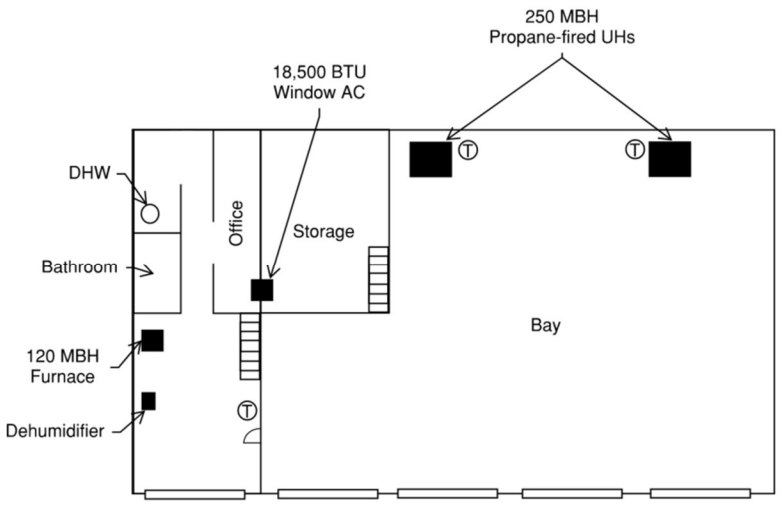


Figure 2- Floorplan is not to scale

The Department of Public Works (DPW) has a Highway Garage and Wash Bay located at 65 Palatine Park Rd in Germantown, New York. The Highway Garage is approximately 6,000 square feet and was constructed in 1979. The facility is typically occupied Monday through Friday from 7:00a – 3:30p. The garage is heated using a propane-fired furnace on one side with propane-fired unit heaters on the other. While the Wash Bay is heated using propane-fired radiant heaters. A small window AC was installed in the interior wall to provide cooling to the smaller bay, which contains the office and breakroom. All exterior windows at the Highway Garage are double paned.

Additionally, there is a 1,100 squarefoot Wash Bay on the property, which is a stand-alone building. It is heated using propane-fired radiant heaters and has no cooling system. Below is a table listing the major equipment found at the Highway Garage and Wash Bay:

Equipment Type	Heating Capacity	Heating Efficiency	Cooling Capacity	Cooling Efficiency
Furnace	120 MBH	93%	N/A	N/A
Unit Heater (x2)	250 MBH	83%	N/A	N/A
IR Heater (x3)	100 MBH	95%	N/A	N/A
AC	N/A	N/A	1.5 Tons	12 EER

**Values in red are estimates*

Activity Building

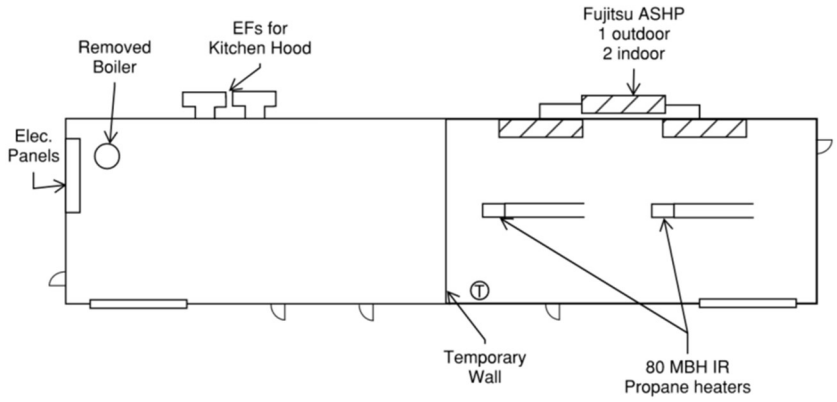


Figure 3 - Floorplan is not to scale

The Kellner Activity Building, located at 54 Palatine Park Rd in Germantown, New York, was constructed in 1984 and is 4,200 square feet. The Activity Building is occasionally occupied for community social events, and a summer camp is run from the facility June through August. There is a heat pump system that provides heating and cooling; however, the back-up propane-fired radiant heaters tend to get used for heating instead. These systems have two separate thermostats, both located in the same space. Instructions have been left for building occupants to manually adjust when they arrive and to turn off when they exit the space. All windows at the Activity Building are double paned. Below is a table listing the major equipment found at the Kellner Activity Building:

Equipment Type	Heating Capacity	Heating Efficiency	Cooling Capacity	Cooling Efficiency
Heat Pump (Outdoor)	48 MBH	3.4 COP	3.75 Tons	19.5 SEER
Heat Pump (Indoor, x2)	25.2 MBH	3.4 COP	1.8 Tons	19.5 SEER
IR Heater (x2)	80 MBH	95%	N/A	N/A

**Values in red are estimates*

Utility Analysis

The Town's electric utility services are provided by National Grid and supplied through Direct Energy Services. Below is the combined usage from January 2024 through December 2024. It should be noted that the propane usage and costs are from the reported usage totals from 2023. However, the price of propane in the Middle Hudson Region has been stable for the past several years according to NYSERDA.[1] The facilities studied had different rates for each utility as shown in the sections below.

Town Hall

Town of Germantown - Town Hall - Utility Usage Summary					
Month	Electrical Usage (kWh)	Propane Usage (Gallons)	Electric Costs (kWh)	Misc Electric Costs	Propane Costs
January	786	1,919	$113.95	$15.33	$3,625.37
February	745		$108.53	$14.34	
March	733		$107.99	$14.77	
April	693		$99.85	$15.82	
May	1,081		$151.02	$16.26	
June	1,320		$185.89	$13.56	
July	1,846		$281.93	-$3.00	
August	1,192		$182.77	$2.04	
September	820		$128.11	$5.37	
October	623		$98.28	$11.21	
November	802		$126.29	$13.82	
December	910		$141.44	$17.29	
Total	**11,551**	**1,919**	**$1,726.05**	**$136.81**	**$3,625.37**
			$1,862.86		

Utility Rates	
$ 0.16	$/kWh
$ -	$/kW
$ 1.89	$/Gal

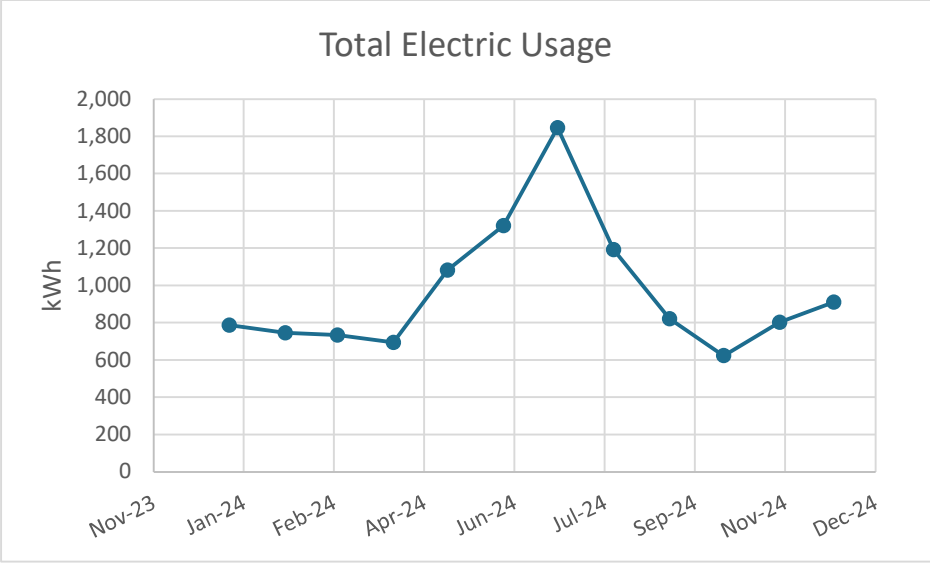
Annual Utility Costs	
Electric	$1,862.86
Propane	$3,625.37
Total	$5,488.23

The utility rates for the Town Hall included in the report were calculated to be $0.16/kWh and $1.89/gallon of propane. The site energy usage index (EUI) of the Town Hall was calculated to be 72.3 kBTU/SF. The EnergyStar median for relevant property types includes:

- 52.9 kBTU/SF for offices
- 56.1 kBTU/SF for meeting halls

The Town Hall is used primarily as an office space, but it also houses the courthouse. With an EUI of 72.3, it is higher than the expected value for an office or meeting hall.

[1] https://www.nyserda.ny.gov/Energy-Prices/Propane/Monthly-Average-Propane-Prices#Middle-Hudson-Region



The graph above shows the electrical usage of the Town Hall over the period described. Annually the facility uses approximately 11,550 kWh, which equates to roughly 1.4 metric tons (MT) of carbon dioxide emissions. The energy used per month ranges from 600 to 1,900 kWh, varying depending on the time of year. Electricity usage peaks in the warmer months, June through September, used to cool the facility and the occupants. The electric utility company does not record or charge for demand at this facility.

Highway Garage

Town of Germantown - Highway Garage - Utility Usage Summary					
Month	**Electrical Usage (kWh)**	**Propane Usage (Gallons)**	**Electric Costs (kWh)**	**Misc Electric Costs**	**Propane Costs**
January	2,020	4,436	$292.83	$13.77	$8,251.38
February	1,492		$217.30	$12.47	
March	1,339		$197.23	$13.04	
April	1,023		$147.38	$14.43	
May	852		$119.05	$15.01	
June	1,336		$188.15	$10.14	
July	2,332		$356.15	-$10.88	
August	1,224		$187.68	-$1.78	
September	650		$101.55	$8.02	
October	759		$119.73	$7.86	
November	1,223		$192.59	$3.86	
December	1,791		$278.35	$16.53	
Total	**16,041**	**4,436**	**$2,397.99**	**$102.47**	**$8,251.38**

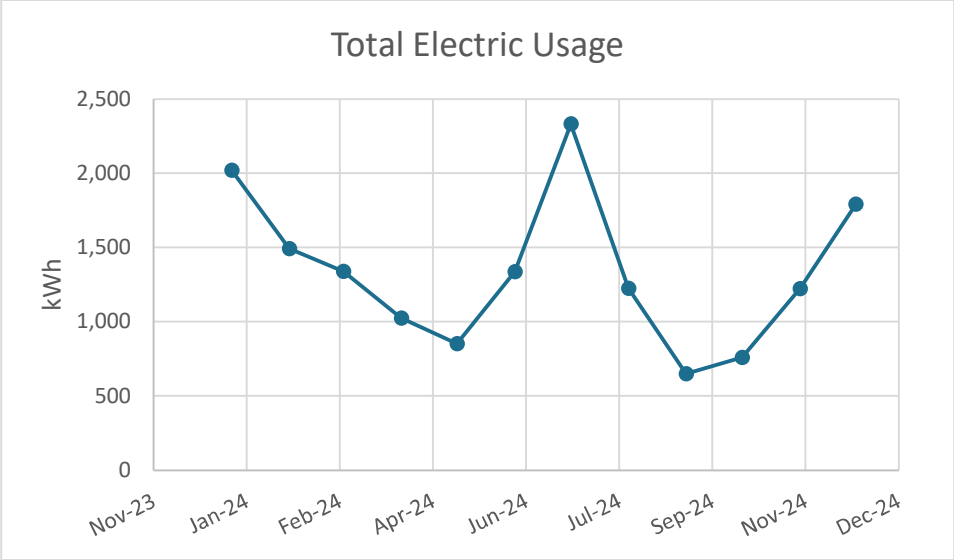
Utility Rates	
$ 0.16	$/kWh
$ -	$/kW
$ 1.86	$/Gal

Annual Utility Costs	
Electric	$2,397.99
Propane	$8,251.38
Total	$10,649.37

The utility rates for the Highway Garage included in the report were calculated to be $0.16/kWh and $1.86/gallon of propane. The site energy usage index (EUIs) of the Highway Garage was calculated to be 70.2 kBTU/SF. The EnergyStar median for relevant property types includes:

- 63.5 kBTU/SF for police stations and fire stations, which feature vehicle bays and office space

The closest equivalent for the Highway Garage is a fire station. With an EUI of 70.2, it is only slightly higher than the expected value.



The graph above shows the electrical usage for the Highway Garage over the described period. Annually the garage uses approximately 16,000 kWh, which equates to roughly 2.2 metric tons (MT) of carbon dioxide emissions. The energy used per month ranges from 650 to 2,400 kWh, varying depending on the time of year. The usage dips in the shoulder months, March through May and September through November, where heating and cooling is not necessarily needed due to the moderate temperatures outside. Additionally, there is a spike in July, which could have been caused by a bad heat wave. The electric utility company does not record or charge for demand at this facility.

Activity Building

Town of Germantown - Activity Building - Utility Usage Summary							
Month	kW	Electrical Usage (kWh)	Propane Usage (Gallons)	kWh Costs	kW Costs	Misc Electric Costs	Propane Costs
January	9.9	2,086	696	$149.74	$145.54	$52.75	$1,344.44
February	9.1	1,928		$139.99	$133.30	$52.75	
March	5.1	582		$43.74	$72.84	$52.75	
April	4.8	59		$4.33	$66.32	$52.75	
May	4.9	-331		-$17.09	$69.19	$52.75	
June	6.1	59		$3.99	$87.18	$54.32	
July	16.4	1,105		$74.14	$256.83	$54.71	
August	7.5	430		$29.06	$117.55	$48.17	
September	6.7	-77		-$4.39	$108.39	$52.75	
October	5.7	130		$8.86	$95.89	$55.10	
November	16.9	3,567		$239.98	$285.51	$52.75	
December	16.8	5,529		$367.80	$278.39	$61.43	
Total	**N/A**	**15,067**	**696**	**$1,040.15**	**$1,716.93**	**$642.98**	**$1,344.44**

Utility Rates	
$ 0.11	$/kWh
$ 15.62	$/kW
$ 1.93	$/Gal

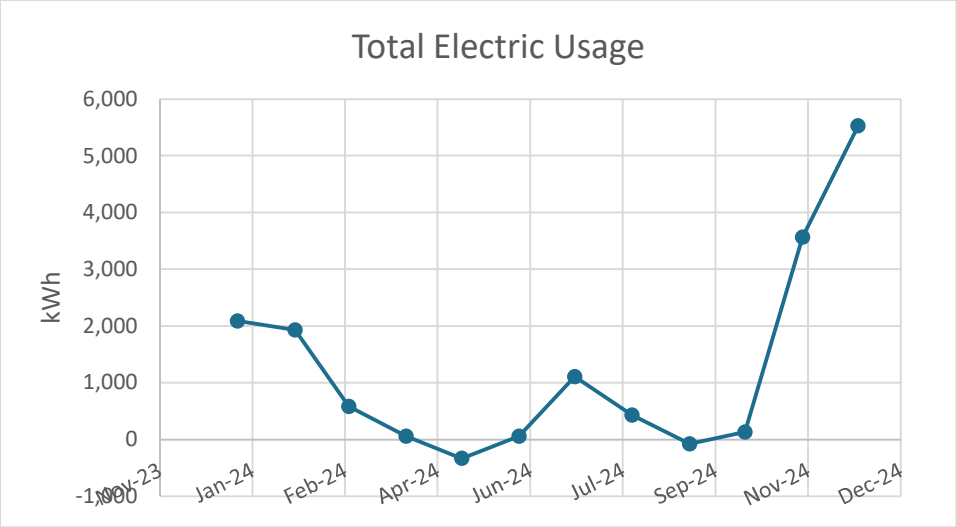
Annual Utility Costs	
Electric	$3,400.06
Propane	$1,344.44
Total	$4,744.50

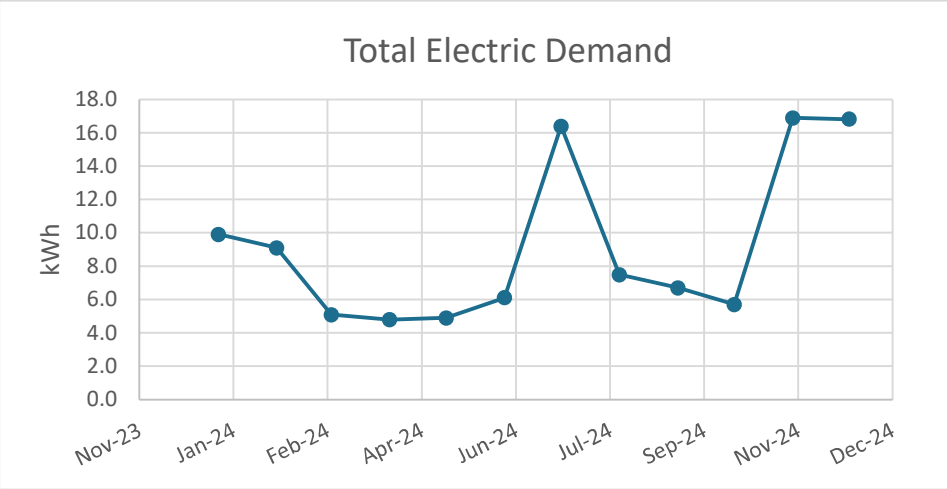
The utility rates for the Activity Building included in the report were calculated to be $0.11/kWh, $15.62/kW, and $1.93/gallon of propane. It is interesting to note that the Activity Building has a demand charge, meaning it has a $/kW in addition to paying a per kWh rate. According to National Grid's service class definitions, this means that the Activity Building used more than 2,000 kWh per month for four consecutive months. This can be seen in the usage from November through February. A demand charge is typical in medium and large commercial buildings, such as company offices or retail stores/supermarkets.

The site energy usage index (EUIs) Kellner Activity Building was calculated to be 28.8 kBTU/SF respectively. The EnergyStar median for relevant property types includes:

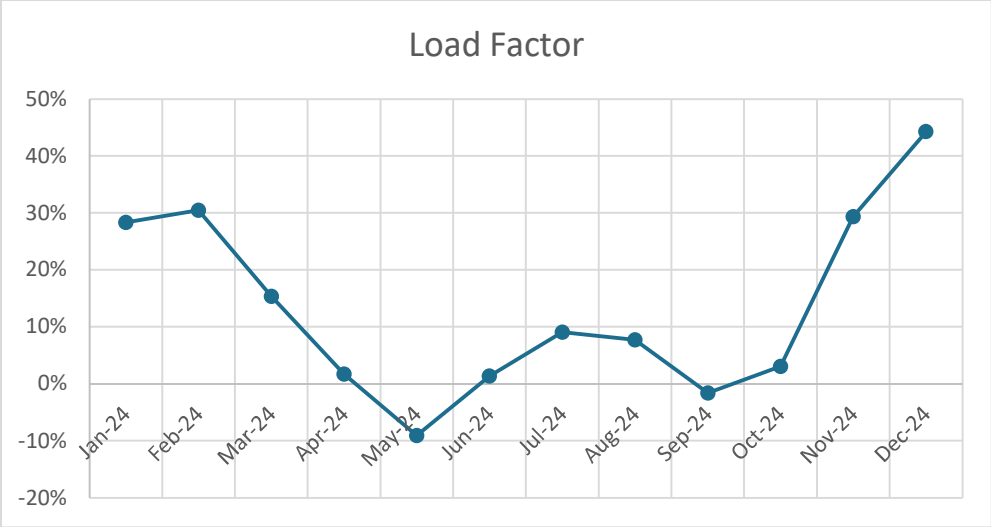
- 56.1 kBTU/SF for meeting halls

The Kellner Activity Building is primarily used as a meeting hall that has very sporadic usage. With an EUI of 28.8, it is much lower than the expected median value for a meeting hall. This is likely due in part to the sporadic usage of the building.





The graphs above show the electrical usage and demand for the Activity Building over the period described. Annually the facility uses approximately 15,100 kWh, which equates to roughly 3.2 metric tons (MT) of carbon dioxide emissions. The energy used per month ranges from -350 to 5,600 kWh, varying depending on the time of year. There is a large jump in usage in the warmer months, June through August, with a smaller spike in November. These could be due to using the heat pump for heating in the winter months and cooling in the warmer months. Additionally, the electrical usage is negative for the months of May and September. This is likely because the solar panels that the town has at the Activity Center generated more electricity than was needed to run the facility.



This third graph shows the load factor of the facility. The load factor can be described as the percentage of the total possible electric usage in a month based on peak demand. A low load factor can indicate that equipment and lighting are turned off when not in use and when areas are unoccupied; a high load factor indicates the opposite. The load factor for the Activity Center ranges from -9% to 44% and varies significantly throughout the year. This is likely partially caused by the "reduction" in electrical usage caused by using energy generated by the solar array instead of pulling from the grid.

Energy Conservation Measures

1 – Envelope Sealing

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Activity Building	308	0	56	0	$142.48	$38,440.00	269.8
Highway Garage	0	0	3,524	20	$6,563.79	$55,460.00	8.4
Town Hall	0	0	919	5	$1,744.88	$13,935.00	8.0
Total	**308**	**0**	**4,499**	**26**	**$8,451.15**	**$107,835.00**	**12.8**

This measure is recommended due to the relatively short payback period associated with it.

Background:

All three facilities were constructed around the same time, and all are pre-engineered metal buildings. Insulation, where visible, is generally in good condition. However, occupants of the buildings have complained about occasional pests like mice and pigeons in the walls and ceiling of the Highway Garage and the Town Hall. The Highway Garage in particular had oxidation from the rodents in the metal exterior siding and the interior insulation appeared to be missing or torn along parts of the wall. The rodents in the Town Hall tend to be concentrated in the attic spaces.

This measure looks at smaller repairs to the envelopes of each facility, which can go undetected for years at a time, due to their size or location, but can be a source of heat loss. These repairs can largely be done using fire rated sealants and weather stripping. In some locations thermal bridging of thermally conductive materials, such as metal, may need to be interrupted.

Evaluation:

Green Building Solutions, a subcontractor to C&S, arrived onsite to take measurements of cracks in the envelope using a drone equipped with a thermal camera. Heating loss calculations were done using the ASHRAE Crack Method, detailed in the Energy Savings Calculations section of the report attached in Appendix B.

Recommendation:

This measure is recommended due to the relatively short payback period associated with it.

Implementation Information:

Please see the attached report in Appendix B for a more complete list of areas for improvement and recommendations for repairing the envelopes. These could either be done in-house or a specialist can be hired to ensure a tightly sealed envelope.

Energy/Economic Analysis:

This analysis was done using the ASHRAE Crack Method, detailed in the Energy Savings Calculations section of the report attached in Appendix B. Findings for the Activity Center were adjusted to account for the building's unique occupancy schedule and partial air-source heat pump heating. Based on the findings from Appendix B and these adjustments, this measure would save approximately 4,499 gallons of propane and 308 kWh annually. With the variable utility rates by facility, that amounts to roughly $8,451 saved annually.

It was estimated that the measure would cost $107,835 to fully implement. The simple payback period was calculated to be 12.8 years, by taking the overall cost and dividing it by the annual savings.

Assumptions:

1. The Heating Degree Days (HDD) for the Activity Center were proportionally scaled down to 303 from 6438 to reflect the minimal usage of the facility.
2. The Therms savings calculated by Green Building Solutions for the Activity Center were split proportionally between electricity and propane based off the facility's utility usage during the heating season (November through February). 41% of the therm savings were attributed to electricity, with the remaining 59% was for propane.
3. For assumptions by GBS, see the Energy Savings Calculations section of the report attached in Appendix B.

2a – Town Hall – Insulation – Replace-in-kind

Summary:

Measure Summary									
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)	Incremental Cost	Incremented Simple Payback (years)
Town Hall	0	0	40	0.2	$76.34	$18,629.87	244	$2,281.66	30

This measure is recommended due to the relatively short incremental payback period associated with it.

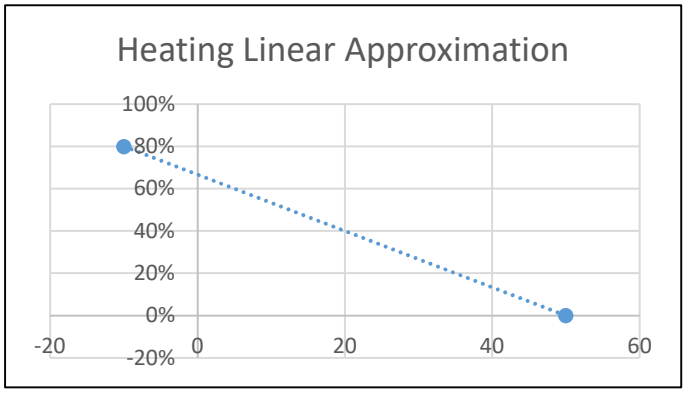
Background:

The Town Hall is working towards getting the roof replaced in the next 1-3 years. Currently, the insulation in the plenum of the building is starting to blacken, indicating air movement and lowering the effectiveness of the existing fiberglass batts. While the roof is being replaced, this measure investigates replacing the insulation with thicker fiberglass batt insulation.

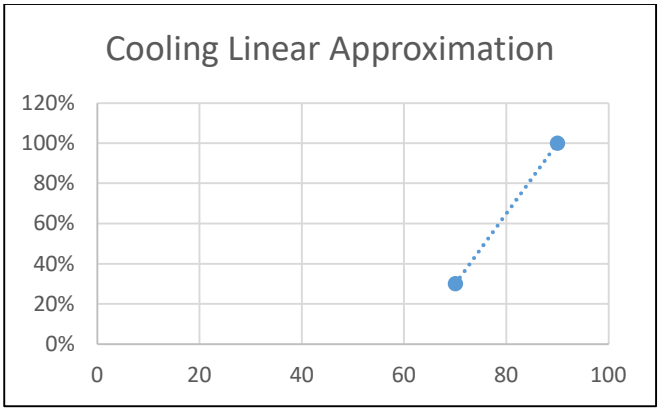
Based on photos taken from Green Building Solutions, it is estimated that the existing insulation has an R-value of 14. This measure investigates replacing the roof insulation with a material that would raise the R-value to at least 38 when the roofing is replaced in the future, to be compliant with 2020 NYS Energy Conservation Code.

Evaluation:

C&S talked to facility staff to understand how the facility was operating. C&S also used bin weather data from nearby Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoor air temperatures. This data, in combination with the provided utility data, was used to determine what percentage of the time the heating and cooling systems were running, which is estimated using the linear approximation below.



It is assumed that the heating system is on for 893 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is -10°F.



It is assumed that the cooling system is on for 761 full load cooling hours annually, with the system operating at 30% when the outdoor air temperature is 70°F and the system operating at 100% when the outdoor air temperature is 90°F.

Recommendation:

This measure is recommended due to the relatively short incremental payback period associated with it.

Implementation Information:

If this measure was to be installed, C&S would recommend engaging a professional contractor to replace the insulation while the roof of the Town Hall is getting replaced.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure.

Heating Savings:

Gal Savings = (A X HR-h X (ti - to-avg-h))/(R-e X C1 X eff-h) - (A X HR-h X (ti - to-avg-h))/(R-p X C1 X eff-h)

Where:

Symbol	Value	Units	Description
A	3,200	ft^2	Roof Area
ti	65	°F	Indoor air temperature during heating season
to-avg-h	42	°F	Average outdoor air temperature while heating is available
HR-h	893	Hours	Hours heating is available
eff-h	81%	N/A	Heating efficiency
C1	91,500	BTU/Gal	Conversion Factor
R-e	14	$°F\text{-}ft^2\text{-}hr/BTU$	R-Value of Existing Insulation
R-p	38	$°F\text{-}ft^2\text{-}hr/BTU$	R-Value of Proposed Insulation

Therefore:

Gal Savings = 40

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.89	Cost per Gal

Therefore:

Savings ($) = $76.34

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing insulation were replaced with new, higher R-valued insulation.

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	40	Gallons	Gallons of Propane Saved
Elec	0	kWh	kWh Saved
C1	0.0058	MT of CO2/Therm	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT of CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 0.2

The cost estimate for this measure is shown below.

Town Hall - Replace Insulation					
Item	Material	Labor	Quantity (SF)	Total	
Demolition	$ -	$ 2.08	3200	$	6,657.60
Installation	$ 1.56	$ 0.58	3200	$	6,842.30
Equipment Rental	$ -	$ -	1	$	-
Notes: Costs are from RSMeans Green Building Costs 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$	2,024.99
			Sub Total	$	15,524.89
			Design Cost (0%)	$	-
			Contingency (20%)	$	3,104.98
			Total	**$**	**18,629.87**

The following chart shows an incremental simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the incremental cost by the annual savings. The incremental cost is calculated using the difference in cost between replacing the insulation in-kind, 3.5 inches of R-14 insulation, with 12 inches of R-38 insulation.

Incremental Simple Payback Summary	
Incremental Cost	$2,281.66
Annual Savings	$76.34
Simple Payback (years)	30

Assumptions:

1. Existing insulation has an R-value of 14.
2. The facility system is estimated to be in heating mode 80% of the time when the outdoor air temperature is -10°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
3. The facility system is estimated to be in cooling mode 30% of the time when the outdoor air temperature is 70°F, in cooling mode 100% of the time when the outdoor air temperature is 90°F, and the percentage of cooling varies linearly between these two temperatures.

2b – Town Hall – Insulation – Replace with Foam Board

Summary:

Measure Summary									
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)	Incremental Cost	Incremented Simple Payback (years)
Town Hall	0	0	42	0.2	$78.57	$45,140.79	575	$35,972.42	458

This measure is not recommended for due to the long payback period associated with it. However, this insulation has several material qualities that may make it a more suitable alternative.

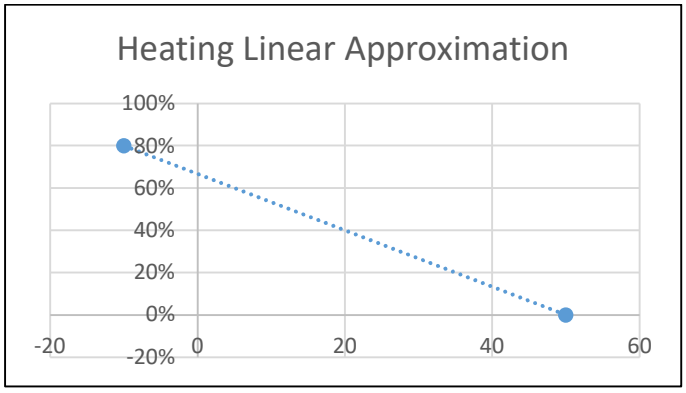
Background:

The Town Hall is working towards getting the roof replaced in the next 1-3 years. Currently, the insulation in the plenum of the building is starting to blacken, indicating air movement and lowering the effectiveness of the existing fiberglass batts. While the roof is being replaced, this measure investigates replacing the insulation with rigid foam board insulation. This type of insulation has a few advantages over fiberglass; it is not a good material for pests to nest in, is more resistant to degradation, resistant to moisture, and is not a skin irritant. However, it is a more expensive material that takes more time to install.

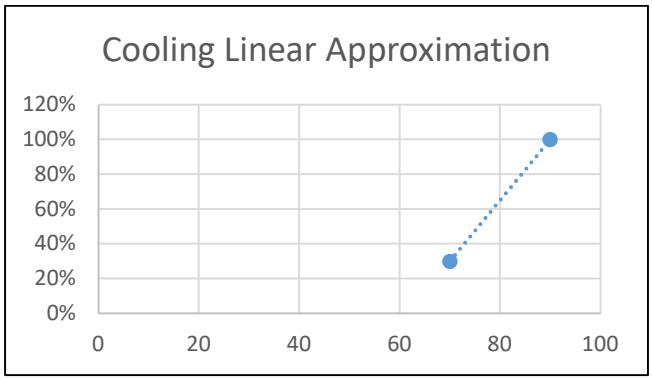
Based on photos taken from Green Building Solutions, it is estimated that the existing insulation has an R-value of 14. This measure investigates replacing the roof insulation with a material that would raise the R-value to at least 40 when the roofing is replaced in the future, to be compliant with 2020 NYS Energy Conservation Code.

Evaluation:

C&S talked to facility staff to understand how the facility was operating. C&S also used bin weather data from nearby Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoor air temperatures. This data, in combination with the provided utility data, was used to determine what percentage of the time the heating and cooling systems were running, which is estimated using the linear approximation below.



It is assumed that the heating system is on for 893 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is -10°F.



It is assumed that the cooling system is on for 761 full load cooling hours annually, with the system operating at 30% when the outdoor air temperature is 70°F and the system operating at 100% when the outdoor air temperature is 90°F.

Recommendation:

This measure is not recommended for due to the long payback period associated with it. However, this insulation has several material qualities that may make it a more suitable alternative.

Implementation Information:

If this measure was to be installed, C&S would recommend engaging a professional contractor to replace the insulation while the roof of the Town Hall is getting replaced.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure.

Heating Savings:

Gal Savings = (A X HR-h X (ti - to-avg-h))/(R-e X C1 X eff-h) - (A X HR-h X (ti - to-avg-h))/(R-p X C1 X eff-h)

Where:

Symbol	Value	Units	Description
A	3,200	ft^2	Roof Area
ti	65	°F	Indoor air temperature during heating season
to-avg-h	42	°F	Average outdoor air temperature while heating is available
HR-h	893	Hours	Hours heating is available
eff-h	81%	N/A	Heating efficiency
C1	91,500	BTU/Gal	Conversion Factor
R-e	14	°F-ft^2-hr/BTU	R-Value of Existing Insulation
R-p	40	°F-ft^2-hr/BTU	R-Value of Proposed Insulation

Therefore:

Gal Savings = 42

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.89	Cost per Gal

Therefore:

Savings ($) = $78.57

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing insulation were replaced with new, higher R-valued insulation.

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	42	Gallons	Gallons of Propane Saved
Elec	0	kWh	kWh Saved
C1	0.0058	MT of CO2/Therm	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT of CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 0.2

The cost estimate for this measure is shown below.

Town Hall - Replace Insulation				
Item	Material	Labor	Quantity (SF)	Total
Demolition	$ -	$ 2.08	3200	$ 6,657.60
Installation	$ 3.15	$ 4.99	3200	$ 26,053.12
Equipment Rental	$ -	$ -	1	$ -
Notes: Costs are from RSMeans Green Building Costs 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 4,906.61
			Sub Total	$ 37,617.33
			Design Cost (0%)	$ -
			Contingency (20%)	$ 7,523.47
			Total	**$ 45,140.79**

The following chart shows an incremental simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the incremental cost by the annual savings. The incremental cost is calculated using the difference in cost between replacing the insulation in-kind, 3.5 inches of R-14 insulation, with 10 inches of R-4 per inch (total R-40) insulation.

Incremental Simple Payback Summary	
Incremental Cost	$35,972.42
Annual Savings	$78.57
Simple Payback (years)	458

Assumptions:

1. Existing insulation has an R-value of 14.
2. The facility system is estimated to be in heating mode 80% of the time when the outdoor air temperature is -10°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
3. The facility system is estimated to be in cooling mode 30% of the time when the outdoor air temperature is 70°F, in cooling mode 100% of the time when the outdoor air temperature is 90°F, and the percentage of cooling varies linearly between these two temperatures.

3 – Man Door Replacement

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Highway Garage	0	0	14	0.08	$25.93	$3,120.19	120
Activity Building	230	0	0	0.03	$25.31	$7,800.47	308
Town Hall	0	0	7	0.04	$13.61	$1,560.09	115
Total	**230**	**0**	**21**	**0.15**	**$64.86**	**$12,480.75**	**192**

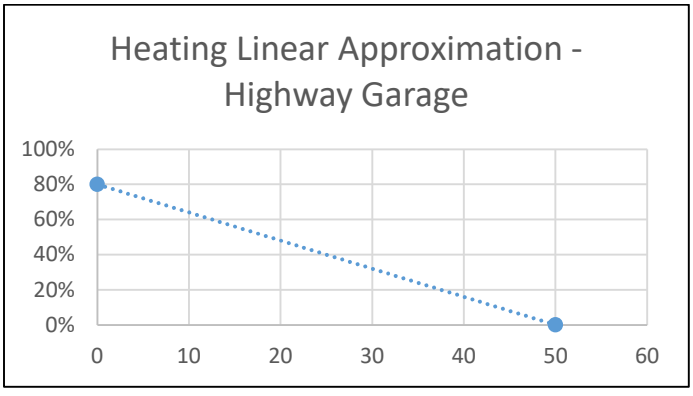
This measure is not recommended due to the large payback period associated with it.

Background:

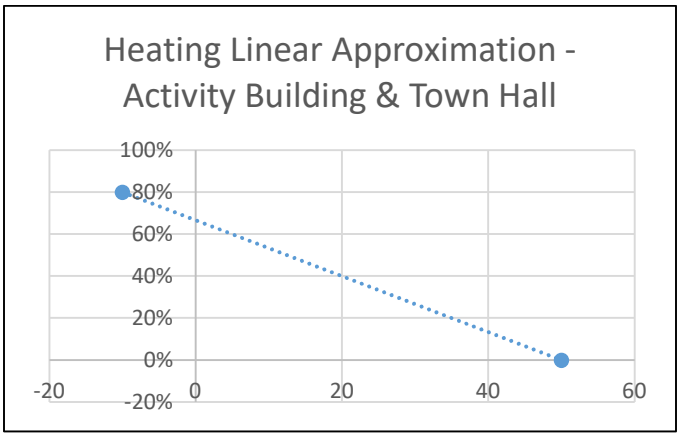
To improve the envelope, this measure investigates replacing the existing man doors with new ones across all the town facilities that are part of this study. It is assumed that the current man doors are made of aluminum and have a hollow construction. This means that the door is made of metal faces surrounding a light-weight core like polyurethane, polystyrene, or a honeycomb structure. The R-value of the existing doors were calculated to be 0.46 °F-ft2-hr/BTU. The proposed doors would have an R-value of 1.22 °F-ft2-hr/BTU. It is also assumed that the door frames would be replaced alongside the doors themselves. The proposed doors are instead made of a hollowed out, lightweight steel, for improved durability and contain an insulation paneling interior.

Evaluation:

C&S gathered information from existing architectural drawings and investigated onsite conditions. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoor air temperatures. Since each of the facilities have different levels of use, separate schedules were made by combining the typical outdoor air temperatures with the effective full load heating/cooling hours for various small commercial facilities from the New York State Technical Resource Manual (NYSTRM). This data, in combination with the provided utility data, was used to determine the percentage of time heating was utilized, which is estimated using the linear approximations below.



It is assumed that the heating system for the Highway Garage is on for 1,066 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is 0°F.



The assumed that the heating systems for the Activity Building and Town Hall are on for 893 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 67% when the outdoor air temperature is 0°F.

Recommendation:

This measure is not recommended due to the large payback period associated with it.

Implementation Information:

C&S recommends engaging a company with expertise in installing exterior metal doors to make these replacements. Alternatively, this is likely a job that can be done in-house.

Energy/Economic Analysis:

An example cost savings calculation is shown below for this measure. This calculation is for replacing the man-sized doors at the Highway Garage. A similar process was followed for the other facilities. It should be noted that the Activity Building is heated and cooled primarily using a heat pump system, so the conversion factor C1 becomes 3,412 BTU/kWh to account for the use of electricity to heat the facility instead of propane.

Gal Savings = (A X HR-h X (ti - to-avg))/(R-e X C1 X eff-h) - (A X HR-h X (ti - to-avg))/(R-p X C1 X eff-h)

Where:

Symbol	Value	Units	Description
A	40	ft^2	Window Area
ti	62.0	°F	Indoor air temperature
to-avg	42.9	°F	Average outdoor air temperature while heating is available
HR-h	1,066	Hours	Hours heating is available
eff-h	86%	N/A	Heating efficiency
C1	91,500	BTU/Gal	Conversion Factor
R-e	0.46	°F-ft^2-hr/BTU	R-Value of Existing Windows
R-p	1.22	°F-ft^2-hr/BTU	R-Value of Proposed Windows

Therefore:

Gal Savings = 14

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.86	Cost per Gal

Therefore:

Savings ($) = $25.93

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing doors were to be replaced with new doors with better thermal resistance and intact seals.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	14	Gallons	Gallons of Propane Saved
Elec	0	kWh	kWh Saved
C1	0.00575156	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 0.1

The cost estimate for replacing all 8 doors that are part of this measure is shown below.

Replace Man-Sized Doors				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 86.69	8	$ 693.50
Installation	$ 870.44	$ 173.38	8	$ 8,350.52
Equipment Rental	$ -	$ -	0	$ -
Notes: Costs are from RSMeans Green Building Costs 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 1,356.60
			Sub Total	$ 10,400.62
			Design Cost (0%)	$ -
			Contingency (20%)	$ 2,080.12
			Total	**$ 12,480.75**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$12,480.75
Annual Savings	$64.86
Simple Payback (years)	192.4

Assumptions:

1. Existing doors are made of aluminum and have a hollow core.
2. Demolition labor costs half as much as installation labor.
3. The doors in this measure are 3'0" x 6'8" (36" x 80").
4. NYSTRM Effective Full Load Heating and Cooling Hours (EFLH) of a Small Office, Small Retail, and Auto Repair facilities in Poughkeepsie were used in combination with bin weather data to estimate operational hours.
5. The Highway Garage system is estimated to be in heating mode 80% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
6. The Activity Building and Town Hall systems are estimated to be in heating mode 67% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.

4 – Bay Door Replacement

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Highway Garage	0	0	293	2	$544.62	$55,899.06	103
Activity Building	462	0	0	0	$50.79	$13,948.83	275
Total	**462**	**0**	**293**	**2**	**$595.42**	**$69,847.89**	**117**

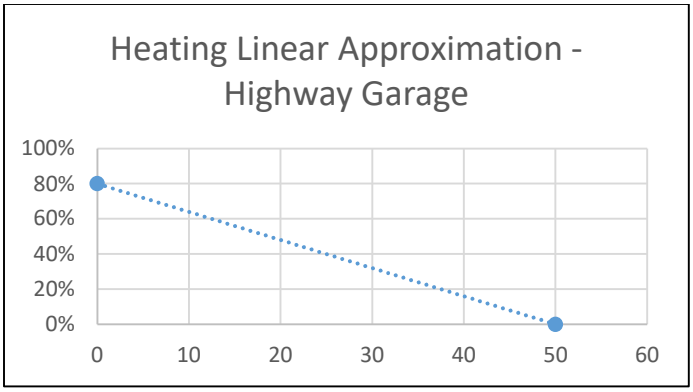
This measure is not recommended due to the substantial payback period associated with it.

Background:

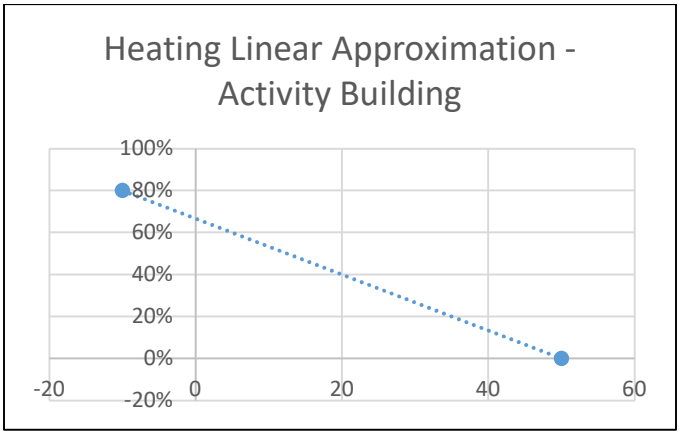
The bay doors at the Activity Building and Highway Garage have damage to the frames, seals, and doors due to age. To improve the envelope, this measure investigates replacing the existing bay doors with new ones at the Activity Building and Highway Garage. There are no bay doors at the Town Hall. It is assumed that the current bay doors are made of aluminum and have a hollow construction. This means that the door is made of metal faces surrounding a light-weight core like polyurethane, polystyrene, or a honeycomb structure. The R-value of the existing doors were calculated to be 0.46 °F-ft2-hr/BTU. The proposed doors would have an R-value of 1.22 °F-ft2-hr/BTU. It is also assumed that the door frames would be replaced alongside the doors themselves. The proposed doors are instead made of a hollowed out, lightweight steel, for improved durability and contain an insulation paneling interior.

Evaluation:

C&S gathered information from existing architectural drawings and investigated onsite conditions. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoor air temperatures. Since each of the facilities have different levels of use, separate schedules were made by combining the typical outdoor air temperatures with the effective full load heating/cooling hours for various small commercial facilities from the New York State Technical Resource Manual (NYSTRM). This data, in combination with the provided utility data, was used to determine the percentage of the time heating was available, which is estimated using the linear approximations below.



It is assumed that the heating system for the Highway Garage is on for 1,066 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is 0°F.



The assumed that the heating system for the Activity Building is on for 893 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 67% when the outdoor air temperature is 0°F.

Recommendation:

This measure is not recommended due to the substantial payback period associated with it.

Implementation Information:

C&S recommends engaging a company with expertise in installing garage doors to make these replacements.

Energy/Economic Analysis:

An example cost savings calculation is shown below for this measure. This calculation is for replacing the bay doors at the Highway Garage. A similar process was followed for the Activity Building. It should be noted that the Activity Building is heated and cooled using a heat pump system, so the conversion factor C1 becomes 3412 BTU/kWh to account for the use of electricity to heat the facility instead of propane.

Gal Savings = (A X HR-h X (ti - to-avg))/(R-e X C1 X eff-h) - (A X HR-h X (ti - to-avg))/(R-p X C1 X eff-h)

Where:

Symbol	Value	Units	Description
A	840	ft^2	Window Area
ti	62.0	°F	Indoor air temperature
to-avg	42.9	°F	Average outdoor air temperature while heating is available
HR-h	1,066	Hours	Hours heating is available
eff-h	86%	N/A	Heating efficiency
C1	91,500	BTU/Gal	Conversion Factor
R-e	0.46	°F-ft^2-hr/BTU	R-Value of Existing Windows
R-p	1.22	°F-ft^2-hr/BTU	R-Value of Proposed Windows

Therefore:

Gal Savings = 293

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.86	Cost per Gal

Therefore:

Savings ($) = $544.62

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing bay doors were to be replaced with new bay doors with better thermal resistance and intact seals.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	293	Gallons	Gallons of Propane Saved
Elec	0	kWh	kWh Saved
C1	0.00575156	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 1.7

The cost estimate for the 7 bay doors that would get replaced with this measure is shown below.

Replace Bay Doors				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 10,073.09	1	$ 10,073.09
Installation	$ 20,395.15	$ 20,146.18	1	$ 40,541.33
Equipment Rental	$ -	$ -	1	$ -
Notes: Costs are from RSMeans Square Foot Costs 2023 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 7,592.16
			Sub Total	$ 58,206.57
			Design Cost (0%)	$ -
			Contingency (20%)	$ 11,641.31
			Total	**$ 69,847.89**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$69,847.89
Annual Savings	$595.42
Simple Payback (years)	117

Assumptions:

1. Existing doors are made of aluminum and have a hollow core.
2. Demolition labor was assumed to cost half as much as labor to install the replacement doors.
3. NYSTRM Effective Full Load Heating and Cooling Hours (EFLH) of a Small Office, Small Retail, and Auto Repair facilities in Poughkeepsie were used in combination with bin weather data to estimate operational hours
4. The Garage system is estimated to be in heating mode 80% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
5. The Activity Building and Town Hall systems are estimated to be in heating mode 67% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.

5 – Activity Building – Occupancy Controls

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Activity Center	983	0	24	0.25	$154.95	$1,710.86	11.0

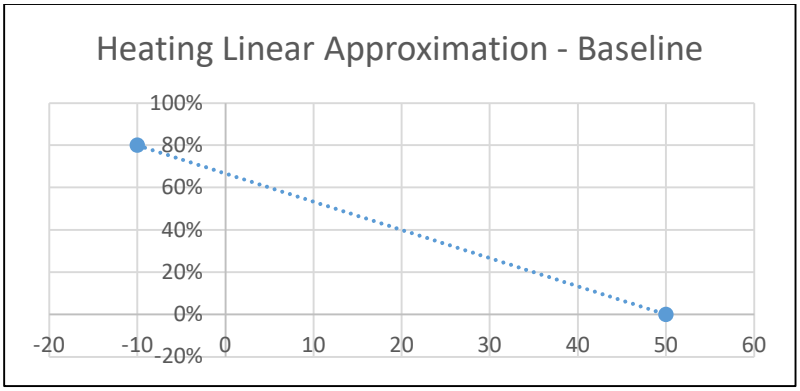
This measure is recommended due to the short payback period associated with it.

Background:

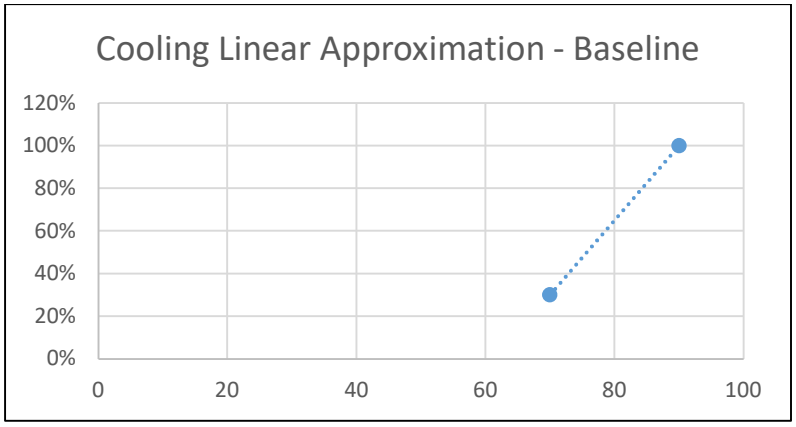
The Activity Building is used sporadically and currently has two thermostats installed. One controls the air-source heat pump, and one controls the gas-fired infrared system. Both thermostats are accessible to the public when using the space and rely on the building occupants to adjust the thermostat back before exiting the building. Reportedly, building occupants tend to prefer the infrared system for heating, as it heats them up faster and the heat pumps are generally distrusted. This measure investigates installing programable thermostats and occupancy sensors in the Activity Building to make an occupied and unoccupied schedule for building use. It is assumed that the building is used every Saturday from 12 – 7p, it is additionally used Monday through Friday from 8a – 5p during the summer for summer camp activities. Because the building is not automatically controlled, it is assumed that the building occupants leave the equipment on approximately 20% of the time when they leave the building. The Department of Public Works comes in and turns off all the units. This results in the equipment being on for, no more than, 4 hours while the building is unoccupied. The proposed schedule assumes that the building will be controlled, such that the 20% addition to the operational time can be removed. It is important that going forward the controls scheme makes sense with the final floorplan of the space. Currently the building is in the middle of renovations, so there are no interior walls.

Evaluation:

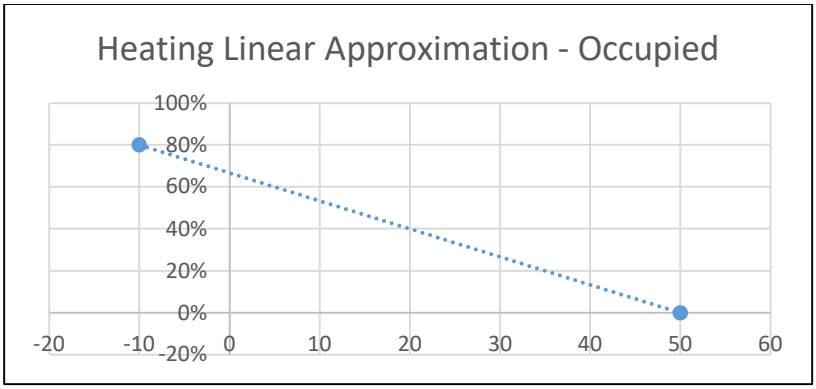
C&S gathered information from unit nameplates and talked to facility staff to understand how the HVAC systems were getting used in the building. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoors air temperatures. This data in combination with the provided utility data, was used to determine the percentage of the time the HVAC equipment was running, which are estimated using the linear approximations below.



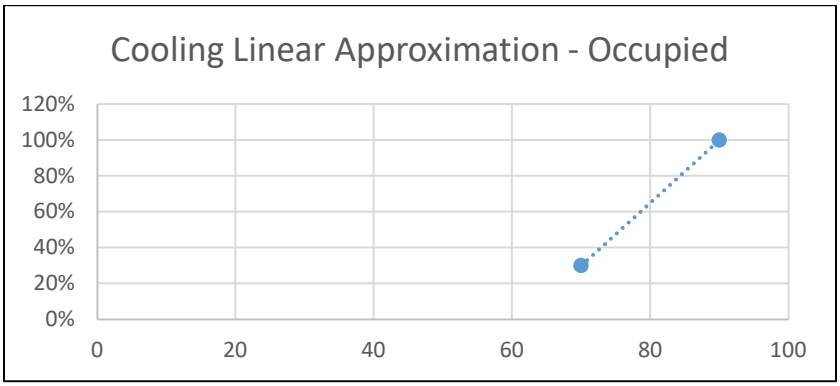
The baseline, uncontrolled schedule assumes that the heating system is on for 42 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is -10°F.



The baseline, uncontrolled schedule assumes that the cooling system is on for 335 full load heating hours annually, with the system operating at 30% when the outdoor air temperature is 70°F and the system operating at 100% when the outdoor air temperature is 90°F.



The occupied schedule assumes that the Activity Building is used every Saturday from 12 – 7p throughout the year and Monday through Friday from 8a – 5p, June through August. The occupied schedule assumes that the heating system is on for 27 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is -10°F.



The occupied schedule assumes that the Activity Building is used every Saturday from 12 – 7p throughout the year and Monday through Friday from 8a – 5p, June through August. The occupied schedule assumes that the cooling system is on for 315 full load cooling hours annually, with the system operating at 30% when the outdoor air temperature is 70°F and the system operating at 100% when the outdoor air temperature is 90°F.

Recommendation:

This measure is recommended due to the short payback period associated with it.

Implementation Information:

This measure is relatively simple to implement, so a Town employee can install and program the new thermostat. However, if the Town does not have an employee on staff that is comfortable with performing the install, then the Town should approach a qualified electrician or controls contractor for assistance.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure. It should be noted that there are two (2) evaporators that each provide 27.6 MBH of heating or 1.83 Tons of cooling in the facility. Their capacities have been combined for the purposes of calculation (55.2 MBH heating / 3.67 Ton cooling). The same has been done for the two (2) 80 MBH propane-fired radiant heaters.

Cooling Savings:

kWh Savings = Tons X Eff-c X HR-c

Where:

Symbol	Value	Units	Description
Tons	3.67	Tons	Tons of Cooling
Eff-c	18.00	SEER	Cooling Efficiency
HR-c	16	hours	Cooling Hours Reduced

Therefore:

kWh Savings = 1,043

Savings ($) = kWh Savings X $/kWh

Where:

Symbol	Value	Description
$/kWh	$0.11	Cost per kWh

Therefore:

Savings = $114.76

Fan Motor Savings:

kWh Savings = (C1 X HP-f X HR-f) / Eff-m

Where:

Symbol	Value	Units	Description
C1	0.746	kW/HP	Conversion Factor
HP-f	0.10	HP	Fan Motor Horsepower
HR-f	29	hours	Fan Runtime Reduced
Eff-m	78%	n/a	Fan Motor Efficiency

Therefore:

kWh Savings = 3

Savings ($) = kWh Savings X $/kWh

Where:

Symbol	Value	Description
$/kWh	$0.11	Cost per kWh

Therefore:

Savings = $0.30

Heating Savings:

Gal Savings = (MBH X HR-h)/(Eff-h X C1)

Where:

Symbol	Value	Units	Description
MBH	160	MBTU/h	Heating Capacity (output)
HR-h	13	Hours	Heating Hours Reduced
Eff-h	95%	n/a	Heating Efficiency
C1	92	MBTU/Gal	Conversion Factor

Therefore:

Gal Savings = 24

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
Gal	$1.93	Cost per Gal

Therefore:

Savings = $46.77

Additional Cost of Electricity:

kWh Savings = (MBH X HR X C1)/ COP

Where:

Symbol	Value	Units	Description
MBH	55.2	MBTU/h	Heating Capacity
COP	3.40	kW/kW	Coefficient of Performance
HR	13	Hours	Heating Hours
C1	0.293	kW/MBTU	Conversion Factor

Therefore:

kWh Savings = -63

Savings ($) = (kWh Savings X $/kWh)

Where:

Symbol	Value	Description
$/kWh	$0.11	Cost per kWh

Therefore:

Savings = -$6.89

Total Savings = $154.95

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing schedule were adjusted to fit the building's sporadic occupancy.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	24	Gallons	Gallons of Propane Saved
Elec	983	kWh	kWh Saved
C1	0.0057516	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 0.3

The cost estimate for this measure is shown below.

Occupancy Controls				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 100.56	2	$ 201.12
Programmable Thermostat	$ 233.35	$ 100.56	2	$ 667.82
Occupancy Sensor	$ 103.71	$ 122.75	4	$ 905.85
Notes: Costs are from RSMeans Mechanical and Electrical 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 266.22
			Sub Total	$ 2,041.00
			Design Cost (0%)	$ -
			Contingency (20%)	$ 408.20
			Total	**$ 2,449.20**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$1,710.86
Annual Savings	$154.95
Simple Payback (years)	11.0

Assumptions:

1. The heat pumps are going to be used more frequently than the IR system.
2. Demolition labor for the existing thermostats is the same as the installation of new thermostats.
3. Occupied from 12 – 7p every Saturday, year-round.
4. Occupied from 8a – 5p Monday through Friday for the months of June through August.
5. The facility system is estimated to be in heating mode 80% of the time when the outdoor air temperature is -10°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
6. The facility system is estimated to be in cooling mode 30% of the time when the outdoor air temperature is 70°F, in cooling mode 100% of the time when the outdoor air temperature is 90°F, and the percentage of cooling varies linearly between these two temperatures.

6 – Garage – Install IR Heaters

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
UH-1	0	0	785	4.5	$1,459.61	$5,240.44	3.6
UH-2	0	0	785	4.5	$1,459.61	$5,240.44	3.6
Total	**0**	**0**	**1,569**	**9.0**	**$2,919.21**	**$10,480.88**	**3.6**

This measure is recommended due to the short payback period associated with it.

Background:

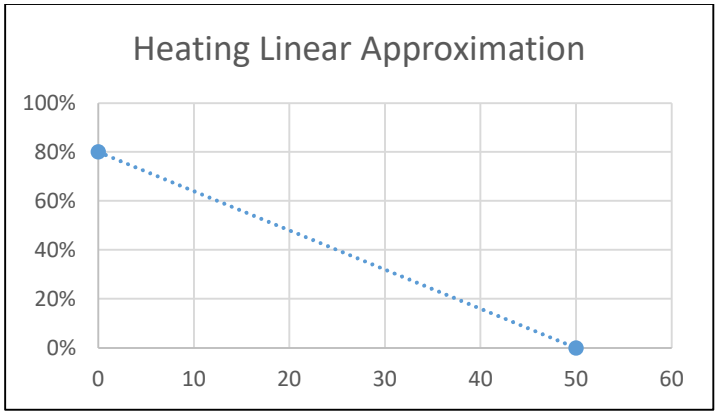
The measure investigates installing natural gas infrared heating in the DPW Garage to heat the people and objects in the garage using radiant heat transfer. This differs from forced-air heating, otherwise known as convention heat transfer, which can be more easily lost when opening garage doors as heated air leaves the building.

The vehicle storage space at the DPW Garage is currently heated by two 250 MBH propane-fired unit heaters that are 15 years old and nearing the end of their useful life. This measure investigates installing propane fired infrared heating in the DPW Garage to heat the people and objects in the garage using radiant heat transfer. This differs from forced-air heating, otherwise known as convention heat transfer, which can be more easily lost when opening garage doors as heated air leaves the building.

This will help reduce the amount of heat lost from opening and closing the bay doors, especially during the colder months. The existing unit heaters have an efficiency of 83%. This new system will have a heating efficiency of at least 95%.

Evaluation:

C&S gathered information from unit nameplates and talked to facility staff to understand how the HVAC systems were getting used in the building. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoors air temperatures. This data in combination with the provided utility data, was used to determine the percentage of the time the unit heaters were running, which is estimated using the linear approximation below.



It is assumed that the heating system is on for 1,066 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 80% when the outdoor air temperature is 0°F.

Recommendation:

This measure is recommended due to the short payback period associated with it.

Implementation Information:

If this measure was to be installed, C&S would recommend engaging an engineering firm to select appropriate units as well as provide engineering drawings and specifications for the project to go to bid. This project should be completed by a qualified mechanical contractor. It is important to ensure that the new equipment is adequately spaced from other objects on the ceiling and that the structure is capable of supporting this new system.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure.

Gallon Savings = (MBH X HR X (1 - ((HDD_55/(55 - T_Design))/(HDD_65/(65 - T_Design))))))/C1

Where:

Symbol	Value	Units	Description
MBH	250	MBTU/hr	Heating Output
HR	1066	Hours	Hours Heating Available
HDD_55	3696	Days	Heating Degree Days with a base of 55F
HDD_65	6026	Days	Heating Degree Days with a base of 65F
T_Design	2.70	°F	Design Temperature
C1	91.5	MBTU/Gal	Conversion Factor

Therefore:

Gal Savings = 785

Savings ($) = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.86	Cost per Gal

Therefore:

Savings ($) = $1,459.61

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing unit heaters were replaced with infrared heaters.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	785	Gallons	Gallons of Propane Saved
Elec	0	kWh	kWh Saved
C1	0.00575156	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 4.5

The cost estimate for this measure is shown below.

Garage - Install IR Heaters				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 99.17	2	$ 198.34
Installation	$ 2,338.15	$ 1,067.99	2	$ 6,812.28
Equipment Rental	$ -	$ -	1	$ -
Notes: Costs are from RSMeans Mechanical 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 1,051.59
			Sub Total	$ 8,062.21
			Design Cost (10%)	$ 806.22
			Contingency (20%)	$ 1,612.44
			Total	**$ 10,480.88**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$10,480.88
Annual Savings	$2,919.21
Simple Payback (years)	4

Assumptions:

1. The structure is capable of holding up the weight of the proposed system.
2. The proposed system will have adequate space from other objects to ensure that the system does not pose a fire hazard.
3. The number of heating degree days used in calculations were based on data from National Oceanic and Atmospheric Administration (NOAA).
4. The design temperatures that the system would be expected to be functional at were based on values from the 2017 ASHRAE Fundamentals Handbook.
5. The IR heaters will have an efficiency of at least 95%.
6. The Highway Garage system is estimated to be in heating mode 80% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.

7 – Garage – Install Heat Pump

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Garage	-1,554	0	24	0	-$204.71	$14,524.33	N/A

While there is not a financial reason to recommend this measure, it is recommended for occupant comfort.

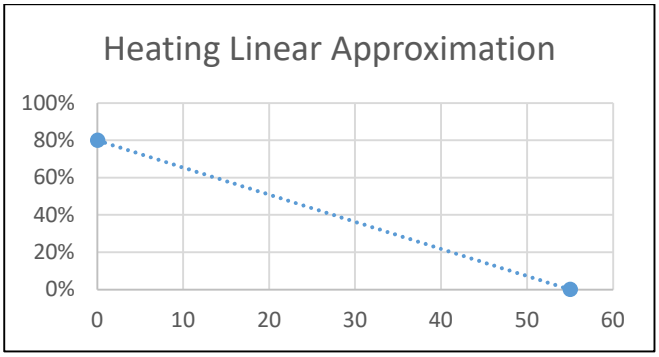
Background:

The office area of the Highway Garage is cooled by a 1.5 ton window AC. The office and break room area of the Highway Garage is approximately 1,800 square feet. There have been complaints about the heat in the facility during the summer months. The system that currently provides cooling to the office area is a 1.5 ton window AC that has an efficiency of 10 SEER. This unit is undersized for the space it is attempting to serve, placing considerable strain on the unit and reducing the comfort of building occupants. The proposed heat pump coil has a cooling capacity of 4.5 tons, which was calculated assuming 1 ton of cooling for every 400 square feet (typical for Zone 6 climates), with an efficiency of 18 SEER. Additionally, it has a heating capacity of 27 MBH with a COP of 3.

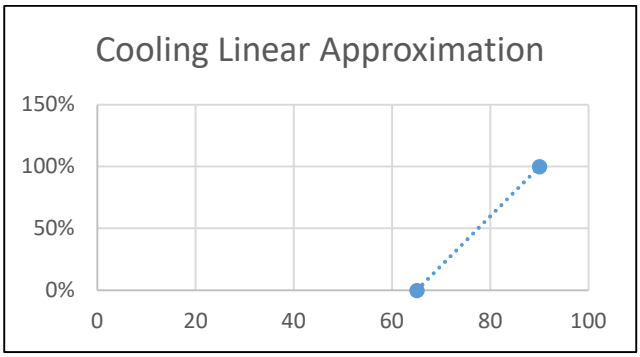
A common step towards electrification when there is an AC and a furnace working together is to replace the AC with a heat pump coil that uses the furnace for back-up heating on extremely cold days. This measure investigates the installation of a heat pump coil to provide cooling to the office and break room areas of the garage.

Evaluation:

C&S gathered information from unit nameplates and talked to facility staff to understand how the HVAC systems were getting used in the building. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoor air temperatures. This data in combination with the provided utility data, was used to determine the percentage of the time the unit heaters, furnace, and AC were running, which are estimated using the linear approximations below.



It is assumed that the heating system is on for 1,304 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 55°F and the system operating at 80% when the outdoor air temperature is 0°F.



It is assumed that the cooling system is on for 768 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 65°F and the system operating at 100% when the outdoor air temperature is 90°F.

Recommendation:

While there is not a financial reason to recommend this measure, it is recommended for occupant comfort.

Implementation Information:

If this measure was to be installed, C&S would recommend having this project completed by a qualified mechanical contractor. An engineer should be consulted to make sure an appropriate unit is selected. It is also important that the electrical service is evaluated to ensure there is ample capacity on the existing service for the new heat pump.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure.

Cooling Savings:

kWh Savings = ((Ton-e X HR X (C1/Eff-e))- (Ton-p X HR X (C1/Eff-p)))/C2

Where:

Symbol	Value	Units	Description
Ton-e	1.5	Tons	Existing Cooling Capacity
Ton-p	4.5	Tons	Proposed Cooling Capacity
Eff-e	10	BTU/(W*hr)	Existing Efficiency
Eff-p	18	BTU/(W*hr)	Proposed Efficiency
HR	768	Hours	Cooling Hours
C1	12000	(BTU/hr)/ton	Conversion Factor
C2	1000	W/kW	Conversion Factor

Therefore:

kWh Savings = -921

Savings ($) = kWh Savings X $/kWh

Where:

Symbol	Value	Description
$/kWh	$0.16	Cost per kWh

Therefore:

Savings = -$147.38

Heating Savings:

Gal Savings = (MBH X HR)/(Eff-p X C1)

Where:

Symbol	Value	Units	Description
MBH	27	MBTU/hr	Proposed Heating Capacity
HR	240	Hours	Heating Hours Served by HP
Eff-e	93%	N/A	Existing Efficiency
Eff-p	3.0	kW/kW	Proposed Efficiency
C1	91.5	MBTU/Gal	Convresion Factor

Therefore:

Gal Savings = 24

Savings = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.86	Cost per Gal

Therefore:

Savings = $43.89

Additional Cost of Electricity:

kWh Savings = (MBH X HR X C1)/ COP

Where:

Symbol	Value	Units	Description
MBH	27	MBTU/h	Heating Capacity
COP	3.0	kW/kW	Coefficient of Performance
HR	240	Hours	Heat Pump Heating Hours
C1	0.293	kW/MBTU	Conversion Factor

Therefore:

kWh Savings = -633

Savings ($) = kWh Savings X $/kWh

Where:

Symbol	Value	Description
$/kWh	$0.16	Cost per kWh

Therefore:

Savings = -$101.21

Total Savings = -$204.71

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing AC unit were to be replaced with a new, more efficient heat pump coil.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	24	Gallons	Gallons of Propane Saved
Elec	-1,554	kWh	kWh Saved
C1	0.00575156	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = -0.1

The cost estimate for this measure is shown below.

Garage - Install Heat Pump				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 135.93	1	$ 135.93
Installation	$ 6,644.05	$ 3,744.90	1	$ 10,388.95
Equipment Rental	$ -	$ -	1	$ -
Notes: Costs are from RSMeans Mechanical 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 1,578.73
			Sub Total	$ 12,103.61
			Design Cost (0%)	$ -
			Contingency (20%)	$ 2,420.72
			Total	**$ 14,524.33**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$14,524.33
Annual Savings	-$204.71
Simple Payback (years)	N/A

Assumptions:

1. There is sufficient space in the ductwork from the furnace that a heat pump coil can be installed.
2. The current electrical service does not need an upgrade to support the heat pump coil.
3. The Highway Garage system is estimated to be in heating mode 80% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
4. The Highway Garage system is estimated to be in cooling mode 0% of the time when the outdoor air temperature is 65°F, in heating mode 100% of the time when the outdoor air temperature is 90°F, and the percentage of heating varies linearly between these two temperatures.

8 – Town Hall – Install Heat Pump

Summary:

Measure Summary							
Unit	kWh Savings	kW Savings	Gallon Savings	Carbon Savings (MT)	Cost Savings	Cost	Simple Payback (years)
Condenser	579	0	7	0	$106.86	$13,975.07	131

This measure is not recommended due to the long payback period associated with it. However, cleaning the grating of the condenser unit would help extend its life.

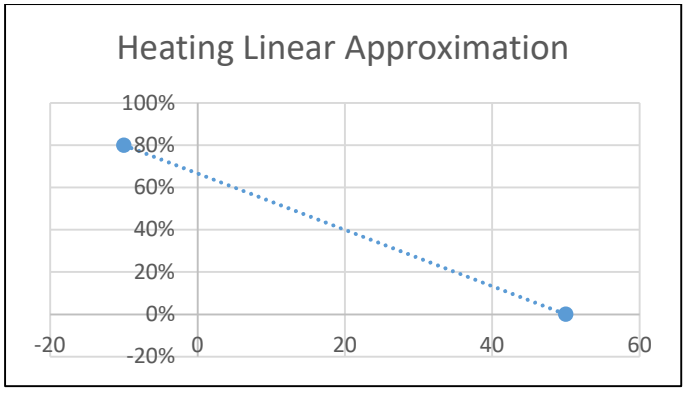
Background:

A common step towards electrification when there is an AC and a furnace working together, is to replace the cooling unit with a heat pump coil that uses the furnace for back-up heating on extremely cold days. This measure investigates the installation of a heat pump coil to provide cooling to the Town Hall. It is assumed that there is enough room in the existing ductwork that a heat pump coil can be installed, and that the electric service does not need to be upgraded to support the installation of a heat pump.

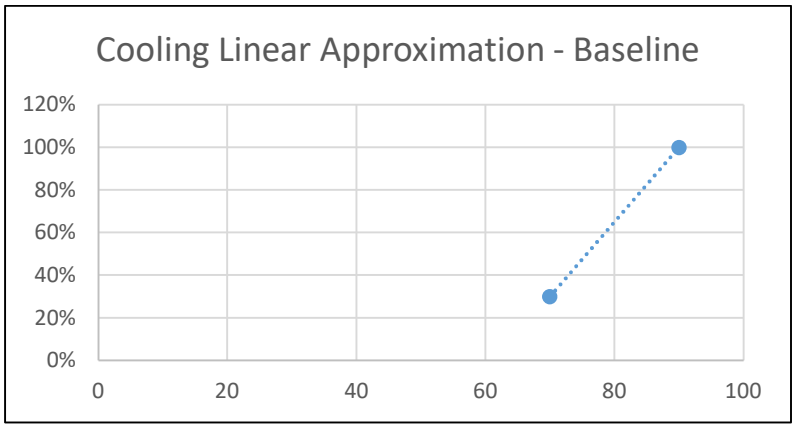
The Town Hall is heated by a 250 MBH, 81% efficient propane-fired furnace that is at least 11 years old. It is cooled by 4-ton, 13 SEER condenser that is only 5 years old. The proposed heat pump will have a heating capacity of 24 MBH at 0°F with a COP of 3.0, and a cooling capacity of 4 tons with a SEER of 18. The furnace provides heating through ductwork and plenums that span the entire facility.

Evaluation:

C&S gathered information from unit nameplates and talked to facility staff to understand how the HVAC systems were getting used in the building. C&S also used bin weather data from nearby the Hudson Valley Regional Airport (formerly Dutchess County Airport) to estimate typical outdoors air temperatures. This data in combination with the provided utility data, was used to determine the percentage of the time both the furnace and condenser were running, which are estimated using the linear approximations below.



It is assumed that the heating system is on for 893 full load heating hours annually, with the system operating at 0% when the outdoor air temperature is 50°F and the system operating at 67% when the outdoor air temperature is 0°F.



The baseline, uncontrolled schedule assumes that the cooling system is on for 761 full load heating hours annually, with the system operating at 30% when the outdoor air temperature is 70°F and the system operating at 100% when the outdoor air temperature is 90°F.

Recommendation:

This measure is not recommended due to the extremely long payback period associated with it.

Implementation Information:

If this measure was to be installed, C&S would recommend having this project completed by a qualified mechanical contractor. An engineer should be consulted to make sure an appropriate unit is selected. It is also important that the electrical service is evaluated to ensure there is ample capacity on the existing service for the new heat pump.

Energy/Economic Analysis:

A cost savings calculation is shown below for this measure.

Cooling Savings:

kWh Savings = (Tons X HR X ((C1/Eff-e)-(C1/Eff-p)))/C2

Where:

Symbol	Value	Units	Description
Ton	4	Tons	Cooling Capacity
Eff-e	13	BTU/(W*hr)	Existing Efficiency
Eff-p	18	BTU/(W*hr)	Proposed Efficiency
HR	761	Hours	Cooling Hours
C1	12000	(BTU/hr)/ton	Conversion Factor
C2	1000	W/kW	Conversion Factor

Therefore:

kWh Savings = 780

Savings ($) = kWh Savings X $/kWh + kW Savings X $/kW

Where:

Symbol	Value	Description
$/kWh	$0.16	Cost per kWh

Therefore:

Savings = $124.84

Heating Savings:

Gal Savings = (MBH X HR)/(Eff-p X C1)

Where:

Symbol	Value	Units	Description
MBH-e	24	MBTU/hr	Proposed Heating Capacity
HR	86	Hours	Heating Hours Serviced by HP
Eff-e	81%	N/A	Existing Efficiency
Eff-p	3.0	kW/kW	Proposed Efficiency
C1	91.5	MBTU/Gal	Conversion Factor

Therefore:

Gal Savings = 7

Savings = Gal Savings X $/Gal

Where:

Symbol	Value	Description
$/Gal	$1.89	Cost per Gal

Therefore:

Savings = $14.17

Additional Cost of Electricity:

kWh Savings = (MBH X HR X C1)/ COP

Where:

Symbol	Value	Units	Description
MBH	24	MBTU/h	Heating Capacity
COP	3.0	kW/kW	Coefficient of Performance
HR	86	Hours	Heat Pump Heating Hours
C1	0.293	kW/MBTU	Conversion Factor

Therefore:

kWh Savings = -201

Savings ($) = kWh Savings X $/kWh

Where:

Symbol	Value	Description
$/kWh	$0.16	Cost per kWh

Therefore:

Savings = -$32.15

Total Savings = $106.86

In addition to the cost savings calculation, a carbon emissions savings calculation was completed. This is an estimate of the metric tons of carbon dioxide that would be saved if the existing condenser were to be replaced with a heat pump.

Carbon Savings:

Carbon Savings = (Gal X C1) + (Elec X C2)

Where:

Symbol	Value	Units	Description
Gal	7	Gallons	Gallons of Propane Saved
Elec	579	kWh	kWh Saved
C1	0.00575156	MT CO2/Gal	Propane Carbon Dioxide Emission Coefficient
C2	0.0001245	MT CO2/kWh	NYS Electricity Carbon Dioxide Emission Coefficient

Therefore:

Carbon Savings = 0.1

The cost estimate for this measure is shown below.

Town Hall - Install Heat Pump				
Item	Material	Labor	Quantity	Total
Demolition	$ -	$ 1,525.70	1	$ 1,525.70
Installation	$ 6,042.15	$ 2,559.02	1	$ 8,601.17
Equipment Rental	$ -	$ -	1	$ -
Notes: Costs are from RSMeans Mechanical 2024 and include location factor multipliers for nearby Kingston, NY			OHP (15%)	$ 1,519.03
			Sub Total	$ 11,645.89
			Design Cost (0%)	$ -
			Contingency (20%)	$ 2,329.18
			Total	**$ 13,975.07**

The following chart shows a simple payback calculation used to show how long this measure would take to pay for itself. It is calculated by dividing the cost by the annual savings.

Simple Payback Summary	
Cost	$13,975.07
Annual Savings	$106.86
Simple Payback (years)	130.8

Assumptions:

1. There is sufficient space in the ductwork from the furnace that a heat pump coil can be installed.
2. The current electrical service does not need an upgrade to support the heat pump coil.
3. The existing unit is sized correctly for the space that it serves.
4. The facility system is estimated to be in heating mode 67% of the time when the outdoor air temperature is 0°F, in heating mode 0% of the time when the outdoor air temperature is 50°F, and the percentage of heating varies linearly between these two temperatures.
5. The facility system is estimated to be in cooling mode 30% of the time when the outdoor air temperature is 70°F, in cooling mode 100% of the time when the outdoor air temperature is950°F, and the percentage of cooling varies linearly between these two temperatures.

Appendix A: Project Summary Sheets

PROJECT SUMMARY SHEET

PROJECT: FT755187 - Town of Germantown
BUILDING: Town Activity Center, 54 Palatine Park Rd, Germantown, NY

List any local laws or executive orders relevant to the project:
(ex. LL87, LL97, EO88, EO166, etc.)

v. March 2025

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Instructions:

- **Complete one (1) Project Summary Sheet per building. Consult with your NYSERDA PM if baseline use cannot be broken out per building.**
- Include each measure that was evaluated in the study as a separate line item within the Itemized Measures section, including measures not recommended for implementation. If the study includes measure packages, list each individual measure within the Itemized Measures section AND include a line item for each measure package evaluated within the Measure Packages section. Additional guidance on itemized and packaged measures is provided in cells B25 & B226, respectively.
- **Refer to the guidance notes provided throughout the spreadsheet in cells that contain red triangles in the upper right corner of the cell.**
- Fill in the light blue cells and red cells, as appropriate. Totals will not populate until all red cells have been addressed.
- Present energy savings as annual savings at the system's utility meter(s) or at the source of generation for fuels.
- Update the baseline energy use conversion factors in the 'References' tab, as necessary.
- Ungroup rows (scroll down to row 226 or 257 and click on + symbol on the left) to enter more measures as necessary. If measures are packaged in the study, report package savings starting at row 227. Refer to the note in cell B226 for additional guidance.
- **The Other Cost Savings in columns S & T are supplemental to the FlexTech program. These cost savings were not technically reviewed under FlexTech and are subject to change depending on factors external to NYSERDA, such as NYC Local Laws and Utility Incentive Programs.**

ANNUALIZED BASELINE ENERGY SUMMARY

	Electric (kWh)		Electric Demand (kW)	Natural Gas (MMBtu)	Oil [Select Type]	Purchased Steam (MMBtu)	Propane (MMBtu)	Coal (MMBtu)	Other (MMBtu) [Indicate in Cell Y16]	Total Baseline Use (MMBtu) *[Fuel Only; No Electric]*
Baseline Energy Use	15,067.0		110.0				63.7			63.7
Average Utility Rate	Marginal	$0.11	$15.62				$21.13			Total Annual Cost ($)
Baseline Annual Cost	$1,683		$1,717				$1,344			$4,744.50

Other Fuel Source(s)

MMBtu Conversion Factors					
Btu	0.000001	#2 gallon	0.139	Steam Mlbs.	1.194
kWh	0.003412	#4 gallon	0.1467	LPG gallon	0.0915
therms	0.1	#6 gallon	0.15	Coal tons	24

Total Electric Cost ($)	$3,400.06
Total MMBtu Cost ($)	$1,344.44

MEASURE SAVINGS SUMMARY

Measure/ Package ID	Measure/Package Name	Measure/ Package Status	Annual Energy Savings: Electric/ Renewable Generation: Supply Savings/ Renewable Generation (kWh)	Annual Energy Savings: Electric/ Renewable Generation: Peak Demand Savings (Annual kW)	Annual Energy Savings: Fuel: Fuel Savings Type	Annual Energy Savings: Fuel: Fuel Savings (MMBtu)	Annual Energy Savings: Total: Energy Savings to Total Baseline Use (%)	Annual Energy Savings: Total: Energy Cost Savings (Annual)	Annual Energy Savings: Total: Energy Cost Savings to Total Annual Cost (%)	Water/ Sewer Savings: Water/ Sewer Savings (Gal)	Water/ Sewer Savings: Water/ Sewer Cost Savings (Annual)	O&M Savings: O&M Cost Savings (Annual)	Project Cost	Payback: Simple Payback (Years)	Other Cost Savings (e.g. Incentives/Rebates) & Penalties: Other Cost Savings (Lump Sum)	Other Cost Savings (e.g. Incentives/Rebates) & Penalties: Cost Penalties	Other Cost Savings (e.g. Incentives/Rebates) & Penalties: Customer Cost with Other Cost Savings & Penalties	Other Cost Savings (e.g. Incentives/Rebates) & Penalties: Simple Payback with Other Cost Savings & Penalties (Years)
Itemized Measures																			
1	Envelope Sealing	R	308.3		Propane	5.1	5.4%	$142	3.0%				$38,440	269.8			$38,440	269.8
3	Man-Sized Door Replacement	NR	230.0				0.7%	$25	0.5%				$7,800	308.2			$7,800	308.2
4	Bay Door Replacement	NR	462.0				1.4%	$51	1.1%				$13,949	274.6			$13,949	274.6
5	Activity Building - Occupancy Controls	R	983.0		Propane	2.2	4.8%	$155	3.3%				$1,711	11.0			$1,711	11.0
TOTAL (All Itemized Measures):			1,983	0.0		7	12.3%	$374	7.9%	0	$0	$0	$61,900	165.7	$0	$0	$61,900	165.7
TOTAL RECOMMENDED (Measures &/or Packages):			**1,291**	**0.0**		**7**	**10.2%**	**$297**	**6.3%**	**0**	**$0**	**$0**	**$40,151**	**135.0**	**$0**	**$0**	**$40,151**	**135.0**

Fuel Savings Breakout				
Measure ID	Fuel Type 1		Fuel Type 2	
	Fuel Savings Type	Fuel Savings (MMBtu)	Fuel Savings Type	Fuel Savings (MMBtu)
		0		0
		0		**0**

PROJECT SUMMARY SHEET

PROJECT: FT755187 - Town of Germantown
BUILDING: Town Highway Garage, 65 Palatine Park Rd, Germantown, NY

List any local laws or executive orders relevant to the project:
(ex. LL87, LL97, EO88, EO166, etc.)

v. March 2025

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Instructions:

- **Complete one (1) Project Summary Sheet per building. Consult with your NYSERDA PM if baseline use cannot be broken out per building.**
- Include each measure that was evaluated in the study as a separate line item within the Itemized Measures section, including measures not recommended for implementation. If the study includes measure packages, list each individual measure within the Itemized Measures section AND include a line item for each measure package evaluated within the Measure Packages section. Additional guidance on itemized and packaged measures is provided in cells B25 & B226, respectively.
- **Refer to the guidance notes provided throughout the spreadsheet in cells that contain red triangles in the upper right corner of the cell.**
- Fill in the light blue cells and red cells, as appropriate. Totals will not populate until all red cells have been addressed.
- Present energy savings as annual savings at the system's utility meter(s) or at the source of generation for fuels.
- Update the baseline energy use conversion factors in the 'References' tab, as necessary.
- Ungroup rows (scroll down to row 226 or 257 and click on + symbol on the left) to enter more measures as necessary. If measures are packaged in the study, report package savings starting at row 227. Refer to the note in cell B226 for additional guidance.
- **The Other Cost Savings in columns S & T are supplemental to the FlexTech program. These cost savings were not technically reviewed under FlexTech and are subject to change depending on factors external to NYSERDA, such as NYC Local Laws and Utility Incentive Programs.**

ANNUALIZED BASELINE ENERGY SUMMARY

	Electric (kWh)		Electric Demand (kW)	Natural Gas (MMBtu)	Oil [Select Type]	Purchased Steam (MMBtu)	Propane (MMBtu)	Coal (MMBtu)	Other (MMBtu) [Indicate in Cell Y16]	Total Baseline Use (MMBtu) *[Fuel Only; No Electric]*
Baseline Energy Use	16,041.0						405.9			**405.9**
Average Utility Rate	**Marginal**	$0.16					$20.33			**Total Annual Cost ($)**
Baseline Annual Cost	$2,398						$8,251			**$10,649.37**

Other Fuel Source(s)

MMBtu Conversion Factors					
Btu	0.000001	#2 gallon	0.139	Steam Mlbs.	1.194
kWh	0.003412	#4 gallon	0.1467	LPG gallon	0.0915
therms	0.1	#6 gallon	0.15	Coal tons	24

Total Electric Cost ($)	**$2,397.99**
Total MMBtu Cost ($)	**$8,251.38**

MEASURE SAVINGS SUMMARY

Measure/Package Information			Annual Energy Savings							Water/ Sewer Savings		O&M Savings	Project Cost	Payback	Other Cost Savings (e.g. Incentives/Rebates) & Penalties			
			Electric/ Renewable Generation		Fuel		Total											
Measure/ Package ID	Measure/Package Name	Measure/ Package Status	Supply Savings/ Renewable Generation (kWh)	Peak Demand Savings (Annual kW)	Fuel Savings Type	Fuel Savings (MMBtu)	Energy Savings to Total Baseline Use (%)	Energy Cost Savings (Annual)	Energy Cost Savings to Total Annual Cost (%)	Water/ Sewer Savings (Gal)	Water/ Sewer Cost Savings (Annual)	O&M Cost Savings (Annual)	Project Cost	Simple Payback (Years)	Other Cost Savings (Lump Sum)	Cost Penalties	Customer Cost with Other Cost Savings & Penalties	Simple Payback with Other Cost Savings & Penalties (Years)
Itemized Measures																		
1	Envelope Sealing	R			Propane	323.4	70.2%	$6,564	61.6%				$55,460	8.4			$55,460	8.4
3	Man-Sized Door Replacement	NR			Propane	1.3	0.3%	$26	0.2%				$3,120	120.3			$3,120	120.3
4	Bay Door Replacement	NR			Propane	26.8	5.8%	$545	5.1%				$55,899	102.6			$55,899	102.6
6	Garage - Install IR Heaters	R			Propane	143.6	31.2%	$2,919	27.4%				$10,481	3.6			$10,481	3.6
7	Garage - Install Heat Pump	RNE	-1,554.0		Propane	2.2	-0.7%	-$205	-1.9%				$14,524	-71.0			$14,524	-71.0
TOTAL (All Itemized Measures):			-1,554	0.0		497	106.8%	$9,849	92.5%	0	$0	$0	$139,484	14.2	$0	$0	$139,484	14.2
TOTAL RECOMMENDED (Measures &/or Packages):			**-1,554**	**0.0**		**469**	**100.7%**	**$9,278**	**87.1%**	**0**	**$0**	**$0**	**$80,465**	**8.7**	**$0**	**$0**	**$80,465**	**8.7**

Fuel Savings Breakout				
	Fuel Type 1		Fuel Type 2	
Measure ID	Fuel Savings Type	Fuel Savings (MMBtu)	Fuel Savings Type	Fuel Savings (MMBtu)
		0		0
		0		**0**

PROJECT SUMMARY SHEET

PROJECT: FT755187 - Town of Germantown
BUILDING: Town Office, 50 Palatine Park Rd, Germantown, NY

List any local laws or executive orders relevant to the project:
(ex. LL87, LL97, EO88, EO166, etc.)

v. March 2025

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Instructions:

- **Complete one (1) Project Summary Sheet per building. Consult with your NYSERDA PM if baseline use cannot be broken out per building.**
- Include each measure that was evaluated in the study as a separate line item within the Itemized Measures section, including measures not recommended for implementation. If the study includes measure packages, list each individual measure within the Itemized Measures section AND include a line item for each measure package evaluated within the Measure Packages section. Additional guidance on itemized and packaged measures is provided in cells B25 & B226, respectively.
- **Refer to the guidance notes provided throughout the spreadsheet in cells that contain red triangles in the upper right corner of the cell.**
- Fill in the light blue cells and red cells, as appropriate. Totals will not populate until all red cells have been addressed.
- Present energy savings as annual savings at the system's utility meter(s) or at the source of generation for fuels.
- Update the baseline energy use conversion factors in the 'References' tab, as necessary.
- Ungroup rows (scroll down to row 226 or 257 and click on + symbol on the left) to enter more measures as necessary. If measures are packaged in the study, report package savings starting at row 227. Refer to the note in cell B226 for additional guidance.
- **The Other Cost Savings in columns S & T are supplemental to the FlexTech program. These cost savings were not technically reviewed under FlexTech and are subject to change depending on factors external to NYSERDA, such as NYC Local Laws and Utility Incentive Programs.**

ANNUALIZED BASELINE ENERGY SUMMARY

	Electric (kWh)		Electric Demand (kW)	Natural Gas (MMBtu)	Oil [Select Type]	Purchased Steam (MMBtu)	Propane (MMBtu)	Coal (MMBtu)	Other (MMBtu) [Indicate in Cell Y16]	Total Baseline Use (MMBtu) *[Fuel Only; No Electric]*
Baseline Energy Use	11,551.0						175.6			**175.6**
Average Utility Rate	**Marginal**	$0.16					$20.65			**Total Annual Cost ($)**
Baseline Annual Cost	$1,863						$3,625			**$5,488.23**

Other Fuel Source(s)

MMBtu Conversion Factors

Btu	0.000001	#2 gallon	0.139	Steam Mlbs.	1.194
kWh	0.003412	#4 gallon	0.1467	LPG gallon	0.0915
therms	0.1	#6 gallon	0.15	Coal tons	24

Total Electric Cost ($)	**$1,862.86**
Total MMBtu Cost ($)	**$3,625.37**

MEASURE SAVINGS SUMMARY

Measure/Package Information			Annual Energy Savings							Water/ Sewer Savings		O&M Savings	Project Cost	Payback	Other Cost Savings (e.g. Incentives/Rebates) & Penalties			
			Electric/ Renewable Generation		Fuel		Total											
Measure/ Package ID	Measure/Package Name	Measure/ Package Status	Supply Savings/ Renewable Generation (kWh)	Peak Demand Savings (Annual kW)	Fuel Savings Type	Fuel Savings (MMBtu)	Energy Savings to Total Baseline Use (%)	Energy Cost Savings (Annual)	Energy Cost Savings to Total Annual Cost (%)	Water/ Sewer Savings (Gal)	Water/ Sewer Cost Savings (Annual)	O&M Cost Savings (Annual)	Project Cost	Simple Payback (Years)	Other Cost Savings (Lump Sum)	Cost Penalties	Customer Cost with Other Cost Savings & Penalties	Simple Payback with Other Cost Savings & Penalties (Years)
Itemized Measures																		
1	Envelope Sealing	R			Propane	84.3	39.2%	$1,745	31.8%				$13,935	8.0			$13,935	8.0
2a	Town Hall - Insulation Replacement - In-kind	RME			Propane	3.7	1.7%	$76	1.4%				$18,630	244.0			$18,630	244.0
2b	Town Hall - Insulation Replacement - Foam Board	ME			Propane	3.8	1.8%	$79	1.4%				$45,141	574.5			$45,141	574.5
3	Man-Sized Door Replacement	NR			Propane	0.6	0.3%	$14	0.2%				$1,560	114.6			$1,560	114.6
8	Town Hall - Install Heat Pump	NR	579.0		Propane	0.6	1.2%	$107	1.9%				$13,975	130.8			$13,975	130.8
TOTAL (All Itemized Measures):			579	0.0		93	44.2%	$2,020	36.8%	0	$0	$0	$93,241	46.2	$0	$0	$93,241	46.2
TOTAL RECOMMENDED (Measures &/or Packages):			**0**	**0.0**		**88**	**40.9%**	**$1,821**	**33.2%**	**0**	**$0**	**$0**	**$32,565**	**17.9**	**$0**	**$0**	**$32,565**	**17.9**

Fuel Savings Breakout				
	Fuel Type 1		Fuel Type 2	
Measure ID	Fuel Savings Type	Fuel Savings (MMBtu)	Fuel Savings Type	Fuel Savings (MMBtu)
		0		0
		0		**0**

Appendix B: Green Building Solutions Report

A Building Envelope Air Leakage Assessment Report

Prepared for:

The Town of Germantown, NY

Climate Smart Community Task Force

&

Taylor Ross CEM Project Engineer

C&S Engineers, Inc.

Memorandum of Understanding &

Disclaimer

This report is prepared by GBS and is proprietary. Variations in the usage of the building and human behavior will affect the simple payback given in the report. Therefore, GBS requires that all parties understand and agree to hold GBS blameless and indemnify GBS for any liabilities incurred by the use of this report.

The Energy Conservation Measures (ECM) put forth in this report are provided in the context of a systematic methodology for building envelope performance. Execution of GBS's ECM strategy is conditioned on the interpretation and implementation of GBS's building science field practitioners as field conditions dictate. It is noted that GBS's building science technicians have a forensic and holistic whole systems approach engaged in the evaluation of each interaction of the energy conservation installation and the interaction of the building systems.

This report is prepared and intended to educate the building owner or client and is not intended for any other use without the express written authority of GBS. The Town of Germantown along with the NYSERD & C&S Engineers Inc. GBS – the subcontractor is authorized the use of this report to this extent it is necessary to verify the accuracy of the content. In Addition, secure the proper funding for the implementation of the project. The scope of work and recommendation should not be used for biding purposes as it is not a specification. Do not copy or distribute without the consent of Green Building Solutions, Inc.

This report is not a bid document. As a proprietary document, it may not be shared in whole or in part with third parties who are not employees of or engineers specifically under contract to the owner/client for whom it was prepared. Therefore, any person who shall divulge the contents of this report to any third party shall be deemed to be acting outside of the scope of his/her employment and shall be individually and personally liable to GBS for liquidated damages equal to 50% of the cost of the scope of work or recommendations in this report. Any employee of owner/client who has knowledge of the contents of this report shall be deemed to also have knowledge and understanding of the conditions set out in this paragraph.



Green Building Solutions Inc. ™

Client:	Town of Germantown / Climate Smart Community Task Force: Matthew Mercer CSC Chair Christina Bohnsack CSC Task Force Coordinator Kaare Christian Town Board Member
Contact:	David Helsley Town Supervisor Town of Germantown 50 Palatine Park Rd. Germantown, New York 12526
Project Engineer:	Taylor Ross CEM office: (518) 915-7349 direct: (315) 703-4486 cell: (518) 538-2179 tross@cscos.com C&S Engineers Inc. 41 State St., Suite 600 Albany, NY 12207
Project Location:	Town of Germantown, NY
Date Submitted:	July 2, 2024
GBS Contact:	Al DeDominicis VP 735 Allen St. Syracuse, NY 13210 Cell (315) 559-4278 *ald@green-building-solutions.com*

Building Envelope Overview

The Town of Germantown buildings were inspected visually to detect air leakage pathways as detailed in the scope of work below.

There are a number of building envelope defects and deficiencies that are contributing to higher than necessary heating and cooling cost. The defects also accelerate the deterioration of building components and increase maintenance costs. For the district buildings combined, we identified cracks, gaps and air passageways for air exfiltration & infiltration equivalent to an air leakage area of approximately **7.75 square feet** through the building envelope, contributing to approximately **5931 therms of heat loss** and costing the district **$12,222 annually.**

The implementation of effective air sealing treatments, such as weather-stripping all exits, entries, and compartmentalizing doors; sealing off air leakage from windows and roof top mechanical penetrations at curbs and ventilator louvers; sealing the intersection of structural assemblies; and sealing a variety of penetrations throughout the complex will yield a **simple payback on average of 8.8 returning** the investment to the district.

Air leakage is driven by pressure differences subject to variations in wind velocity, stack effect and mechanical systems. A pressure boundary and thermal alignment must be established in order to control heating and cooling loads and to allow the mechanical systems to effectively control pressure differences from the outdoor environment to the indoor space of the facility without interference from the unpredictable and undesirable natural airflow forces caused by wind and stack effects across the building envelope.

Establishing a pressure boundary from inside to the outdoor environment involves the air tightening of the building envelope. Within the air sealing process and scope of work to air tighten a building envelope, it is important to decouple spaces and to compartmentalize components of the building in order to balance and equalize pressure and temperature differences.

The building envelope treatments to be implemented will increase the overall energy performance of the building. Beyond the energy saving opportunities, the measures will also improve the air quality by limiting ingress of contaminants from outside and moisture migration throughout the structures. This air sealing process will also aid in the ability of the mechanical systems to control pressure imbalances more effectively. Because air is a transporting mechanism for distributing moisture that affects the structural integrity of the building envelope, controlling uncontrolled air movement will extend the life cycle of the building along with increasing the thermal comfort as well as the health and safety of the students, faculty and staff that enjoy and occupy the buildings.

Causes of Building Envelope Air Leakage

There are two primary factors driving air leakage: the size of the leakage area (hole-size) and pressure differences across the building. Airflow will be increased linearly by the hole-size and by the square root of the pressure. The linear component is comprised of a building's gaps, cracks and holes that provide air pathways to the exterior.

Pressure differences may exist between the exterior and the interior of a building, and between internal building spaces. The pressure component that drives airflow into and out of buildings consists of three major forces:

- **Stack Effect** - pressure moving air through a building caused when indoor and outdoor air densities differ as a result of indoor and outdoor temperature differences.
- **Wind Effect** - wind driven pressure differences across the building.
- **Mechanical Effect** - either deliberate or inadvertent pressure differences moving air into or out of buildings caused by the use of HVAC systems.

All buildings are subject to unwanted air movement as a result of these forces. It is the combination of the driving forces of stack effect, wind, and mechanical ventilation systems that will determine airflow patterns for a building.

Air movement through leaks in the building envelope can either be into the building - infiltration; or out of the building - exfiltration. The leakier the building, that is, the greater the sum of the building's gaps, cracks, and holes – the greater the air infiltration and exfiltration caused by the interaction of the indoor-outdoor air temperature differences, wind, and the operation of the building's HVAC systems.

The leakier the building, the more difficult it will be to maintain the HVAC balance as pressure differences drive air across the pressure boundaries of the building and the energy cost of maintaining the preferred pressure increases. Tightening the building envelope decreases the amount of energy used and increases the probability that the building will perform within expected design pressure parameters.

Moreover, building mechanical engineers are often forced to oversize heating and cooling system requirements to compensate for major energy losses occurring in buildings that are not properly air sealed or insulated, adding unnecessarily to energy bill expenditures. There is a growing consensus between building scientists that reducing the heating and cooling load of a building is the first and most essential step to consider before the design of any HVAC system.

Building Envelope Airtightness

Building airflow patterns impact energy consumption, occupant health and comfort, and building durability. This airflow is driven by the airtightness of the building envelope in combination with pressure differences. It is a common misconception that institutional and commercial buildings are sufficiently airtight and that air leakage in these buildings does not significantly increase energy costs.

> "It is often assumed that commercial and institutional buildings are fairly airtight and that envelope air leakage does not have a significant impact on energy consumption and indoor air quality in these buildings. Furthermore, it is assumed that more recently constructed buildings are tighter than older buildings. However, very little data is available on the airtightness of building envelopes in commercial and institutional buildings. The data that exist show significant levels of air leakage in these buildings and do not support correlations of airtightness with building age, size or construction" (1).

In 2009, the United States Department of Energy estimated that buildings account for over 40% of America's total energy consumption and over 70% of the electricity used in the United States (2). The National Institute of Standards and Technology (2005) examined the energy impact of improving envelope airtightness in commercial buildings to targeted tightness levels based on existing baselines and blended national average heating and cooling energy prices. The predicted annual heating and cooling energy cost savings ranged up to 36% with the greatest savings occurring in cold weather climates (3). Studies by the NIST have demonstrated that utilization of building envelope air sealing treatments significantly contributes to increased energy efficiency, extended building durability, and enhanced occupant health and safety. Improvements to the building envelope remain one of the most reliable and effective methods available to increase an existing building's energy efficiency with simple paybacks between two to ten years on average.

In addition to energy saving benefits, building envelope air sealing treatments improve health and safety concerns related to uncontrolled air movement throughout a building. Historically, within the industry, an apparent lack of understanding exists concerning the interrelationship between "sick building syndrome," safety, durability and energy efficiency as it pertains to the most vital and expensive part of the operation of any building: its human occupants.

In summary, building envelope air sealing treatments provide significant opportunities for energy savings. Moreover, there are many non-energy benefits associated with the work. Uncontrolled airflow carries airborne water vapor into or out of the building envelope leading to condensation. Thermal comfort of occupants is often improved, and indoor air quality helped as outside pollutants are stopped from entering the building. Pressure differences from mechanical system imbalances can be mitigated. Problems related to pests, odor, and water infiltration are improved following building envelope retrofit work. In many instances, implementing effective air sealing treatments to tighten the building envelope can extend the length of time before structural problems begin to appear.

References:

1. Persily, A.K. 1999. “Myths About Building Envelopes.” ASHRAE Journal, Vol. 41(3): 39-47
2. DOE (2009). "Buildings Energy Data Book." Retrieved from *http://buildingsdatabook.eren.doe.gov/*.
3. NIST (2005). “Impact of Infiltration on Heating and Cooling Loads in U.S. Office Buildings.” Building and Fire Research Laboratory, National Institute of Standards and Technology, Gaithersburg, MD

COST SUMMARY OF THE INSTALLATION COSTS AND ENERGY SAVINGS IN SIMPLE PAY BACK AND THERMS

Town of Germantown, NY

Town of Germantown, NY	Projected Cost	Energy Saving	Simple Payback	Therms Saving	Leakage Area Sq.Ft.	
Town DPW Garage	$55,460.00	$6,563.79	8.4	3233.36	5.80	FT^2
Kellner Activity Building	$38,440.00	$3,914.06	9.82	1854.99	0.33	FT^2
Town Hall	$13,935.00	$1,744.88	7.99	842.93	1.62	FT^2
			Avg.			
Totals:	$107,835.00	$12,222.73	8.8	5931.28	7.75	FT^2

ENERGY CONSERVATION MEASUREMENTS

Scope of Work & Recommendations

Town of Germantown, NY

Town of Germantown - DPW Garage	Photos #	Doors	Leakage Area	Total Fl.
Energy Conservation Measures & Scope of Work Recommendations		Quantity	/Perimeters	Air Leakage
Entry / Exit Doors	**Photo #1**			
Install New Compression Weather Stripping & Sweeps at the following Locations:				
Single Leaf Entry		2	21	42
Seal all associated points and connection of air infiltration's include rough opening and threshold.				
Totals:		2		42
Overhead Doors:	**Photo #2**	unit	Dimension	
Install New -Fin & Brush Weather Stripping - Replace Bottom Seal		6	14' X !4"	336
Repair- Splice & Plate bottom 4' of Side Jams - w/ Steel or Aluminum / Mortar as Needed				
Totals:		6		336
Exterior Siding :	**Photo #3**			Total Lf.
Replace siding panels from the bottom of siding to 4" above the oxidizing siding panels. Fasten securely with exterior siding fasteners.		1	50'x140'	380
Apply sealant to achieve a air & weather tight seal (Perimeter of Building)				
Totals:		1		380
Roof/Wall Interface:	**Photo #4**	**Units**	**Dimension**	**Total Lf.**
Seal at sidewall to roof deck interface for the perimeter of the building:				
Dismantle - Soffit Panel to Access Roof / Wall Interface and Seal		1	50'x140'	380
Install Class A - E84 Fire Rated Material Only				
Totals:		1		350
Pipe penetrations:	**Photo #5**	Units	Dimensions	Total Circumferences
Seal Pipes at the circumference of the pipe penetration -		11	1/2"	29.029
Pipe Size		1	1' 1/2	5.969
Totals:		12		21.00
Windows & A/C Units:	**Photo #6**	**Unit**	**Dimension**	**Total Lf.**
Install Upper Awning Sash & Relocation existing exhaust hood		1	6' x 4'4"	21
Awing Windows - Double Glazing - Seal Perimeter - Frame to Casing		1	4'x 2'	12
Replace upper sash or reglaze if sash is in place				
A/C Units Seal perimeter connection	**Photo #7**	2	2'x 1' 6"	7
Totals:		4		40
Asphalt to Siding Sill:	**Photo #3**	**Unit**	**Dimension**	**Total Lf.**
Seal the following connections - Using Polyurethane Caulking			50'x140'	
Gable ends sill plate to bottom of siding		2	50	100
Seal Siding to asphalt at the eve sides of the building		1	140	140
Note: Seal intermittingly: for every 10' leave 1-inch inner flute of the siding unsealed. This will allow dewpoint moisture condensation to dispense from the equalization pressure zone across the wall section.				
Totals:		**3**		**240**

Germantown Town Hall	Photos #	Doors	Leakage Area	Total Lf.
Energy Conservation Measures, Scope of Work & Recommendations		Quantity	/Perimeters	Air Leakage
Entry / Exit Doors :		Leaf's		
Install New Compression Weather Stripping at the following Locations:				
Single Eixt Door		1	21	21
Double Entry Doors: (Two leafs per opening)		2	21	42
Install New Fin & Wool Pile Astertral at Meeting Stiles of the Doors.				
Totals:		3		63
Roof/Wall Interface:		Units	Dimensions	Total Lf.
Seal at sidewall to roof deck interface for the perimeter of the building:				
Dismantle - Soffit Panel to Access Roof to Wall Interface. Seal expose corrugated roof deck to sidewall siding intersection, Seal with an Class A - E84 foam sealant.		1	45'x35	160'
Totals:		1		160
Window /AC Units - Air Sealing:	Photo #9	Units:	Dimensions	Total Lf.
Window - Double Hung- Insulated Glazing				
Seal at the following air lackage connections:			4'4" x 4'	
Seal frame to side jams, header, sill & apron to wall and all lackage connections.		5	17	85
Seal casing at permitter connection to wall paneling.		5	17	85
A/C Units - Seal perimeter, provide backer rod to fill opening.		1	2'x1'6"	7
Totals:		11		177
Sidewall Insulation:	Photo #8	**Units:**	**Dimensions**	**Total Lf.**
Re-Install sidewall insulation located above ceiling tile .				
Re-seal with appropriate materials - vinyl tape		1	15'x3'	15
Totals:		1		15
Siding Exterior - Bottom Plate & Asphalt:	Photo #11	Unit	Dimensions	Total Lf.
Seal the following connections using - (Polyurethane Caulking)		Beads of Caulking	35'x145'	
Sill plate to bottom of siding and sill plate to asphalt		2	35	70
Note: Seal intermittingly: for every 10' leave 1-inch inner flute of the siding unsealed. This will allow dewpoint moisture condensation to dispense from the equalization pressure zone across the wall section.		2	45	90
Totals:		2		160

Kellner Activity Center	Photos	Doors	Leakage Area	Total Lf.
Energy Conservation Measures -Scope of Work & Recommendations		Quantity	/Perimeters	Air Leakage
Entry / Exit Doors:				
Install New Compression Weather Stripping and Sweeps at the following Locations:				
Single Entry / Exit Doors		5	21	105
Insulate and Seal at the door Jam Head rough opening and all associated connection.				
Totals:		5		105
Overhead Doors:	Photo #15	Units	Dimensions	
Re-Weather Strip w/ finned brush seal				
Repair overhead door frame - Splice and Plate as needed		2	12' x 9'	84
Seal all associated connections				
Totals:		2		84
Roof/Wall Interface:	Photo #13	Units	Dimensions	Total Lf.
Seal at sidewall to roof deck interface for the perimeter of the building:				
Dismantle - Soffit Panel to Access Roof / Wall Interface and Seal		1	35'x145'	360
Install Class A - E84 Fire Rated Material Only				
Totals:		1		360
Fiber - Air Leakage & Convection Looping	Photo #10	Units	Locations	Total Lf.
Seal at the following locations:		Approx.	Approx.	Approx.
"I" Beam Truss to Vinyl Battens				
Install ridged board insulation on both side of the exposed fiberglass above the "I" Beam Truss to existing vinyl backed battens, seal all connection to achieve an airtight seal. Use (Class A Fire Rated Board)		1	40'x2'	70
Re-Tape ceiling insulation vinyl covering with compatible tape at tears & punctures locations thought-out the ceiling (approx., 24 point)		24	24	24
Totals:		25		94
Window - Air Sealing:		Unit	Dimensions	Total Lf.
Windows are Double Glazing Slider				
Seal Window frame to extension jams		5	4'3"x 4'	85
Seal Window betide casings to siding and frame to extension jams connections		5	4'3"x 4 '	85
Totals:		10		170
Siding to Bottom Plate & Asphalt:	Photo #11	Unit	Dimensions	Total Lf.
Seal the following connections using - (Polyurethane Caulking)		Beads of Caulking	35'x145'	
Gable ends - seal sill plate to bottom of siding and sill plate to asphalt		4	35	140
Seal bottom siding to asphalt at the eve sides of the building		2	145	290
Note: Seal intermittingly: for every 10' leave 1-inch inner flute of the siding unsealed. This will allow dewpoint moisture condensation to dispense from the equalization pressure zone across the wall section.				
Totals:		2		430

Photographic Documentation

Town of Germantown, NY



DPW Photo #1

Weather Stripping:

Existing doors have been manufactured without weather stripping or bottom sweeps.

Seal door frame to sidewall.

Air Leakage at the threshold to sweep.



Photo #2-DPW

Garage Overhead Door:

Missing & Ineffective Weather Stripping

Jams “L” Channel & Side are Oxidizing.

Install high quality bush & fin weather-stripping.

Repair – Splice & Plate.

Photo #3 DPW

Repair Oxidizing Siding & Seal Asphalt to Siding w/Polyurethane Caulking





Photo #4 DPW

Air Infiltration Roof / Wall

Air Convection Looping in Fiber

Dismantle - Soffit Panel to Access Roof / Wall Interface

Seal at Roof Deck to Wall Interface

Insulation Voids



Photos #5 DPW

Seal Conduit Penetrations



Photo #6 DPW

Window And Hood:

Replace Window Sash

Re-locate Hood to side wall

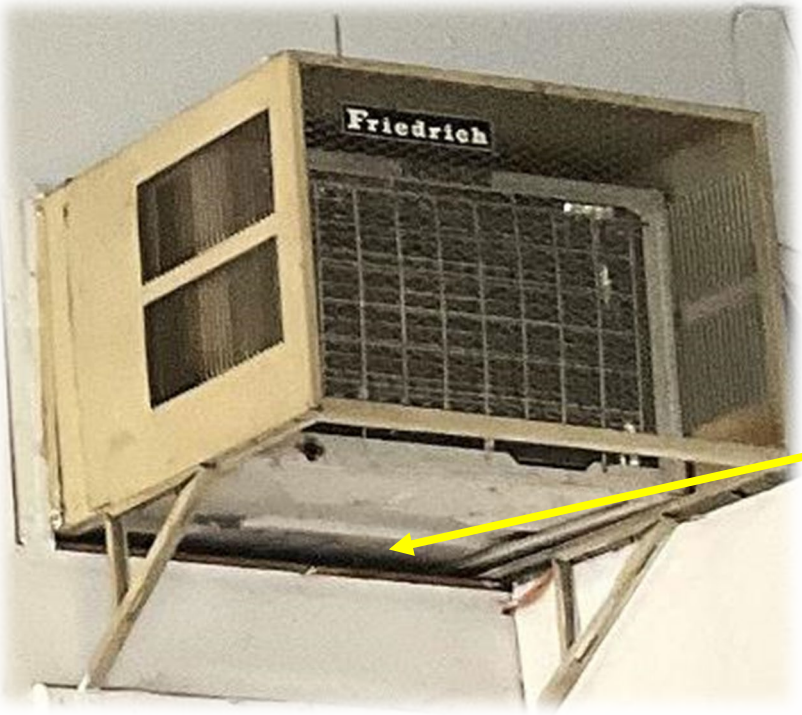


Photo #7 DPW

A/C Unit

Excessive Air Leakage

Install backer rod and seal perimeter connections.

Town Hall Building Photo #8



Air Exchange at the Roof to Wall Interface

Cobweb indicating air movement.

Blackening Fiber indicating air filtering and convection looping thought the fiber.

Open Soffit to access fiberglass batten to roof to wall interface and seal the connection. Re-install fiberglass battens and seal seams.



Town Hall Photo #9

Air Seal at All Connections

Window Frame to Jam, Header & Sill

Sill to Apron & Case to Jam & Wall

Activity Building



Activity Building Photo #10

Encapsulate the fiberglass above the “I” Beam Truss to the vinyl backing of the ceiling battens. Install A class fire rated rigid board reflexive insulation. Seal all Connections.



Activity Building – Photo #11

Retape with vinyl tape as needed to seal existing duct tape.



Activity Building Photo #12

Seal Siding to Sill Plate & Asphalt to Underside of Sill

Note: Leave (1) inner flute unsealed every 10 Lf.



Activity Building: Photo #13

Dismantle Soffit Panel to Access Roof / Wall Interface and Seal



Activity Building Photo #14

Replace Weather Stripping & Repair Overhead Door Jam as needed to achieve an air-tight seal

Thank You for the Opportunity to Provide This Report