AGENDA

For Web Publication

December 5, 2023

TOWN OF HENNIKER, NEW HAMPSHIRE

SELECTMEN & SEWER COMMISSIONERS

AGENDA & PUBLIC HEARING

Place: Henniker Community Center 57 Main Street
Henniker, NH 03242

Tuesday December 5, 2023
6:15 PM

I. CALL TO ORDER

II. NON-PUBLIC SESSION

III. PLEDGE OF ALLEGIANCE

IV. ANNOUNCEMENTS

V. CONSENT AGENDA

1) Consent Agenda December 5, 2023

VI. PUBLIC COMMENT #1 – (For any comment by any Henniker resident on a topic. Request time limit, up to 3 minutes)

VII. 6:30 p.m. PUBLIC HEARING

2) RSA 31:95 Accept and Appropriate Unanticipated State of NH Highway Block Grant Funding

VIII. APPOINTMENTS WITH THE BOARD

3) Dina Pinnell, Energy Committee – Henniker Energy Audit Reports

IX. NEW BUSINESS

X. CONTINUED BUSINESS

4) 2024 Budget

XI. TABLED BUSINESS

- Policies
  - III.1, III.3, III.5, III.7, IV.5
  - Personnel Policies – tabled 3/21/23 pending input from TA/Finance/HR
- Crosswalk on Main St. Pending CNHRPC study and public input.
- ARPA Fund Prioritization
- Solar PILOT

XII. PAST MEETING MINUTES

5) Acceptance of Board of Selectmen public meeting minutes November 21, 2023, 6:15 p.m.
6) Acceptance of Board of Selectmen & Budget Advisory Committee joint public meeting minutes November 18, 2023, 8:30 a.m.

XIII. COMMUNICATIONS

7) Town Administrator Report
8) Correspondence - Letters and Notices
9) Selectmen Reports

XIV. PUBLIC COMMENT #2 (For any comment by any Henniker resident on a topic. Request time limit, up to 3 minutes)

XV. NON-PUBLIC – If Necessary Non-public Session 91-A:3 II a, b, c, d, or e

XVI. ADJOURNMENT

XVII. UPCOMING DATES 2023

December 6, 2023 – Broadband Committee Meeting @ 4:30 p.m.
December 6, 2023 – Henniker Community School Board Meeting @ 6:00 p.m.
December 6, 2023 – Conservation Commission Meeting @ 7:00 p.m.
December 7, 2023 – Capital Improvement Program Meeting @ 6:00 p.m.
December 12, 2023 – Concert Committee Meeting @ 6:30 p.m.
December 13, 2023 – Town Hall Closed 12:00 p.m. – 2:00 p.m.
December 13, 2023 – John Stark School Board Meeting @ 6:00 p.m.
December 13, 2023 – Planning Board Meeting @ 6:00 p.m.
December 14, 2023 – Capital Improvement Program Meeting @ 6:00 p.m.
December 18, 2023 – Budget Advisory Committee Meeting @ 4:30 p.m.
December 18, 2023 – Energy Committee Meeting @ 5:30 p.m.
December 18, 2023 – Henniker Youth Athletic Committee Meeting @ 7:00 p.m.
December 19, 2023 – Board of Selectmen Meeting @ 6:15 p.m.

Please see the town website www.henniker.org and bulletin boards for meeting dates, times, locations, and agendas. **(**Calendar: Public Meeting + Holiday | Henniker, NH)

Visitor Orientation to the Town Selectman's Meeting

Welcome to this evening's Selectmen's meeting. Please note that the purpose of the meeting is for the Selectmen to accomplish its work within a qualitative timeframe. Meetings are open to the public, but public participation is limited. If you wish to be heard by the board, please note the "Public Comment" at the beginning and end of the meeting to speak about items on a meeting agenda and/or matters pertaining to the business of the Selectmen. In addition, public hearings may be scheduled for public comment on specific matters. Speakers must be residents of the Town of Henniker, property owners in the town of Henniker, and/or designated representatives of recognized civic organizations or businesses located in the Town of Henniker. When they are at the podium, speakers first need to recite their name and address for the record. Visitors should address their comments to the board and not to any individual member. Each speaker shall be provided with a single opportunity for comment, limited to three (3) minutes. Public forum shall be limited to fifteen (15) minutes. Visitors should not expect a response to their comments or questions since the Board may not have discussed or taken a position on a matter. Public Comment is not a two-way dialogue between speaker(s), Selectmen, and/or the Town Administrator. The Chair will preserve strict order and decorum at all Board of Selectmen meetings. Outbursts from the public are not permitted.

CONSENT AGENDA

TOWN OF HENNIKER, NEW HAMPSHIRE
BOARD OF SELECTMEN & SEWER COMMISSIONERS
CONSENT AGENDA

Tuesday, December 5, 2023

Consent Agenda

Item 1: SW Cole Contract Approval – Communications Tower Project
Item 2: Payroll Check Register – November 29, 2023
Item 3: Account Payable Manifest – December 6, 2023

Board of Selectmen Approval:

*Please note that the Consent Agenda is subject to change until 4:00 pm the day of a scheduled Selectmen's Meeting.

TOWN OF HENNIKER, NEW HAMPSHIRE

Consent Agenda
STAFF REPORT

DATE: 11/27/2023
TITLE: SW Cole Contract Approval
INITIATED BY: Communications Tower Project Team
PREPARED BY: Diane Kendall, Town Administrator
PRESENTED BY: Consent Agenda

AGENDA DESCRIPTION: The purpose of this consent agenda item is to authorize the Town Administrator to execute the contract between the Town of Henniker and S.W. Cole on behalf of the Board.

BACKGROUND: This contract is for a third-party engineering consultant to provide construction materials testing and observation services for the Communications Tower Project. This item was discussed at the November 7 meeting, but a record of authorization was not recorded.

Legal Authority: n/a

Financial Details: $1,000 to $2,000 and within the scope of the additional $100,000 local ARPA funds allocated to the project.

Craney Hill Communications Tower Project Team: Technical expertise requirement.

Town Administrator Comment: NA

Suggested Action/Recommendation:
By way of signature the Henniker Selectboard authorizes Town Administrator Diane Kendall to execute presented contract for S.W. Cole as presented.

Kris Blomback: ______________________ Date: ____________

Bill Marko : ______________________ Date: ____________

D. Scott Osgood: ______________________ Date: ____________

Jeff Morse: ______________________ Date: ____________

Neal Martin: ______________________ Date: ____________

TOWN OF HENNIKER
PAYROLL CHECK REGISTERS
DATE: November 29, 2023

WAGES:	$56,427.06
PAYROLL DEDUCTIONS:	$12,180.25
TOTAL:	$68,607.31

BOARD OF SELECTMEN APPROVAL

Kris Blomback Date

Scott Osgood Date

Bill Marko Date

Neal Martin Date

Jeff Morse Date

11/28/23
Town Administrator Date

Treasurer Date

WAGES

DEPARTMENTAL HOURS AND GROSS SUMMARY REPORT FOR TOWN OF HENNIKER

For 11/29/2023 to 11/29/2023

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
Department: CODE CODE					
Department Totals For: CODE					
SALARY	18.00	0.00	485.57	0.00	0.00
Totals:	18.00	0.00	485.57	0.00	0.00
Department: CSWW CSWW					
Department Totals For: CSWW					
HOLIDAY	16.00	0.00	1,118.88	0.00	0.00
REGULAR	11.00	0.00	504.58	0.00	0.00
Totals:	27.00	0.00	1,623.46	0.00	0.00
Department: FIRE/RESCUE FIRE/RESCUE					
Department Totals For: FIRE/RESCUE					
OVERTIME	0.00	0.00	0.00	3.50	118.23
REGULAR	39.00	0.00	776.04	0.00	0.00
Totals:	39.00	0.00	776.04	3.50	118.23
Department: HIGHWAY HIGHWAY					
Department Totals For: HIGHWAY					
HOLIDAY	96.00	0.00	2,646.40	0.00	0.00
OVERTIME	0.00	0.00	0.00	39.00	1,943.83
REGULAR	150.00	0.00	4,174.20	0.00	0.00
VACATION	8.00	0.00	160.40	0.00	0.00
Totals:	254.00	0.00	6,981.00	39.00	1,943.83
Department: LIBRARY LIBRARY					
Department Totals For: LIBRARY					
REGULAR	92.00	0.00	2,043.54	0.00	0.00
SALARY	45.00	0.00	1,608.40	0.00	0.00
Totals:	137.00	0.00	3,651.94	0.00	0.00
Department: POLICE POLICE					
Department Totals For: POLICE					
EVENING	161.50	0.00	121.13	0.00	0.00
HOLIDAY	23.00	0.00	569.56	0.00	0.00
MIDNIGHT	78.00	0.00	78.00	0.00	0.00
OVERTIME	0.00	0.00	0.00	6.00	235.05
REGULAR	404.00	0.00	12,176.71	0.00	0.00
VACATION	12.00	0.00	332.68	0.00	0.00
Totals:	678.50	0.00	13,278.08	6.00	235.05
Department: RESCUE RESCUE					
Department Totals For: RESCUE					
COMP OVER BASE	1.75	0.00	47.69	0.00	0.00
HALFTIME - FIRE	36.00	0.00	462.48	0.00	0.00
HOLIDAY	65.50	0.00	1,798.80	0.00	0.00
OVERTIME	0.00	0.00	0.00	66.50	2,384.70
REGULAR	252.50	0.00	6,227.21	0.00	0.00
SICK	12.50	0.00	400.63	0.00	0.00
Totals:	368.25	0.00	8,936.81	66.50	2,384.70
Department: SELECTMAN SELECTMAN					
Department Totals For: SELECTMAN					
HOLIDAY	85.00	0.00	2,784.38	0.00	0.00
REGULAR	70.00	0.00	1,558.28	0.00	0.00
SALARY	44.25	0.00	1,908.77	0.00	0.00

WAGES

DEPARTMENTAL HOURS AND GROSS SUMMARY REPORT FOR TOWN OF HENNIKER
For 11/29/2023 to 11/29/2023

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
Totals:	199.25	0.00	6,251.43	0.00	0.00

Department: TC/TX TOWN CLERK / TAX COLLECTOR
Department Totals For: TC/TX

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
HOLIDAY	32.00	0.00	836.53	0.00	0.00
OVERTIME	0.00	0.00	0.00	1.00	29.94
REGULAR	24.00	0.00	479.04	0.00	0.00
SALARY	28.00	0.00	775.75	0.00	0.00
Totals:	84.00	0.00	2,091.32	1.00	29.94

Department: TRANSFER TRANSFER
Department Totals For: TRANSFER

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
HOLIDAY	57.50	0.00	1,470.08	0.00	0.00
REGULAR	95.00	0.00	2,215.07	0.00	0.00
Totals:	152.50	0.00	3,685.15	0.00	0.00

Department: WELFARE WELFARE
Department Totals For: WELFARE

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
HOLIDAY	2.00	0.00	42.48	0.00	0.00
REGULAR	5.00	0.00	106.20	0.00	0.00
VACATION	7.00	0.00	148.68	0.00	0.00
Totals:	14.00	0.00	297.36	0.00	0.00

Department: WWTP WASTE WATER TREATMENT PLANT
Department Totals For: WWTP

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
HOLIDAY	48.00	0.00	1,370.88	0.00	0.00
OVERTIME	0.00	0.00	0.00	6.00	229.95
REGULAR	53.50	0.00	1,486.33	0.00	0.00
SICK	10.50	0.00	373.59	0.00	0.00
USECOMP	8.00	0.00	196.40	0.00	0.00
Totals:	120.00	0.00	3,427.20	6.00	229.95

Grand Totals:

Pay Code	Regular Hours	Suppl. Hours	Regular Gross	OT Hours	OT Gross
COMP OVER BASE	1.75	0.00	47.69	0.00	0.00
EVENING	161.50	0.00	121.13	0.00	0.00
HALFTIME - FIRE	36.00	0.00	462.48	0.00	0.00
HOLIDAY	425.00	0.00	12,637.99	0.00	0.00
MIDNIGHT	78.00	0.00	78.00	0.00	0.00
OVERTIME	0.00	0.00	0.00	122.00	4,941.70
REGULAR	1,196.00	0.00	31,747.20	0.00	0.00
SALARY	135.25	0.00	4,778.49	0.00	0.00
SICK	23.00	0.00	774.22	0.00	0.00
USECOMP	8.00	0.00	196.40	0.00	0.00
VACATION	27.00	0.00	641.76	0.00	0.00
Totals:	2,091.50	0.00	51,485.36	122.00	4,941.70

= $56,427.06

PAYROLL DEDUCTIONS

Vendor	Item Code	GL Number	Amount
IRS - IRS PAYMENT			
	FITW	01-0000-2025-001	5,200.35
	SOCSEC_EE	01-0000-2025-001	2,505.84
	SOCSEC_ER	01-0000-2025-001	2,505.84
	MEDICARE_EE	01-0000-2025-001	799.39
	MEDICARE_ER	01-0000-2025-001	799.39
Invoice Total:			11,810.81

Sub Totals:

FITW	5,200.35
MEDICARE	1,598.78
SOCSEC	5,011.68

Vendor	Item Code	GL Number	Amount
EMPOWER - EMPOWER RETIREMENT			
	EMPOWER	01-0000-2025-020	107.50
	EMPOWER-ROTH	01-0000-2025-020	261.94
Invoice Total:			369.44

Sub Totals:

EMPOWER	107.50
EMPOWER-ROTH	261.94

Grand Totals:

Invoice Count: 2 — 12,180.25

Sub Totals:

EMPOWER	107.50
EMPOWER-ROTH	261.94
FITW	5,200.35
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Bill Marko — Date

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[signature] 11/28/23

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	MEDICARE_ER	01-0000-2025-001	799.39
Invoice Total:			11,810.81

Sub Totals:

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Sub Totals:

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Grand Totals:

Invoice Count: 2 — 12,180.25

Sub Totals:

EMPOWER	107.50
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FITW	5,200.35
MEDICARE	1,598.78
SOCSEC	5,011.68

APPOINTMENTS WITH THE BOARD

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE
S.E.E.D.S.
SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES
Margaret Dillon—603-532-8979—MDILLON@myfairpoint.net

Diane Kendall
Town Administrator
18 Depot Hill Road
Henniker, NH 03242

November 17, 2023

Diane,

The purpose of the is letter is to serve as a very brief summary of the separate scoping studies, or energy audits, completed for The Town Hall, Grange, and Community Center. The second page offers comparison snap shots of the three buildings.

There is a great deal of information in the individual reports, in both explanations and details which would be important to successful projects. This two page summary is just offered to assist in decision making, but also to propose treating the recommendations as a single project. Potential funding opportunities from the Inflation Reduction Act (IRA –which is a tax credit, but offers municipalities and others without a tax liability a direct cash payment) and other incentives from Eversource or NHCDFA, may make 'packaging' worthwhile.

As shown in the chart below, a total investment of an estimated $50,826 is predicted to save an estimated $3,678 a year at current energy prices, and 344 million Btus of Source Energy. Contact Jack Paloucek at Eversource to determine whether the energy savings warrant financial incentives from the NH Saves program for municipal buildings.

	Investment	Annual $ Savings	Simple Payback Years	Annualized ROI	Site Energy Saved MMBTU	Source Energy Saved MMBTU	Annual Reduction Tons CO2
Town Hall	$18,320	$1,437	12.7	2.7%	78.6	98.5	6.8
Community Center	$8,554	$1,035	8.3	4.5%	107.6	163.0	8.0
The Grange Tier 1	$1,820	$166	11.0	2.8%	57.6	70.1	4.0
The Grange Tier 2	$22,232	$1,040	21.4	0.6%	9.6	12.6	0.7
Totals	$50,926	$3,678	13.8	2.4%	253.4	344.2	19.5

The estimated costs for each ESM is just that; an estimate. I recommend you show the reports to an insulation contractor for a cost proposal for each ESM. Targeted air sealing and improving insulation levels is recommended for each of the buildings. This is especially so for the Town Hall to create continuous air and thermal barrier between the first floor and the unheated 2nd floor.

The second most significant set of recommendations involves revisiting thermostat controls and settings in the Town Hall and Teen Center in particular. Each of those reports include a discussion on thermostat settings and set backs. In a nut shell—more aggressive thermostat set backs for nighttime and weekends are recommended for fossil fuel equipment, while heat pumps operate most efficiently if kept at the same thermostat setting. Heating and cooling load calculations were performed for each building, in large part to determine if the heating capacities of the installed heat pumps are adequate to rely on the heat pumps for heating, thereby reducing oil usage at the Town Hall and the much more costly electric resistance baseboard at the Teen Center. Completing the recommended envelope improvements—which reduces loads and improves comfort—is expected to allow the heat pumps to serve for primary heating., thereby reducing the reliance on less efficient systems.

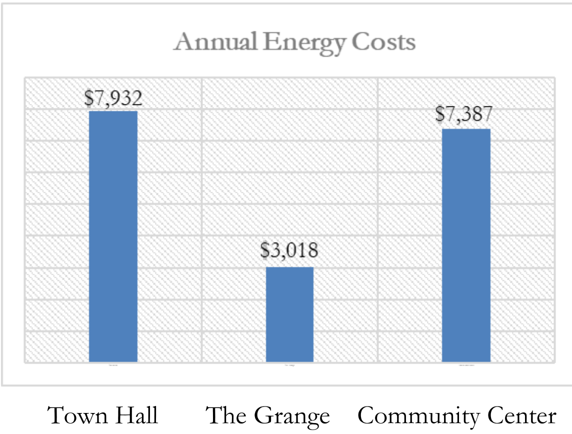
Lastly, I appreciate that the reports can seem quite technical and dense. Please know that I would be willing to meet with the Energy Committee on zoom to answer specific questions.

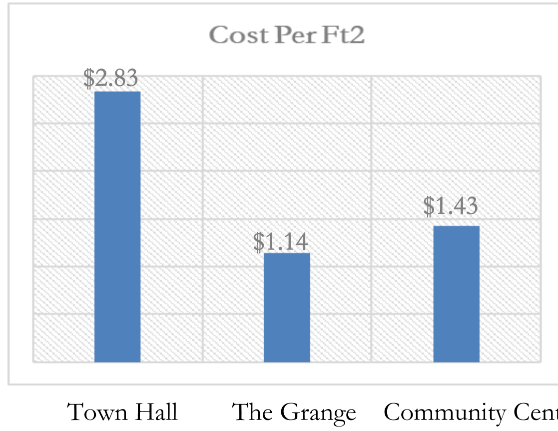
Sincere regards,

Margaret

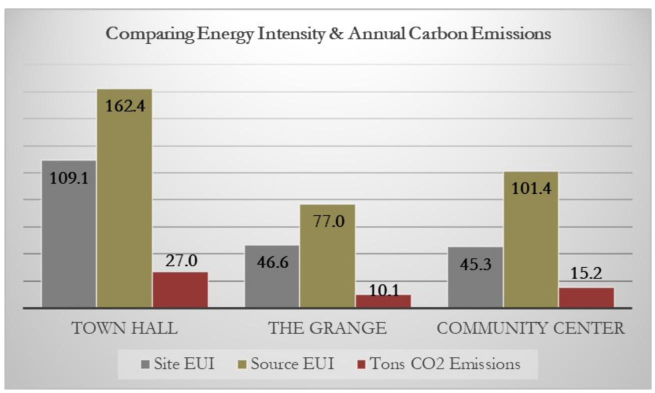
Energy Metric Comparisons

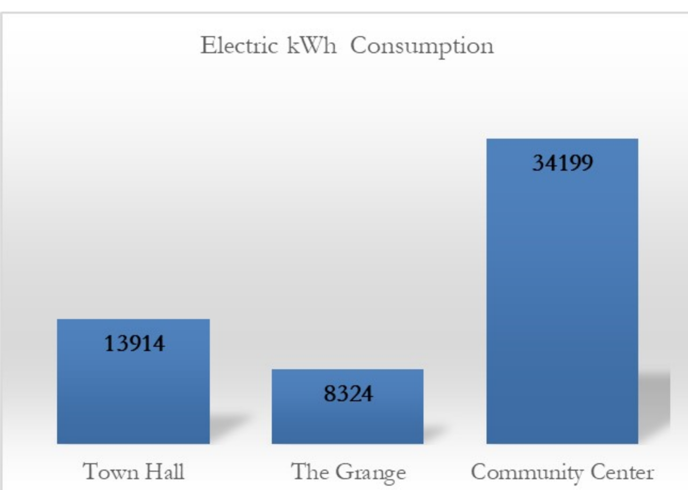
There are several ways to compare energy usage in buildings if needing to prioritize investment dollars. From annual cost perspective, the Town Hall and Community Center have the highest annual costs, though the larger floor area of the Community Center makes it appear 'more cost effective' per square foot. Considering the infrequent use of the CC, it may then appear to be 'more wasteful' in terms of the energy used to maintain a largely unoccupied building.

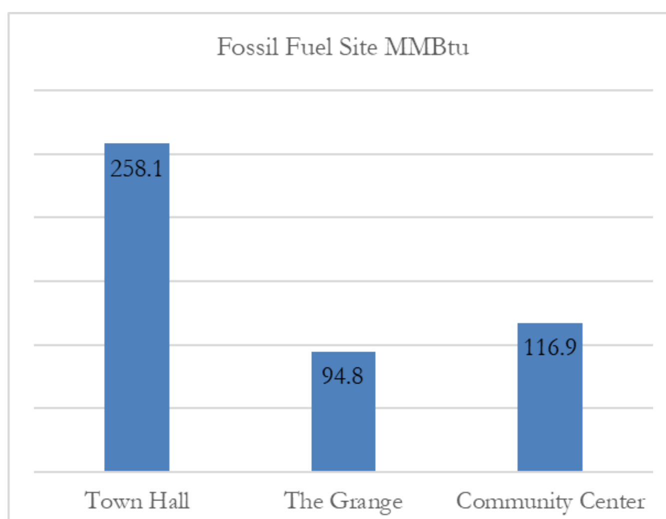




The EUI of a building is being used more often to not only compare buildings of similar uses, but to measure reductions in energy usage following efficiency improvements. But that can be misleading, as improvements to the envelope may not register the level of improvement on a larger building. Looking at Source EUI highlights the inefficiency of the existing electric grid, but overall the pattern is the same as costs.







In terms of energy usage by type or source, the Community Center (actually the Teen Center) uses the most electricity by far, where as the Town Hall consumes the most fossil fuels. The recommendations suggest relying on the installed heat pumps in both locations: to use less electricity at the Teen Center and burn less oil at the Town Hall.

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

MEMORANDUM

TO Nichol Tyc, Eversource

CC Mounaim Hamim, Eversource

FROM Alyssa Gianotti, GDS Associates

DATE May 30, 2023

RE Town of Henniker, Scoping Study Memo

GDS Associates, working on behalf of Eversource, has conducted a scoping study of three municipal buildings serving the Town of Henniker: Transfer Station/Recycling Center located at 1393 Weare Road (Route 114), the Fire and Rescue Station located at 216 Maple Street, and the Highway Garage located at 209 Ramsdell Road. GDS performed the following major activities:

- Performed site visits on April 11th and 12th to document existing conditions.
- Identified loads and potential energy conservation measures (ECMs).
- Collected and benchmarked historical electric consumption to understand usage profiles.
- Developed high-level savings and cost estimates.

This scoping study provides a description of potential electric ECMs that were identified during the site visit and outlines next steps for further developing the measures based on the Town's interest. Table 1 provides a summary of estimated costs and savings[1].

TABLE 1. SUMMARY OF SCOPING STUDY OPPORTUNITIES

Measure	Installation Cost[1,2]	Annual Electric Savings (kWh)	Annual Propane Savings (Gal)	Annual Cost Savings	Simple Payback (years)
ECM-1: Fire Station - Pipe Insulation	$100	370	0	$63	1.6
ECM-2: All Buildings - Lighting Upgrades	$5,400	5,900	0	$1,003	5.4
ECM-3: Fire Station and Transfer Station Weatherization	$2,400	880	42	$300	8.0
ECM-4: Transfer Station (Hopper) - Ductless MSHP	$8,500	6,300	0	$1,071	7.9
ECM-5: Fire Station - Ducted ASHP	$65,400	-23,000	2,700	$5,729	11.4
Total	**$81,800**	**-9,550**	**2,742**	**$8,165**	**10.0**
[1] **Budgetary costs estimated based on past experience**					
[2] **Installation cost assumes each measure is a retrofit and the total cost is eligible**					

PROJECT OVERVIEW

Town of Henniker has nine municipal buildings, excluding schools. Of these nine, the Energy Committee selected three to receive scoping studies:

- Transfer Station at 1393 Weare Road
- Fire and Rescue Station at 216 Maple Street

[1] The costs and savings provided are estimates and require further refinement prior to implementing ECMs for incentive eligibility.

- Highway Garage at 209 Ramsdell Road

Transfer Station

The Transfer station and Recycling Center has multiple small buildings associated with the operations. Each of the three buildings has their own electric meter. The recycle building is a metal framed building with multiple doors for town residents to pass through recyclable materials. Materials are sorted and placed in one of four compactors. The building is heated by a waste oil heater controlled by a manual thermostat. The high bay lighting has been converted to LED. One T12 fixture was found in the bathroom. Other process electric loads include an air compressor and wire tripper that are used infrequently.

The Parks Barn is an unheated storage building with LED strip fixtures lighting much of the interior. A few examples of incandescent bulbs were found in the storage garages and one high pressure sodium (HPS) bulb was observed in a wall mounted exterior fixture.

The Hopper building has two parts, a conditioned office space and the unheated drop space where trash goes down the chute to the compactor that fills trailers to be hauled offsite. The motor on the compactor is 30HP with a NEMA nominal efficiency of 91-percent. Interior lighting throughout both parts of the building is LED. Most of the wall packs are LED with daylight and motion sensing. One non-LED wall pack was noted but may be out of service. The office portion of the Hopper building has electric resistance baseboard heat and window air conditioner that stays in the window year-round. Both systems are controlled manually. The roof of the office is partially damaged, and the windows and door have inconsistent weatherstripping.

HISTORICAL ENERGY CONSUMPTION AND BENCHMARKING

The building is served by electricity. Figure 1 shows the historical electric use by month for 2019 through 2021. The use profile is consistent with an electric heating load.

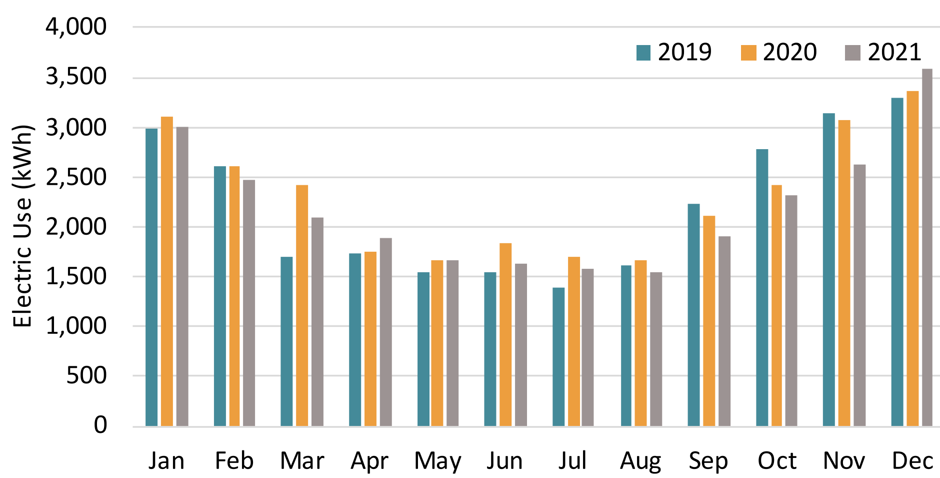


FIGURE 1. HISTORICAL ELECTRIC CONSUMPTION: TRANSFER STATION

Benchmarking the energy use of the facility against buildings of similar type is critical to assess the energy savings potential and performance of the end-use equipment. The energy use intensity (EUI) is used for benchmarking since it represents a normalized use per facility area and allows similar buildings to be compared directly.

Figure 2 shows historical and benchmark[2] electric EUI. The use of the facility is slightly above the electric benchmark use which indicates opportunity for energy savings.

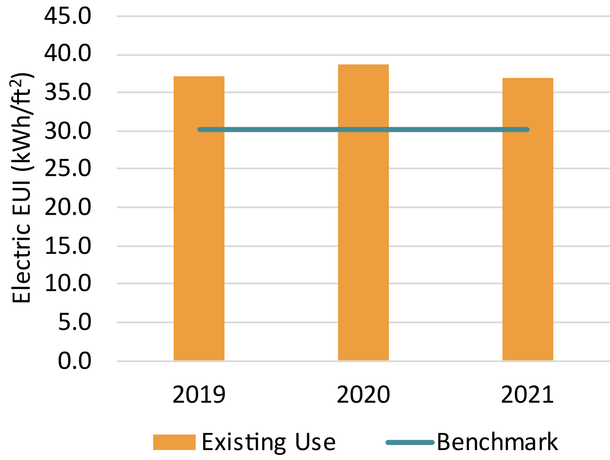


FIGURE 2. HISTORICAL AND BENCHMARK ELECTRIC EUI COMPARISON: TRANSFER STATION

The electric use is not related to warmer outside air conditions, as shown in Figure 3. The cooling degree days (CDDs) are a representation of how much cooling is required when outside air temperatures are above the balance point of 65°F. As CDDs increase the electric use does not correlate, indicating there is a non-weather dependent cooling use.

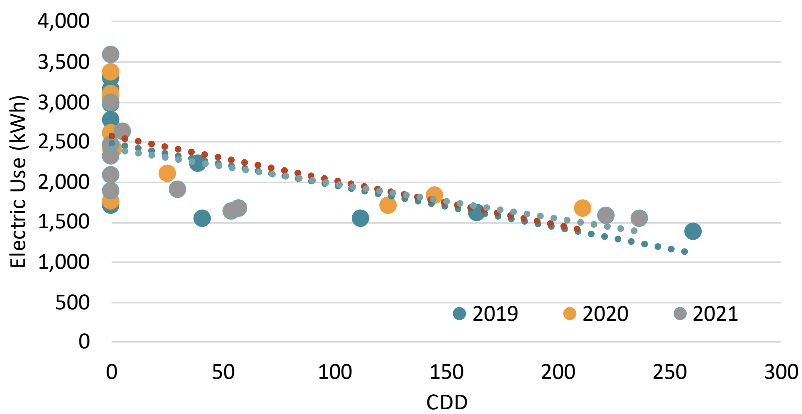


FIGURE 3. ELECTRIC USE COMPARED TO COOLING DEGREE DAYS: TRANSFER STATION

Electric use is, however, related to colder outside air conditions as shown in Figure 4. The heating degree days (HDDs) are a representation of how much heating is required when outside air temperatures are below the balance point of 65°F. As HDDs increase electric use trends higher, indicating there is weather-dependent heating use.

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[2] Using Commercial Buildings Energy Consumption Survey data compiled by the U.S. Energy Information Administration.

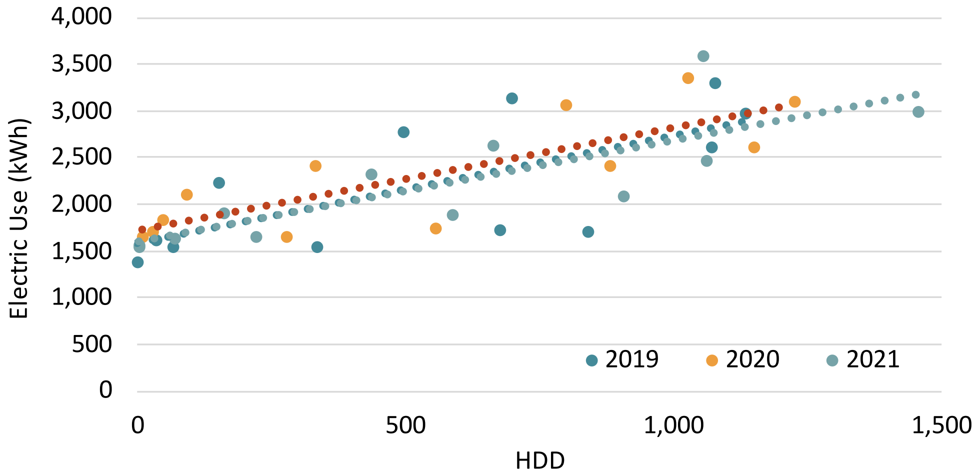

FIGURE 4. ELECTRIC USE COMPARED TO HEATING DEGREE DAYS: TRANSFER STATION

Fire and Rescue Station

The Fire Station is a slab-on-grade building with wood framing and ventilated pitched attic. The building was constructed in 1994. The attic has received additional insulation since the original construction. The windows, man doors, and most of the garage doors are original. The six overhead doors appeared to be in adequate condition. Air gaps were observed around exterior man doors. The seals around the wood windows are also worn from age. The two propane furnaces with split system direct expansion (DX) air conditioning serving the non-garage areas were noted as original. These systems were efficient at the time of construction; however, more energy efficient technology is available today. The systems are controlled by programmable thermostats that are not programmed for setbacks. Domestic hot water (DHW) is provided by a 50-gallon tank-style electric water heater that was installed in January 2020. The DHW piping is uninsulated. Lighting throughout the interior and exterior of the building has been replaced with efficient LED technology. Occupancy sensors have been installed adequately in rooms with infrequent utilization.

The garage is heated by propane unit heaters. There is one thru-wall exhaust fan controlled by a timer located by the workbench. The garage has an efficient engine exhaust removal system[3] that filters particulates from the air without exhausting conditioned air from the space. The system is triggered when the garage doors open and runs on a timer currently set to 15 minutes. All vehicles in the garage are plugged in to charge all on board equipment batteries 24/7. Other electric loads in the garage include an air compressor, a residential sized washer and dryer, and a washer and dryer specifically designed for fire fighter gear. The building is occupied at all times, though certain spaces are used more than others.

HISTORICAL ENERGY CONSUMPTION AND BENCHMARKING

The building is served by electricity and propane. Only electric data was available for analysis. The fire station has two electric meters, one for the station and another for the radio tower. Since the data received was already aggregated, it is unknown whether both meters are included in the electric data or not. Figure 5 shows the historical electric use by month for 2020 through 2022. The use profile is consistent with a significant electric baseload and negligible cooling load.

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[3] http://www.airvac911.com/system.html

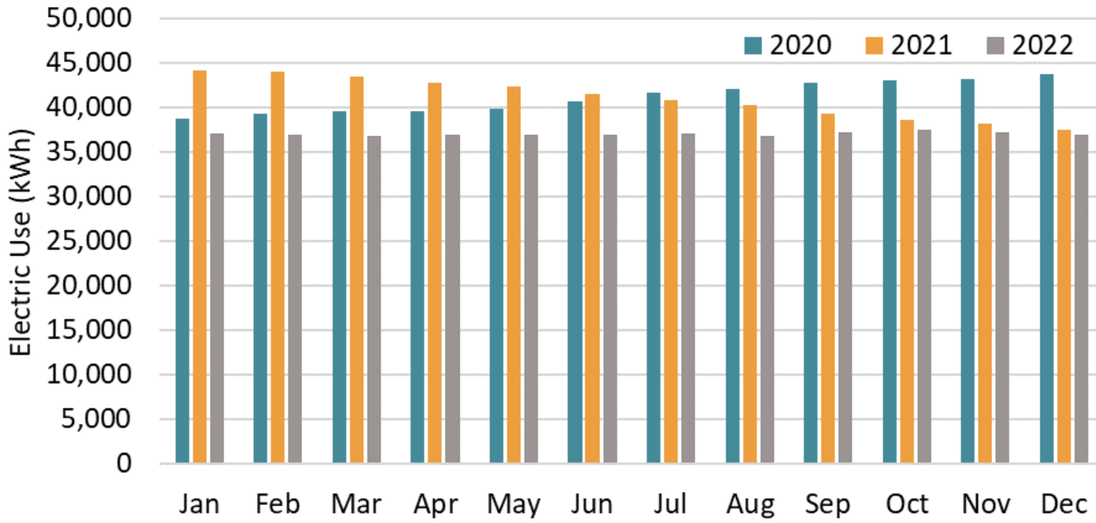


FIGURE 5. HISTORICAL ELECTRIC CONSUMPTION: FIRE AND RESCUE STATION

Figure 6 shows historical and benchmark electric EUI. The use of the facility is above the electric benchmark use which indicates the electric data likely includes both the radio tower and fire station metered usage. The EUI is nearly triple that of a typical public order and safety building indicating either the building's electric loads are much greater than similar buildings or there is more floor area served under the meters.

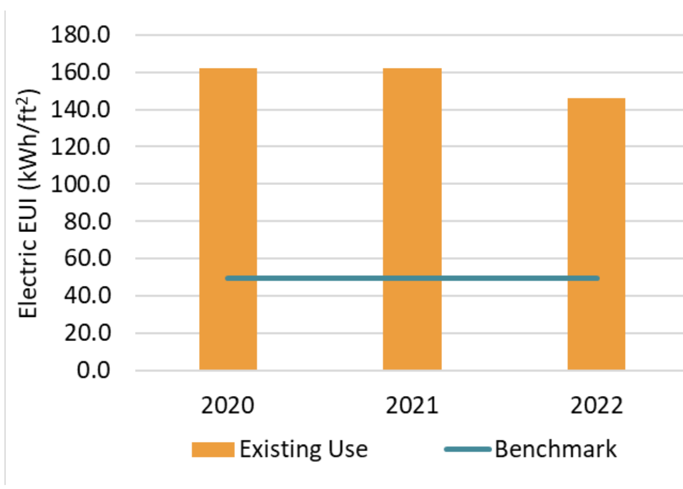


FIGURE 6. HISTORICAL AND BENCHMARK ELECTRIC EUI COMPARISON: FIRE AND RESCUE STATION

The electric use is not related to warmer outside air conditions as shown in Figure 7. As CDDs increase the electric use does not correlate, indicating there is a non-weather dependent cooling use.

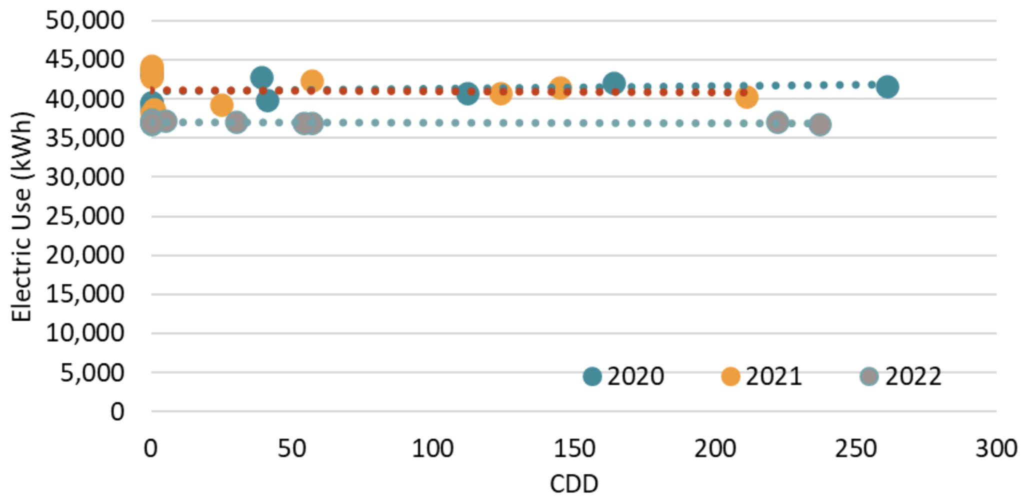


FIGURE 7. ELECTRIC USE COMPARED TO COOLING DEGREE DAYS: FIRE AND RESCUE STATION

Highway Garage

The Highway Garage building was constructed in 2016. Its envelope, lighting, DHW, and HVAC are all modern and efficient for their age. All but one garage bay has radiant floor heating. Heating hot water (HHW) is produced by a wood pellet boiler and distributed by pumps with integrated VFDs. The garage bays have back up propane unit heaters. The thermostats for both systems are programmable although they are set to hold one temperature. The radiant floor thermostats are set to 64°F while the unit heaters are set to 60°F to help raise the temperature in the space when it drops after bay doors are opened. There are multiple exhaust fans and louvers set to run off carbon monoxide levels.

Electric process loads in the building include an air compressor and a welder. The Highway Department is busiest in the winter months for road clearing activities. Operations are generally one shift per day with crews in and out of the building depending on the season and work to be done. The lighting in the garage bays is controlled by manual switches. The work in these areas necessitates that lighting is not shut off for safety, however, manual controls can lead to long periods of lighting runtime when lighting is not switched off before a shift on the roads.

The small office and breakroom area in the building are heated and cooled by a ductless multizone heat pump system. This system has occupancy sensors and a programmable thermostat that is set to hold at 70 degrees. The lighting in the area is controlled by an occupancy sensor.

HISTORICAL ENERGY CONSUMPTION AND BENCHMARKING

The building is served by electricity, wood pellets, and propane. Only electric data was available for analysis. Figure 8 shows the historical electric use by month for 2020 through 2022. The use profile is inconsistent over time. This is reasonable considering that the highway department is as busy as the weather conditions dictate. The greater electric loads in the winter could be indicative of long lighting runtimes during the busy season or the heat pumps running on electric resistance backup heat.

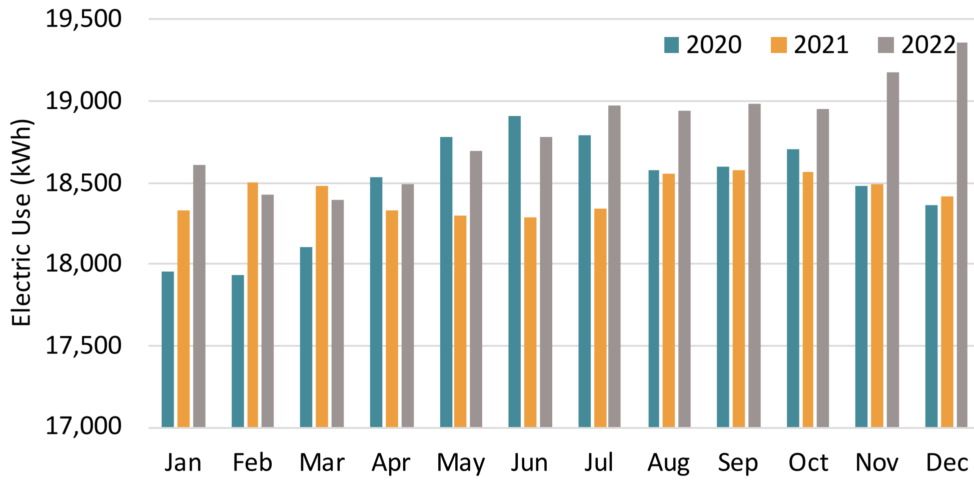


FIGURE 8. HISTORICAL ELECTRIC CONSUMPTION: HIGHWAY GARAGE

Figure 9 shows historical and benchmark electric EUI. The use of the facility is above the electric benchmark use which indicates either long runtime or process loads outside of a typical facility.

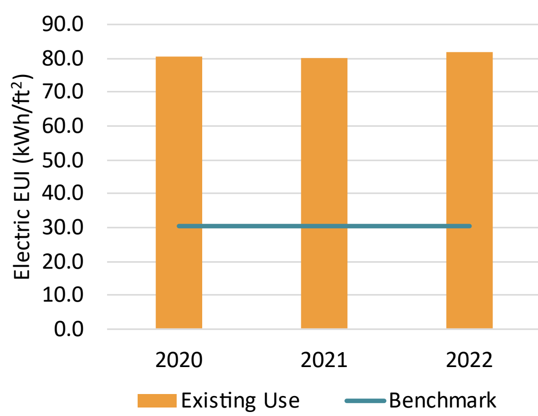


FIGURE 9. HISTORICAL AND BENCHMARK ELECTRIC EUI COMPARISON: HIGHWAY GARAGE

The electric use is weakly related to warmer outside air conditions as shown in Figure 10. As CDDs increase the electric use somewhat correlates indicating there is a weak weather-dependent cooling use.

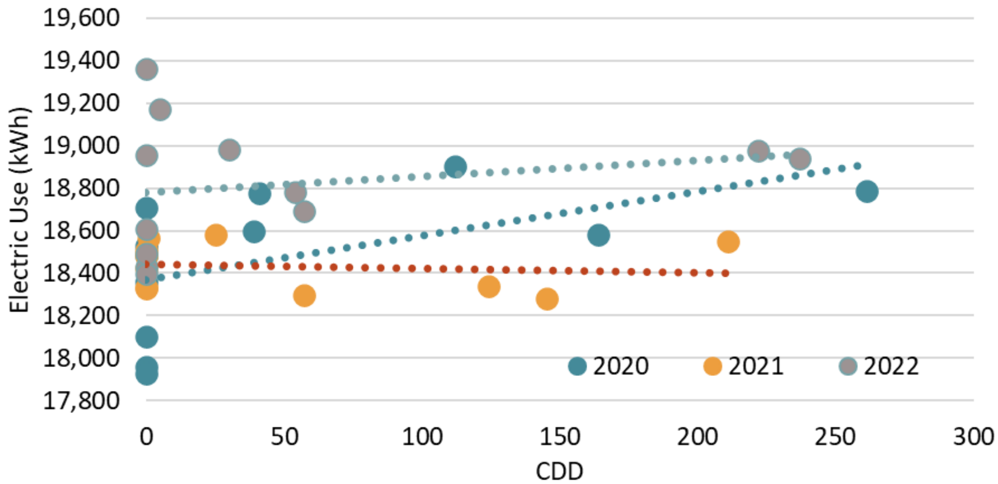


FIGURE 10. ELECTRIC USE COMPARED TO COOLING DEGREE DAYS: HIGHWAY GARAGE

PRELIMINARY ENERGY CONSERVATION MEASURE

ECM-1: Fire Station - Pipe Insulation

The DHW piping in the fire station was bare copper pipe. GDS recommends insulating the DHW piping to decrease heat loss and more efficiently deliver hot water to the building. Due to the relatively low cost of the piping insulation, the payback for this measure is generally low. Insulating bare pipes or pipes with failed insulation will cost-effectively reduce electric use and protect staff from unsafe high-temperature surfaces.

ECM-2: All Buildings - Lighting Upgrades

The majority of the lighting throughout all three buildings has been converted to LED and is controlled efficiently by occupancy sensors. A few non-LED fixtures were noted at the Transfer station. These fixtures have low run hours, however, changing over to LEDs will result in electric savings. Additionally, the Highway Garage has manual controls for the lighting in the garage bays. Infrequent occupancy patterns in this building may lead to long lighting runtimes when the lights are left on after workers leave to do work outside of the building. Installing occupancy sensors or another auto-off device would reduce the runtime of the lighting in the bays when they are not in use.

ECM-3: Fire Station and Transfer Station Weatherization

Small gaps around doors and windows are a source of air infiltration into the building. Air infiltration introduces unconditioned air that increases the load on heating and cooling systems necessary to maintain temperature set points. Weatherization includes installing weatherstripping on doors and windows, caulking gaps in the envelope and air sealing any unnecessary penetrations. GDS recommends conducting a thorough survey of the fire station and Hopper building at the transfer station to identify and address weatherization opportunities that will reduce energy costs.

ECM-4: Transfer Station (Hopper) – Ductless MSHP

The Hopper office is currently heated with an electric resistance baseboard and cooled by a window air conditioning unit. Both systems are inefficient and could be replaced by a ductless mini-split heat pump (MSHP) Heat pumps provide heating and cooling using only electricity and transfer energy from outside using a refrigeration cycle. When considering new high efficiency equipment, ensure the units have the highest SEER, EER, and/or HSPF rating available to maximize energy savings and provide the greatest economic return on the cost.

ECM-5: Fire Station - Ducted ASHP

The Fire Station offices and dormitory are served by aging propane furnaces with DX cooling. Both systems are inefficient by today's standards and could be replaced by a ducted air source heat pump (ASHP) system. Heat pumps provide heating and cooling using only electricity and transfer energy from outside using a refrigeration cycle. When considering new high efficiency equipment, ensure the units have the highest SEER, EER, and/or HSPF rating available to maximize energy savings and provide the greatest economic return on the cost.

ADDITIONAL MEASURES FOR CONSIDERATION

The measures identified in Table 3 below are recommended for future consideration. However, additional information is required to develop estimated costs and any associated benefit.

TABLE 2. SUMMARY OF ADDITIONAL MEASURES FOR CONSIDERATION

Measure	Location	Summary	Typical Payback (years)[1]
1	Fire Station and Highway Garage	**Review Thermostat Scheduling**: Programable thermostats are installed in multiple building however, they are not currently programmed with temperature setbacks. Implementing temperature setbacks will save energy by reducing the load during unoccupied periods. Typically, a temperature setback of five degrees can reduce annual energy use by around 15 percent. Confirming thermostat settings match occupancy schedules on a regular basis is also recommended. Frequently, occupants will manually override thermostat setpoints and schedules to address their specific comfort needs and forget to return the settings back to normal. Performing this review on a regular basis will help to maintain occupant comfort and ensure energy savings are realized.	n/a
2	Transfer Station	**Programmable Thermostats:** Manual thermostats control the waste oil heat in the Recycle building and the electric resistance baseboards in the Hopper office. Installing programable thermostats and implementing temperature setbacks will save energy by reducing the load during unoccupied periods.	1-2
3	Transfer Station and Fire Station	**EnergyStar Appliances (end-of-life)**: When it comes time to replace residential style appliances like refrigerators or laundry machines, choose high efficiency appliances. Most high-efficiency units can be identified by ENERGY STAR® ratings.	3-4
4	Fire Station	**Automatic Battery Charger**: All emergency vehicles are plugged in after returning from a call to recharge all batteries on board. They remain connected to power 24/7 until they leave for the next call. Investigating to determine if smart charging systems exist to reduce electric demand when charging is not required, or charge more efficiently is recommended.	4-5
5	Fire Station	**Heat Pump Water Heater (end-of-life)[2]**: Upgrading the existing electric domestic water heater with a heat pump water heater (HPWH) will more efficiently produce hot water. HPWHs reduce energy use by transferring heat from the surrounding space into the water rather than using an electric resistance heating coil. HPWHs provide efficiency ratings that are two to three times an electric resistance unit. As a result of transferring heat from the ambient air, HPWHs provide cool exhaust air	4-5

		that can be ducted to spaces to offset cooling loads further reducing energy use.	

The payback provided is an estimate and requires further refinement prior to implementing ECMs for incentive eligibility.
[2] These measures are recommended when equipment fail or are nearing end of useful life. Potential incentives would be based on the incremental cost difference between code-compliant and high efficiency equipment. Only high efficiency equipment is eligible for incentives.

RECOMMENDED NEXT STEPS

GDS will review the identified ECMs with the Town of Henniker to determine which, if any, are of interest to pursue. Once ECMs are selected for implementation, the Town has the following options:

- Solicit proposals from preferred contractors and coordinate with Eversource to submit an NHSaves Custom application.
- Request GDS or preferred engineering vendor perform a Technical Assistance (TA) study which would be cost shared between theh Town of Henniker and Eversource. GDS would coordinate with preferred contractors or existing partners to determine ECM cost, develop custom energy savings analyses, and assist the Town of Henniker with completing NHSaves Custom application and program documentation.

Energy Audit

Funded by

EVERSOURCE ENERGY

Community Center

57 Main Street

Henniker, NH

November 1, 2023

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE

S.E.E.D.S.

SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES

Margaret Dillon—603-532-8979—MDILLON@myfairpoint.net

Table of Contents

Introduction

This Energy Audit has been funded by Eversource. Funds may, or may not, also be available to help reduce cost for eligible Energy Saving Measures (ESM) including weatherization efforts and equipment upgrades.

The purpose of an energy audit is to identify energy saving measures (ESM) in a building. Computer simulated energy models are developed to estimate energy consumption based on the local climate conditions, physical dimensions and characteristics of a building, mechanical systems, presumed lighting, equipment, and occupancy patterns, in addition to a number of other variables.

With the building modeled in existing conditions, energy savings can be estimated for improvements to the thermal envelope and/or more efficient mechanical systems. The cost of those measures can then be analyzed in terms of predicted energy saved and savings potential from converting to different sources of energy. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures.

This audit has been prepared with the best of intentions to assist the Town of Henniker make informed decisions regarding energy saving improvements in keeping with long term goals for the property. We do not make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed.

Executive Summary

The Community Center is a historic brick building, originally constructed as a Church, and which consists of two floors. It was purchased by the Town in 2002 and now each floor has its own heating and cooling systems and serves two different purposes. A description of the building and a brief history is on pages 8-9.

The ceiling and foundation walls have some insulation, but the above grade brick walls are not insulated and account for an estimated 43% of the building's heat loss. Insulating to the interior of brick walls is not impossible but complicated and often not recommended. An article about the complexity of masonry walls, by New England's premier building scientist, is included in the Appendix.

Four ESM addressing envelope improvements have been recommended, along with making changes to thermostat settings and other controls. The summary on the next page shows that an estimated total investment of $8,554 will result in an estimated annual energy savings of $1,035 in both electricity and propane, based on current energy pricing, and 163 million Btu of source energy.

The upper floor is referred to here as the Meeting Room (MR) and the basement level as the Teen Center (TC). The MR's primary or first stage heating is by (2) propane fired forced warm air furnaces, with a standard air source heat pump (ASHP) as secondary—intended primarily as a quieter source of heating during meetings. The TC has a Hyper Heat ASHP with electric resistance baseboards installed as back up, but were found to be on and serving as primary heating during the site visit. Pages 11-17 go into considerable detail describing the existing systems and how they might be able to be operated or controlled differently to effect energy savings.

Completing the thermal envelope improvements will help both floors rely more on the more efficient heat pumps for heating by making adjustments to thermostat programs and installing programmable thermostats to control the TC's baseboards. Based on the estimated heat loss of that floor, and the published ratings of the heat pump, heating by very costly electric resistance baseboards should be all but eliminated.

Summary of Energy Saving Envelope Measures

The recommended ESM are described in more detail later in this report.

The chart below summarizes the estimated cost of each ESM, estimated annual dollar savings, a simple payback in years, and return on investment (ROI) of each measure based on the service life of the improvement.

ESM #	Energy Saving Measures (ESM)	Cost of Measure	Annual Savings	Simple Payback Years	Life of Measure	Investment Gain	ROI	Annual ROI
MR-1	Put Ceiling Fans on timer	$175	$68	2.6	25	$1,525	871.4%	9.5%
TC-1	Mysa Smart Thermostat	$1,000	$297	3.4	25	$6,425	642.5%	8.4%
MR2/TC-2	Weatherstripping	$450	$45	10.0	15	$225	50.0%	4.1%
TC-3	Rim Joists	$1,360	$160	8.5	25	$2,640	194.1%	4.4%
MR-3	Curved Ceiling Upgrade	$2,400	$241	10.0	25	$3,625	151.0%	3.8%
MR-4	Innerglass	$3,344	$224	14.9	25	$2,256	2256.0%	2.1%
All	TOTALS	$8,554	$1,035	8.3	25	$16,871	197.2%	4.5%

In total, an investment of an estimated $8,554 is predicted to save over $1,000 in annual energy costs at the three year average propane cost per gallon, and $0.13 per kWh. This would result in a simple payback within 8.3 years. Since ESM continue to save energy for the life of each measure, this also results in a minimum annual return on investment (ROI) of 4.5 % over each of the next 25 years. Again, the savings are based on recent average energy prices. If (when) prices increase, so too will the ROI.

This next chart presents the same ESM with resulting annual energy savings from each implemented measure and the annual reduction of CO2 emissions. Potential Eversource incentives are based on energy saved for the cost of the measures. Contact your Eversource representative, Jack Paloulek, to determine if the project is

ESM #	Energy Saving Measures (ESM)	Cost of Measure	LP Gallons Saved	kWh Saved	MMBTU Site Energy Reduction	MMBTU Source Energy Reduction	Tons CO2 Reductions Annually
MR-1	Put Ceiling Fans on timer	$175		523	1.8	5.9	0.23
TC-1	Mysa Smart Thermostat	$1,000		2285	7.8	26.0	1.0
MR 2/TC-2	Weatherstripping	$450	12	192	1.8	3.5	0.2
TC-3	Rim Joists	$1,360		1231	4.2	14.0	0.5
MR-3	Curved Ceiling Upgrade	$2,400	854	769	80.6	98.4	5.6
MR-4	Innerglass	$3,344	116	262	11.5	15.1	0.8
All	TOTALS	$8,554	982	5262	107.6	163	8

Also recommended is replacing the 21 year old 40 gallon electric water heater with a far more efficient heat pump water heater. Savings will be determined by the amount of water consumed as well as the added benefit of dehumidification from the heat pump—somewhat offset by the space cooling. Utility incentives for equipment are not based on predicted savings but by the efficiency of the selected product.

Assessed Values for The Grange and Other Model Inputs

The thermal envelope is the assembly of materials which form the barrier between inside conditioned space and outdoor weather and climate. Its ability to conserve heat and manage moisture determines, primarily, the heating load or demand of a building. Continuity and thickness of insulation, in direct contact with air barrier, is key to an effective thermal barrier.

Square Feet Area (whole)	4,585	
Volume (ft3) Upper	60,870	
Design Temps	Outdoor Dry	Indoor Dry
Winter	-2	70
Summer	87	75
Reference City	Concord NH	

Summary reports for load calculations of the existing and retrofitted condition has been included at the end of this study. Below is a summary of values for existing and improved envelope components.

Envelope Component	Surface Area FT2	Assessed Effective R-Value	U-Factor	Improved U-factor	Improvement
SP Historic Windows with Ext. Storm	296	1.29	0.78		Inner-Glass
SP Wood Frame 5/4	12	1.1	0.91		
Exterior Wood Door	37	1.85	0.54		Weather-Strip
Exterior Metal Doors	61	2.82	0.35		Weather-Strip
12" Brick Walls, plaster and paint	2412	6.1	0.16		
Framed walls - 2006	264	10.3	0.097		
Basement walls	1335	8.5	0.12	0.091	Dense pack voids
Exposed Foundation & Slab Edge	196	9	0.11		
Rim Joists	160	3	0.33	0.056	3" SPF with intumescent paint
Above Flat Ceilings	1936	42	0.02		
Above Curved Tin Ceiling	600	13.5	0.07	0.02	Blow in or place R38
Volume: 60,870 ft3 Above Grade		Exist		Improved	
CFM Air Leakage Winter		110		80	

Other formulas used in this analysis:

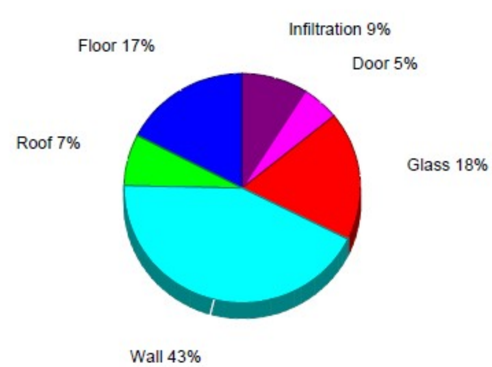
Propane: 91,300 Btu per gallon for site energy
Source energy: 104,995 Btu per gallon (1.15xSite)

Electric: 3412 Btu per kWh site energy.
Source energy: 11,361 Btu per kWh

CO_2 Emissions:

Propane: 12.35 lbs per gallon

Electric: CO_2 lbs = kWh X .89



Heat loss by the thermal envelope component

Historic Energy Use Analysis

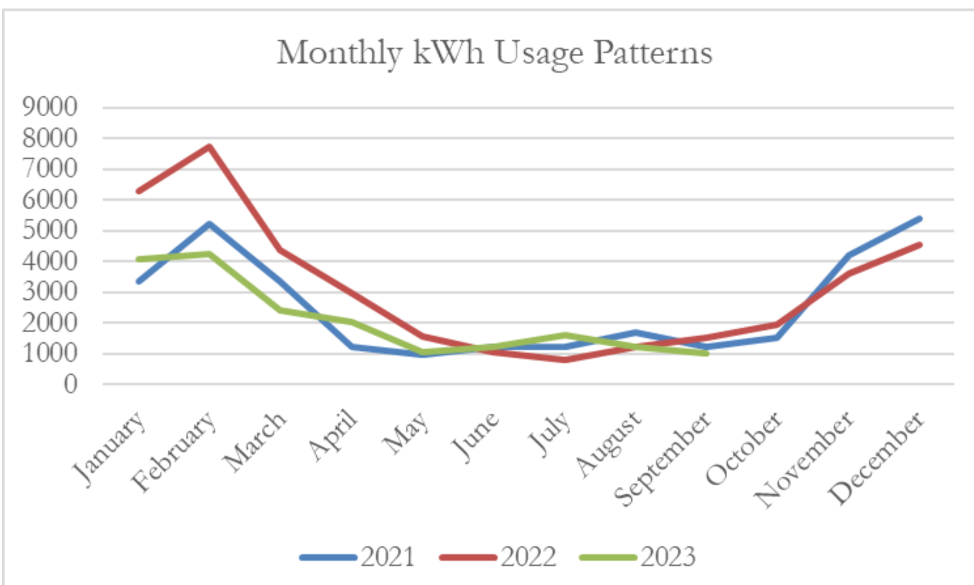
The energy analysis below is based on the energy data provided for 2022.

Energy	Units	Site Btus	Source Btus	$Cost
Electric kWh	34,199	116,686,988	388,534,839	$5,211
Propane	1,281	116,955,300	134,498,595	$2,176
Totals		233,642,288	523,033,434	$7,387
EUI KBtu/FT2	5160	45.3	101.4	$1.43

The Energy Utilization Index (EUI) offers a simple snapshot analysis of a building's energy use by looking at total amount of energy input (converted to Btu's) divided by the floor area of conditioned space. "Site Energy" refers to units of energy delivered to a site. Source energy includes transmission and some allowance for off site generation and other considerations.

Based on the information provided the Site EUI for 2022 was 45.3 KBtu/ft2 for the whole building. Source EUI was 101.4 KBtu/ft2, with a cost per square foot of $1.43per ft2 based on current energy prices. Since the per unit cost for energy can vary greatly over time, converting all forms of energy to Btus is a more useful way of looking at a building's energy demands and potential reductions from energy saving measures.

Monthly patterns of electric consumption can sometimes tell a useful story, though assumptions are never as useful as hard facts. Still, it is most likely that the peak consumption pattern in the winter is due to the use of electric heating, especially in the basement where electric resistance (ER) baseboards are used to supplement, or instead of, the one indoor heat pump unit.



Electric heating is estimated to consumer 25,000 kWh, or over 66%, of the annual electric consumption. In addition to the high efficiency of heat pumps, another significant advantage if the potential to generate clean, renewable energy on, or near to, the site of use.

KW Demand and the Cost of Supply

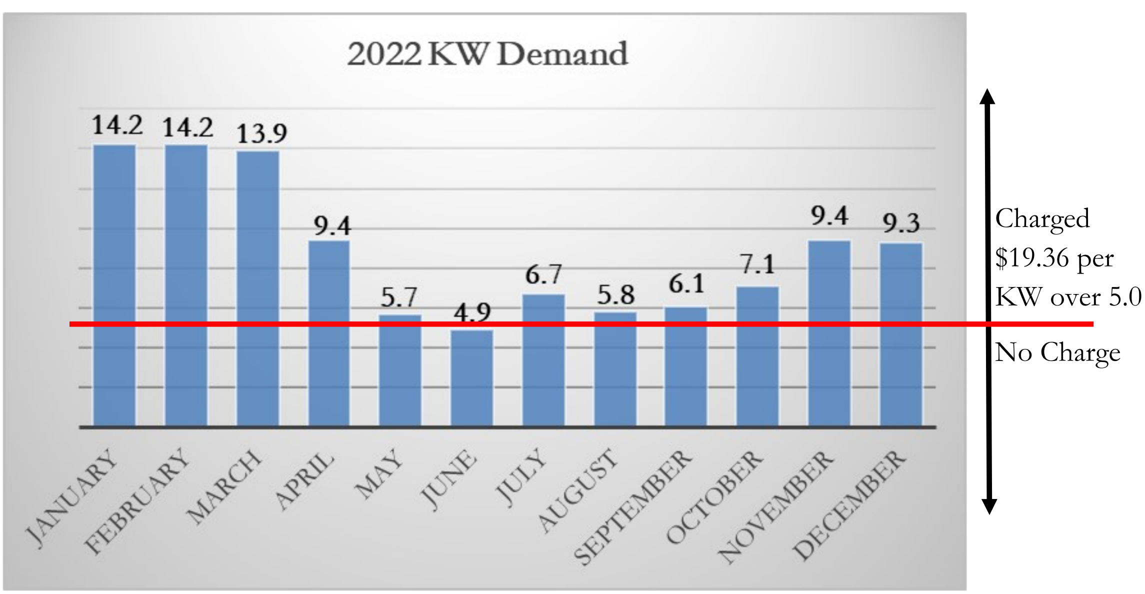
The KW Demand is determined each month by the peak call for power during any 30 minute window within a billing cycle. The total charges for KW Demand in 2022 was $906, or just over 17% of the total cost for electricity in 2022.

Corresponding with the highest usage of kWh, demand for power was highest in the coldest months of the year, due to space heating. Reducing reliance on the electric baseboards would reduce both demand for power and actual consumption. Heat pumps operate most efficiently when left at a stable thermostat setting.

Reducing electric usage saves energy and monthly costs in both the supply side (actual electricity used) and the delivery side (the very real transmission costs of delivering kWh to the meter, maintaining lines, etc).

Lowering peak demand on the regional grid plays a critical part in reducing the need to build more generation plants. It may be impacted by a reduction in kWh consumption, but is mostly determined by time and the appliance used. Customers are allowed a peak use of 5.0KW each month before incurring charges.

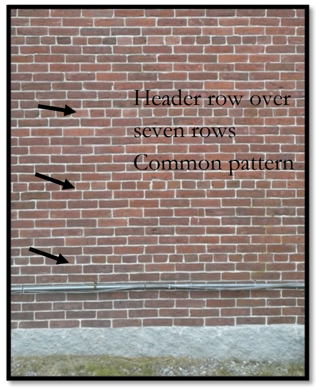
A good explanation about Demand Charges can be found at [Making Sense of Demand Charges: What Are They and How Do They Work? - Renewable Energy World]

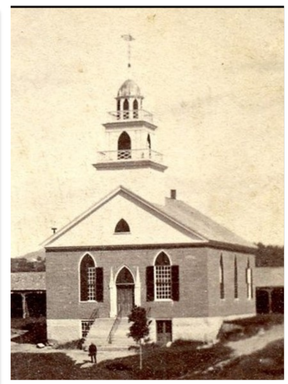


Building Description and Brief History

The one story brick Henniker Community Center was constructed in 1834 as a Church on a large granite block foundation. "The granite was quarried in Henniker, likely by William Smith who obtained the granite from ledge in the eastern part of Henniker."

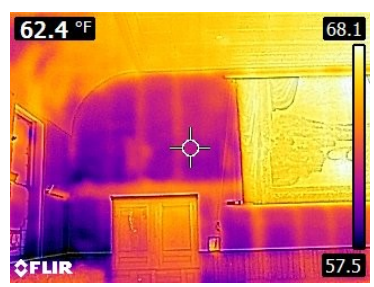
"The brick walls are laid in the Common or Bond pattern of seven common bond rows and an eight header row. The exact source of the brick is not known…(though) extensive brick making was conducted in Hooksett, the most likely nearby source." A photo from around the 1920's shows the interior walls with likely lathe and plaster finished walls.





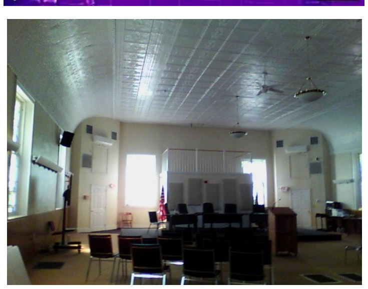
Circa 1870's

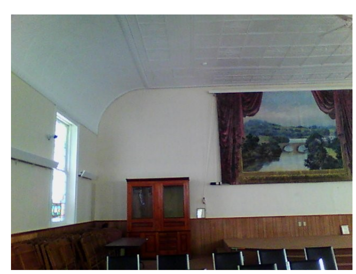
Thermographic imaging taken for this study indicates large wood framing, still without any insulation against the brick. Adding insulation in the walls would result in a substantially improved thermal envelope and occupancy comfort with significant energy savings. However insulation would also result in colder brick and the risk of degradation of the bricks and mortar from freezing and thawing. The level of risk depends greatly on the type of brick and mortar—which can only be determined through chemical analysis.



The most effective and risk-free way to dramatically improve the thermal envelope of masonry buildings is to insulate on the exterior of the brick, adding a drainage plane and new exterior brick façade, though this strategy conflicts with current historic preservation goals, of significant interest for this building in particular.

With respect to the goals of energy efficiency and a carbon neutral economy, Dr. Lstiburek's "The Perfect Wall", Building Science Insight 001, is in the appendix.





* Information, and some photos taken, with gratitude, from the Application to the NHDHR, Individual Inventory Form, Completed by Susan Fetzer, August 1, 2023.

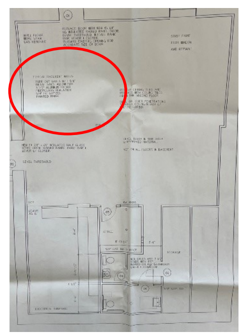
From 1834 till 1969, the building served as a Baptist, then Methodist house of worship on the upper floor with the vestry in the lower, basement level.

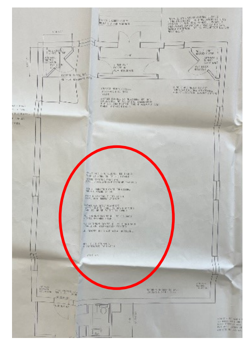
Following five years vacancy, it was purchased in 1974 by the Henniker Masonic Association and served as a place for meetings and activities until it was again sold to the Town of Henniker in 2002.

"The sale (to the Town) included three stipulations: the building would be available for use by community organizations without charge, a granite monument with the Masonic emblem would be retained in the building as a representation of its prior use and finally, if the building was ever sold for non-municipal purposes, half the proceeds would be payable to the Masonic Association in Hillsborough."

(Application to the NHDHR, Individual Inventory Form, Completed by Susan Fetzer, 8.1.2023)

The only drawings available were floor plans made in 2003 by Architectural Link out of Pembroke. Those plans included brief notes regarding insulation.

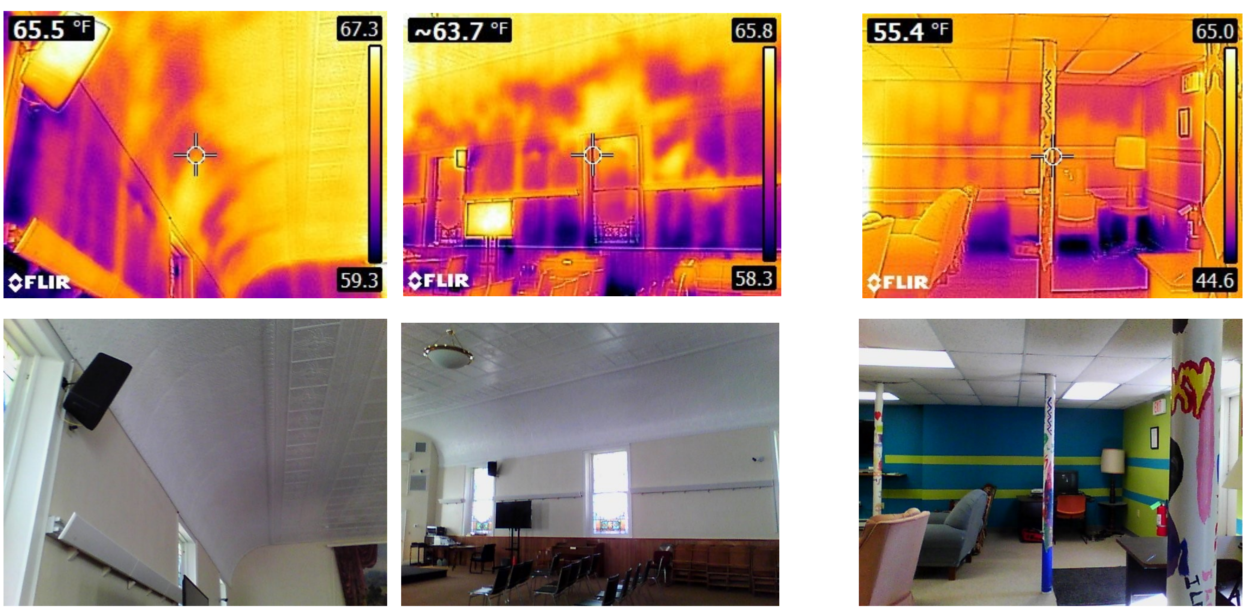




"remove acoustic ceiling tile and grid, repair existing tin ceiling, blow in insulation over tin ceiling minimum R-value of 38"

Presumably, this was done, though IR images suggest that insulation covering the curvature of the ceiling was minimal at best and offers an opportunity for improvement. There may be access to an attic above the vestibule on the south where the bell rope extends, however accessing the attic was not attempted for this study.

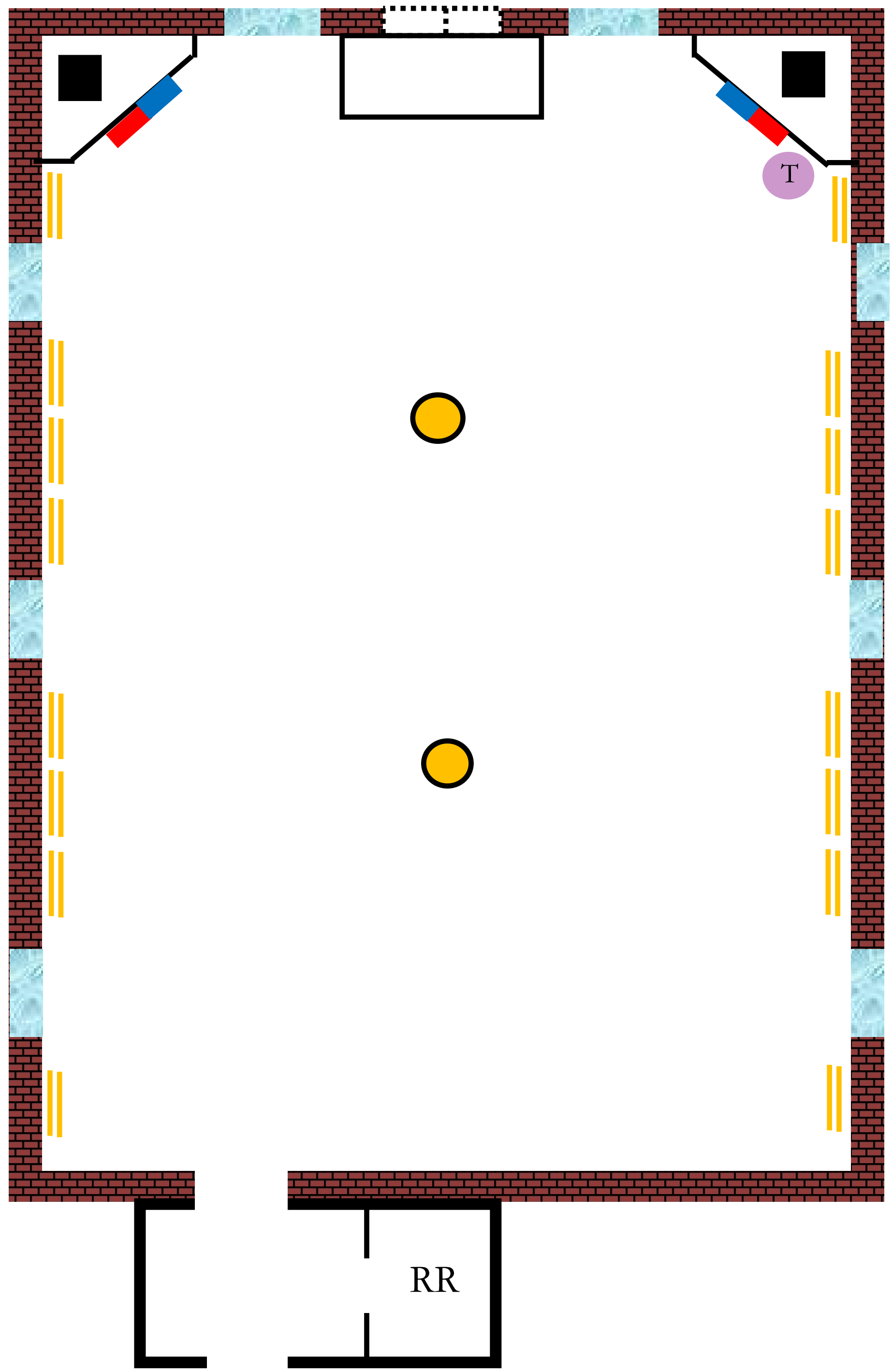
"Typical basement walls: Furr out walls with 1 5/8" metal stud. Allow for 3 1/2" aluminum faced fiberglass insulation. 5/8" FC Gyp Bd, painted finish"



Upper floor walls and ceiling (above) Basement walls (right) show non-continuous fiberglass batts with voids and cold air migration from the floor, indicating a non-continuous air and thermal barrier.

Upper Floor Graphic

Only roughly to scale.



Key

(2) 4' LED

Ceiling lights

Indoor Unit for heating & cooling

Thermostat

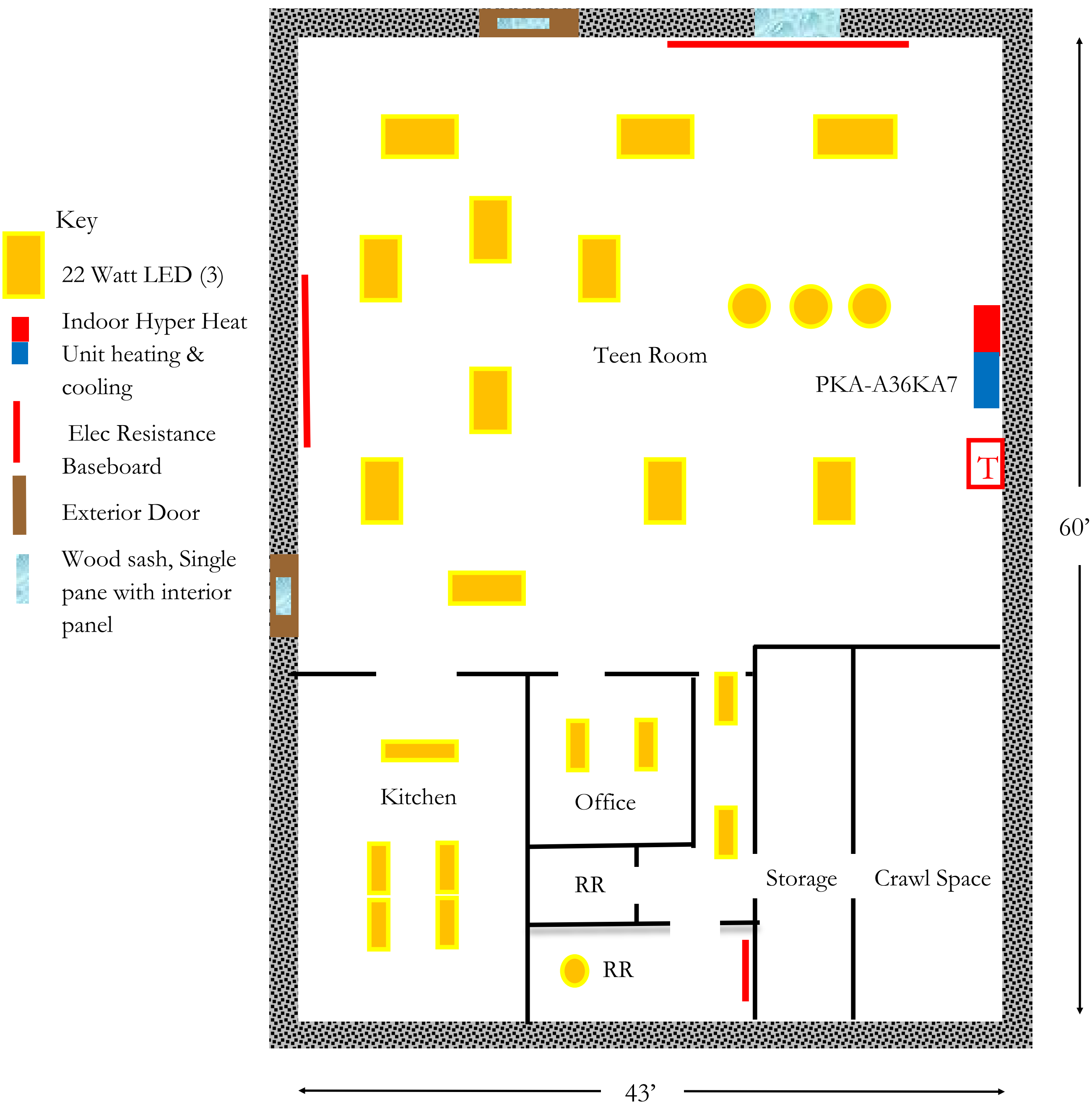
FHA Furnace (s)

Double Hung Single pane stained glass with exterior storm

Ceiling Fan

Exterior Door

Teen Center—Basement Level



ESM # TC1 and # MR-1

Turning devices off when they are not needed is the simplest and most cost effective way to save energy. In this case, reduce (or eliminate) the number of hours the electric baseboards and ceiling fans run by installing programmable to both controls. Fans can be shut off at least 50% of the time.

Mysa Smart Thermostat for Electric Baseboard Heaters $149 x 3 = $447

- 24/7 mobile app control
- Easy heating Schedules
- Voice control/smart home integration
- Premium design
- Temperature/humidity alerts
- In-app energy use monitoring
- Monthly room-by-room energy cost report
- Touch-screen control
- Group your thermostats in zones
- Temperature range 41°-86°F

BN-Link 7 Day Programmable in wall Timer Switch for Lights, Fan,s and Motors. $26..99 Amazon

- Easily set up to 18 on/off programs, each with 7-day options

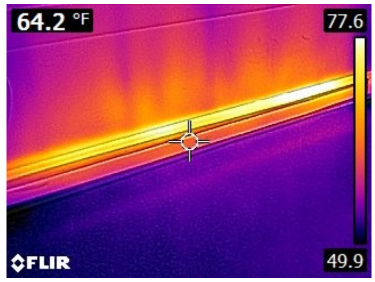
Replacing the Noisy Dehumidifier with a quieter and more efficient model is recommended.

Midea 50 Pint SmartDry Dehumidifier - $260.00

- • Energy Star
- • 50 pints/day
- • Smart Phone compatible
- • Built in Pump

Teen Center Electric Heating

On the day of the CC first site visit, March 27, the outdoor air temperature (OAT) was about 36° F. The heat pump was not running, but all three electric resistance baseboards were on and the indoor air temperature was a comfortable 68°F, though unheated wall surfaces ranged from 52°-58°F. It is impossible to know how the baseboards are controlled, but the presumption is that they are likely relied on more consistently than the heat pumps, possibly because they warm the walls which may provide greater comfort than standing/sitting next to colder walls.



The Bin Analyses below reflects the 30 year average number of hours (for Concord, NH) the OAT falls within 5-degree "bins". It also reflects the estimated heating load for each bin, and whether the heating capacity of the installed heat pump (maximum of 38,000 Btu/hr at 5° OAT) is capable of meeting the heating load without a back up source.

In the top example, the hourly heated load, based on the assessment of the envelope and outdoor temperature, back up heating for the Hyper Heat PUZ-HA36NHA5 would expected to be only needed when the OAT dropped below around –5°F. That means the far more efficient heat pump *should* be able to maintain indoor ambient temperature for all but about 40 hours a year and the cost to run the back up resistance heat during those hours would be an estimated $11.

Based on a number of assumptions, it is estimated that the baseboard may be on far more than necessary which could results in an estimated $500 higher energy bill for the Teen Center.

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Bin Analysis Report - System 3 - Existing BASEMENT. ER OFF

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	42,146	35,824	0	0.000	35,824	0.00	1.42	1.42
-15 to -10	18	39,751	33,789	33,789	0.534	33,789	10.56	9.62	20.18
-10 to -5	19	37,357	31,753	31,753	0.836	0	16.46	0.00	16.46
-5 to 0	52	34,962	29,718	29,718	0.782	0	39.86	0.00	39.86
0 to 5	136	32,567	27,682	27,682	0.728	0	92.11	0.00	92.11
5 to 10	154	30,173	25,647	25,647	0.675	0	91.90	0.00	91.90
10 to 15	209	27,778	23,611	23,611	0.621	0	109.45	0.00	109.45
15 to 20	312	25,383	21,576	21,576	0.568	0	142.64	0.00	142.64
20 to 25	385	22,989	19,540	19,540	0.514	0	150.15	0.00	150.15
25 to 30	666	20,594	17,505	17,505	0.461	0	194.82	0.00	194.82
30 to 35	878	18,199	15,469	15,469	0.407	0	206.47	0.00	206.47
35 to 40	650	15,805	13,434	13,434	0.354	0	121.75	0.00	121.75
40 to 45	658	13,410	11,399	11,399	0.300	0	96.57	0.00	96.57
45 to 50	679	11,015	9,363	9,363	0.246	0	76.04	0.00	76.04
50 to 55	619	8,621	7,328	7,328	0.193	0	50.65	0.00	50.65
55 to 60	717	6,226	5,292	5,292	0.139	0	39.74	0.00	39.74
60 to 65	685	3,831	3,257	3,257	0.086	0	21.99	0.00	21.99
Totals:	6,838						$1,473.60	$11.04	$1,484.64

Energy Audit - Energy Analysis and Cost Comparison
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Elite Software Development, Inc.
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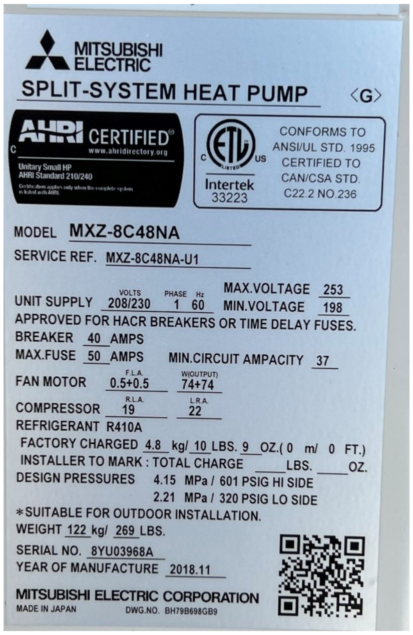
Bin Analysis Report - System 1 - Existing BASEMENT

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	42,146	35,824	0	0.000	35,824	0.00	1.42	1.42
-15 to -10	18	39,751	33,789	0	0.000	33,789	0.00	24.06	24.06
-10 to -5	19	37,357	31,753	0	0.000	31,753	0.00	23.86	23.86
-5 to 0	52	34,962	29,718	0	0.000	29,718	0.00	61.12	61.12
0 to 5	136	32,567	27,682	0	0.000	27,682	0.00	148.91	148.91
5 to 10	154	30,173	25,647	0	0.000	25,647	0.00	156.23	156.23
10 to 15	209	27,778	23,611	0	0.000	23,611	0.00	195.19	195.19
15 to 20	312	25,383	21,576	0	0.000	21,576	0.00	266.27	266.27
20 to 25	385	22,989	19,540	0	0.000	19,540	0.00	297.57	297.57
25 to 30	666	20,594	17,505	17,505	0.461	0	194.82	0.00	194.82
30 to 35	878	18,199	15,469	15,469	0.407	0	206.47	0.00	206.47
35 to 40	650	15,805	13,434	13,434	0.354	0	121.75	0.00	121.75
40 to 45	658	13,410	11,399	11,399	0.300	0	96.57	0.00	96.57
45 to 50	679	11,015	9,363	9,363	0.246	0	76.04	0.00	76.04
50 to 55	619	8,621	7,328	7,328	0.193	0	50.65	0.00	50.65
55 to 60	717	6,226	5,292	5,292	0.139	0	39.74	0.00	39.74
60 to 65	685	3,831	3,257	3,257	0.086	0	21.99	0.00	21.99
Totals:	6,838						$814.90	$1,174.64	$1,989.53

Upper Floor Heating and Cooling



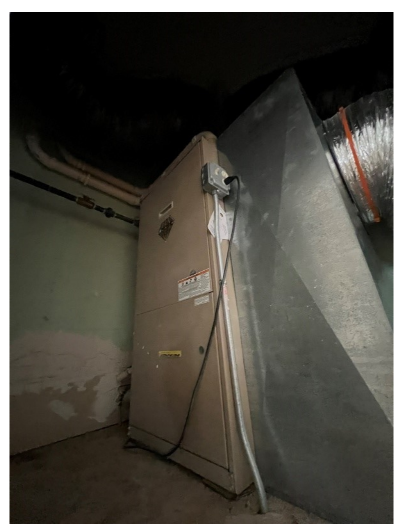
Outdoor Unit: MXZ-8C48NA

Multi Zone Heat Pump with (2) two-ton Indoor Units

MSZ-GL24NA

GENERAL FEATURES • Slim wall-mounted indoor units provide zone comfort control • The outdoor unit powers the indoor unit, and should a power outage occur, the system is automatically restarted when power returns • Multiple fan speed options: Quiet, Low, Medium, High, Super-high, Auto • Multiple control options available: - Hand-held Remote Controller (provided with unit) - kumo cloud® smart device app for remote access - Third-party interface options - Wired or wireless controllers • Hot-Start Technology: no cold air rush at equipment startup or when restarting after Defrost Cycle • Quiet operation • Smart Set: recalls a preferred preset temperature setting at the touch of a button

The multi-split heat pumps installed in the Community Room were intended to supplement the two propane condensing furnaces, located in each corner closet. The furnace blowers make too much noise to be used during meetings so the quiet heat pumps offer more acceptable heating.



Based on the assessed envelope, the estimated hourly 'peak' heat loss is just over 61,000 Btu with a temperature difference of 72 degrees between inside and outside. The capacity of each propane fired furnace is not available, but each of them likely has an output capacity greater than 61,000 Btu/hr.

Getting into the mathematical weeds a bit:

The overall average heat transmission of a building's thermal envelope is calculated by the u factors and gross surface area of each different component (UA).

Based on the assessment conducted in this study, the UA is an estimated 857 Btu/hr. The chart below reflects the heat loss at varying OAT when the indoor temperature is 70ºF.

OATºF	ΔTºF	Heat Loss Btu/Hr
60	10	8570
55	15	12855
50	20	17140
47	23	19711
40	30	25710
35	35	29995
40	30	25710
35	35	29995
30	40	34280
25	45	38565
20	50	42850
17	53	45421

Turning to the stated heating capacities of the outdoor compressor (heat pump) installed for the meeting room, (bottom chart) the maximum capacity at 17º is 35,000 Btu/hr. But the heat loss of the meeting room at 17 ºis 45,421Btu/hr. In other words, the heat pump won't be able to replace the hourly heat loss at that OAT.

We don't know what the heat pump capacities are exactly at different OAT, but its fair to assume that, based on the assessment and the chart to the right, it should be able to be effective at heating the space down to at least 30º OAT when the heat loss is less than 35,000 Btu/hr.

At a temperature difference of 40º degrees between inside and outside air temperature (40°ΔT), ie when its 70°inside and 30° outdoor air temp (OAT), the hourly heat loss is less than 35,000Btu (857 x 40 = 34280).

The efficiency of heat pumps is referred to as the Coefficient of Performance (COP). That is how many kWh worth of heat is moved for every kWh consumed. Since a kWh has 3412Btus, a COP of 2.45 means that 8,359 Btu is made available for space heating. To compare the cost of heating with propane vs heat pumps, we look at how many units of energy is required for one million Btu worth of heating.

1,000,000 / 8,359 = 119 kWh (at a COP of 2.45) 119 kWh x $.13 per kWh = $15.47 per million Btu

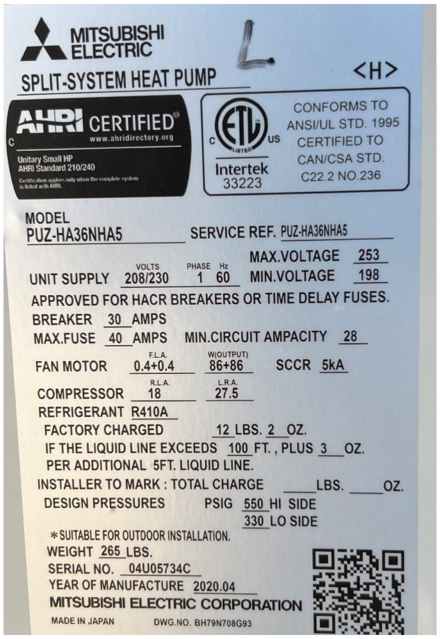
It takes about 12 gallons of LP in these furnaces to create a million Btu—so LP costs $17.52 per million Btu.

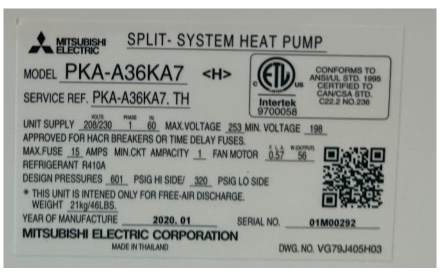
In sum: at current energy prices, it is less expensive to maintain the Meeting Room at 70º with the heat pumps till the OAT drops below 30 degrees, *then* rely on the propane units.

MXZ 8C48NA	Max Capacity BTU/H	Range Capacity BTU/H	Rated Input Watts	Efficiency COP
Heating at 47º OAT	54,000	22,500-54,000	4220/4990	3.75
Heating at 17º OAT	35,000	36,000	3,720	2.45
Heating at 5º OAT				
Cut out OAT				-4
	Max Capacity	Range	Rated Input	
Cooling	BTU/H	BTU/H	Watts	
	48,000	15,500-48,000	4,000-5,050	

Teen Center (Basement) Heating and Cooling

Outdoor Unit





PUZ-HA36NHA5 H2i Hyper Heat Production 2007– Retired

Manufactured Aril 2020 Refrigerant R410A

Serial # 04U05734C

- Variable speed INVERTER-driven compressor
- High heating capacity: flash injection circuit maintains 100% heating capacity at 5°F outdoor temperature
- Wide heating range: heating performance down to -13°F (average of 80% heating capacity)
- High speed heating at start up: Hyper-Heating INVERTER® reduces the time for heating at start up by about half compared to standard models
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft.
- Twinning of two indoor units possible with the 36 kBTU/H model
- High pressure/temperature protection

INDOOR UNIT FEATURES

- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode

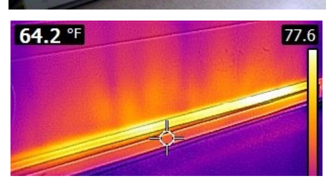
The heat pump for the basement is different. It relies on electric resistance as a back up so the unit selected was a "Hyper Heat" meaning it has greater capacities at lower OAT and it will always be less expensive to rely on maintaining 70º from the heat pump for heating, with no weekday set backs.

Calculated peak heat loss: 34,643 Btu/hr

	Max BTU/H	Rated BTU/H	Rated Watts	Efficiency COP
Heating at 47º OAT	40,000	38,000	3410	3.26
Heating at 17º OAT	38,000	25,000	3330	1.85
Heating at 5º OAT	38,000		6760	1.65
	Max Ca-	Rated Ca-	Rated	SEER
Cooling	33,500	33,500	2790	16.2
Moisture Removal	8.7	pints/hr		

Data from Mitsubishi Submittal

Three electric resistance (ER) baseboards, for a total of 20 linear feet) provide heating of the walls via both convection and radiant heat transfer. Where as heat pumps which transfer heat through compression and a refrigerant, ER generates heat at an efficiency of about .99% or a COP of less than 1. That means every kWh generates about 3378 Btu, ($38.48 per million Btu) where as the heat pump moves between 11,123 and 5,600 Btu per kWh ($11.68-$23.14 per MMBtu).



Thermostat Set Backs

There is a bit of controversy around whether setting a thermostat to a lower temperature saves energy or not.
Two common myths:

1. "Thermostat setbacks during the winter won't save you money. Any energy you saved when the thermostat was turned down will be lost because of the amount of fuel the furnace needed to get you back to a comfortable level."
2. "Setting your thermostat back will save energy, but no more than four degrees." (or 6 or some set number)

The reality is that lowering the indoor air temperature through thermostat setbacks for fuel burning equipment almost always saves heating energy because one of the factors of heat transfer is the temperature difference between inside and outside (aka delta T or ΔT): the lower the ΔT, the slower the rate of heat transfer, therefore heat loss is reduced. While its true that a furnace or boiler will run longer to bring the temperature back up to comfort levels, fossil fuel (and biomass) equipment operates more efficiently when it keeps running as opposed to turning on and off multiple times. For those two reasons, the energy saved from lower setbacks will *almost* always be more than the energy used to bring it back up to temperature. NOTE: This does NOT apply to variable speed heat pumps which operate most efficiently when left at one temperature.

But it is especially true for single stage oil fired equipment which is 'oversized'. That is when its hourly BTU output capacity far exceeds the hourly heat loss. Ideally, peak capacity will equal peak heat lost—ie the BTU/hr heat loss during the coldest hour of the location's winter, occurring 99% of the time on average. But non-modulating furnaces and boilers are frequently oversized—but as much as 50-150% . So when it comes on to satisfy the thermostat setting, it puts out a lot of heat, likely turns off fairly quickly, then on again minutes later. This on and off again is referred to as 'short cycling' and it results in low seasonal efficiency. (There are other maintenance reasons for short cycling, including a damaged flame sensor and dirty or misaligned air filters, so regular maintenance and inspections and can keep a furnace performing as efficiently as possible.)

But when a building is unoccupied overnight or for days at a time, keeping the thermostat set back means that the boiler will be off for many if not most of the winter hours, then run at its highest efficiency to recover.

All that said, there are other considerations with thermostat set backs, especially in a building with minimal insulation levels. As surfaces cool, there is a risk of condensation forming if surface temperatures drop below the dew point, though with low interior humidity, this should be a very low risk. The other common consideration is preventing the risk of freezing pipes on exterior walls, though again, this should not be an issue in the Community Center as long as the baseboard in the meeting room restroom is left on to 45 degrees.

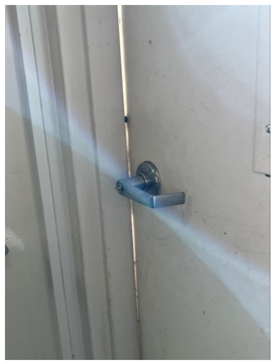
There is likely an 'optimal' set back temperature for the propane and oil systems in these buildings. But it is unique to each building based on the thermal performance of the envelope and which will vary for each hour as the delta T varies. I've asked contractors who recommend specific set back temperatures, why they pick 4º or 6º or whatever and the response has usually been something on the order of "because its complicated and customers won't understand. They just want simple instructions."

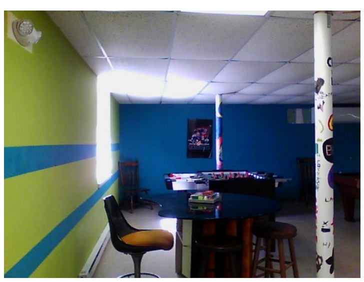
The mission of S.E.E.D.S. is based on the principle that to transition to a low energy, carbon neutral economy, people, as consumers, deserve to at least be offered the opportunity to understand the complexities of physics as they relate to our energy usage. For more information, check out the links below.

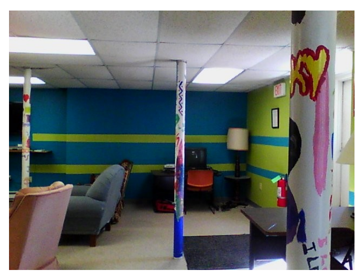
https://cbe.berkeley.edu/research/setpoint-energy-savings-calculator/
https://www.energyvanguard.com/blog/if-you-think-thermostat-setbacks-don-t-save-energy-you-re-wrong/
https://www.thisoldhouse.com/heating-cooling/21016013/how-thermostat-setbacks-save-money

ESM # MR-2 & TC-2

The south facing door to the Teen Center is in worse functional condition and has larger air gaps than the wood door above. Again, adding weather-stripping is a cost effective energy saving improvement, but this door is rusting and hard to open and close and, in my opinion, replacing it with a new insulated door would be a priority over the historic door above it.







ESM # TC-3

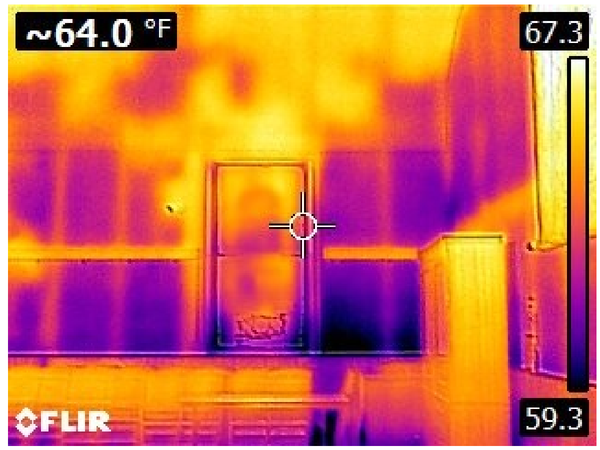
This vapor barrier was installed at some point, presumably to reduce moisture loads from exposed earth or rock. Reducing moisture loads does reduce the amount of vapor that needs to be extracted by a dehumidifier so does save energy. But even greater savings—and load reductions—can result from insulating rim & band joists, foundation walls, and even floors.

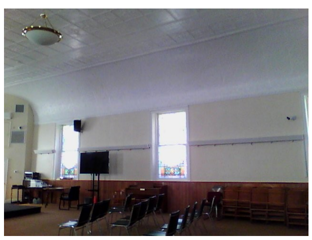
The recommendation is to spray 3" closed cell foam into all accessible rim/band joists (an estimated 160 ft2 here and above suspended ceiling tiles) and onto this membrane from the top of the foundation to 2-3 sloped feet below grade. Also spray at bottom plate of interior wall IF/SO to create a continuous vapor barrier. An intumescent paint needs to be applied over the foam to meet a 15 minute flame barrier, per code.

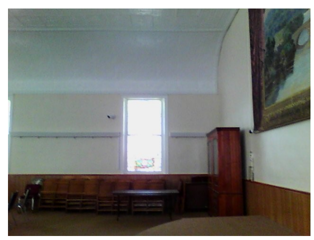
Where possible via raising suspended ceiling tiles, blow in mineral wool insulation into bays with voids or compromised fiberglass batts. Mineral wool is recommended over cellulose as it resists moisture from potential condensation on cold granite.

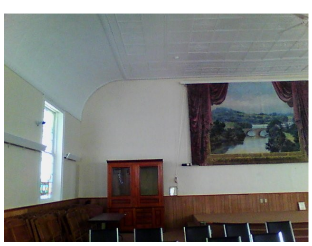
Upper Level Meeting Room—ESM #MR-3

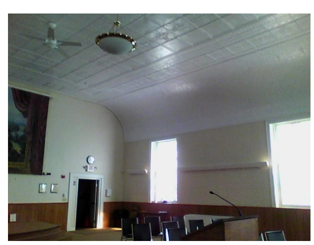
Thermographic (aka Infra Red or IR) images depict differences in surface temperatures. Darker colors indicate cooler surfaces than brighter colors. Dark "blobs" or streaks can indicate cold air leaking into the building on a cold day, or washing through low density insulation such as fiberglass. Though in this case, the voids or uninsulated and narrow wall cavities reflect the highly conductive cold brick of the exterior walls.

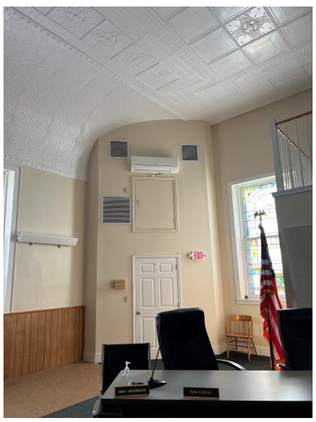


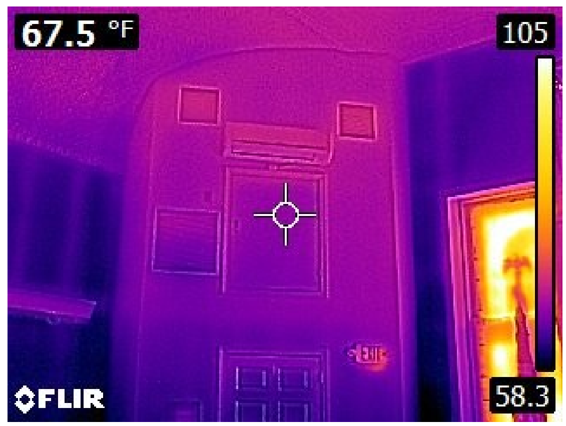


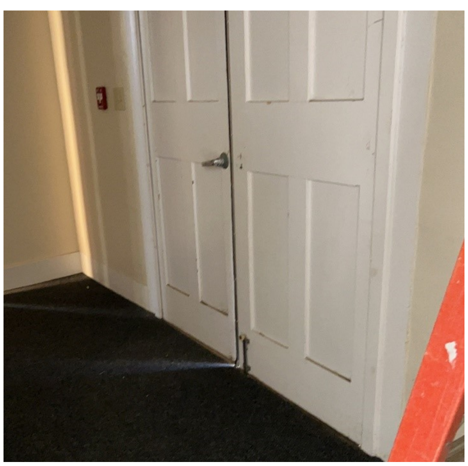












There are apparently plans to replace the double wood paneled door. The most cost effective upgrade would be to install commercial grade weather-stripping to close the gaps around the edges and reduce cold air infiltration. It is true that the door itself has a relatively low resistance to conductive heat transfer (ie low R-value). Even on this cold day in March, the solar gains are actually contributing BTUs into the vestibule. But its also the case that the heat loss of all four exterior doors in the building only accounts for about 5% of the total heat loss. This means that replacing the door will save energy, but the cost vs savings would result in a very long payback, where as just sealing the gaps of all doors for a fraction of the cost would yield greater savings than replacing this door.

ESM # MR-4 Interior Glazing Units

Exterior storm windows do reduce the amount of heat loss through windows to a certain extent, by adding an air space between the single pane of glass and storm. Importantly, they also serve to protect historic window frames and glass. But they do not stop air infiltration because they need 'weep holes' to allow drainage of condensation that forms.

As restoring historic wood windows becomes increasingly popular, many companies now offer a variety of interior options which are less expensive than full replacements and often as, or more, effective at reducing heat loss.

Interior glazing panels are a very effective option. They can be custom made with wood for $800-$2,000, OR a non wood unit can be custom ordered on line and easily installed for less than $300. In this case, a compression fitting unit is estimated to cost $418 per window.

They can be single units and easily removed, or double hung, and left in place.

The statements below were copied in part from stormwindows.com and reference Innerglass Windows specifically, though many of the statements describe any quality interior glazing panel. Advantages include:

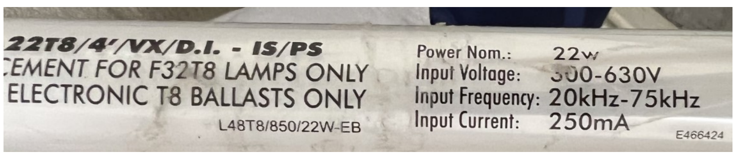
- Uses a concealed stainless steel springing system that requires no all-around track. It conforms to the window opening, automatically compensating for most out of square conditions.
- Custom made to your window dimensions, we can fit any window, no matter how crooked!
- Significantly more effective at insulating your home and lowering your heating and cooling bills than traditional exterior storm windows.
- Much tighter than exterior storms, because outside storm windows must be ventilated (you know, the weep holes) to get rid of the condensation that has already happened.
- So tight it provides a vapor barrier on the warm side that stops condensation in the first place.

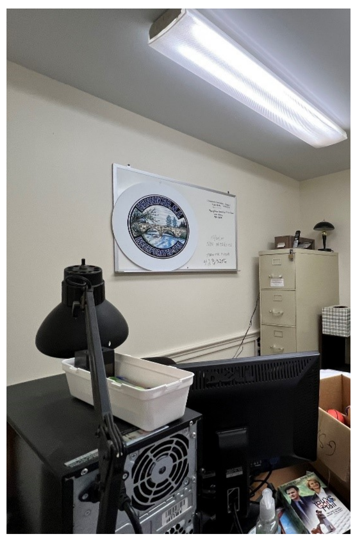
Innerglass Window Systems pioneered the use of high performance Low-E glass in our interior storm windows. Low-E glass doubles the R value of regular glass making you warmer in the winter and cooler in the summer. It also cuts out 2/3 of the ultra-violet rays that damage your rugs and furniture.

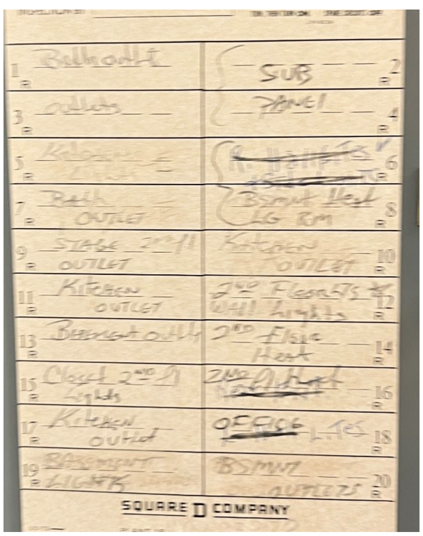
https://stormwindows.com/index.php/storm-windows-how-to-order/

Innerglass	U.I / FT2	Per	Per Unit	# Units	Cost
Compression Unit	152	$2.75	$418.00	8	$3,344

Inventory of Electric Appliances







The Basics of Heat Transfer in a Building

Heat moves in three basic ways in a building: Conduction, convection, and radiation.

Heat **conducts** to coolth or cold in any direction and through physical contact of materials. Insulation can slow the rate of heat loss to the outside. The rate at which it moves is determined by the type and thickness of material and the temperature difference between inside and outside. Compare holding a ceramic mug of hot water vs a glass of hot water, vs a glass of cold water. The skin of your hand will be heated—or cooled—based on the conductivity of the mug, glass, and the temperature difference of the water and your hand.

In a building in our climate, heat moves, or 'is lost' to the outside as it moves from inside heated space to the colder outside through an assembly of materials. For the walls, the assembly may consist of plaster or sheet-rock, brick, or wood framing with insulation in cavities (or not), exterior board sheathing, wood clapboards, or perhaps a thin layer of insulation and vinyl siding. The rate of heat loss varies with the difference between the inside temperature and outside temperature. That is why setting the thermostat back to 55 degrees when the building is unoccupied saves energy; because the rate of heat loss is slowed.

Heat can also be transferred through air or water by **convection.** While heat moves to cold via conduction, warmer air rises because it is lighter, or less dense, than cooler air. This means that insulation can only work well if it doesn't allow air to pass through it. The other way to say it is: Insulation needs to be in contact with an air barrier on all sides to perform as expected. Weatherstripping around doors and windows, for example, can stop cold air infiltration which, when warmed, rises to the ceiling and exfiltrates through any cracks or gaps in the ceiling material.

Insulation is usually described by its R-value, or resistance to allow heat transfer. But R-value doesn't tell the whole story because it only refers to conductive heat loss and doesn't consider convection. Manufactures of insulation test their products in a laboratory by placing it, fully lofted, in a perfectly sealed box, and measure the rate that heat moves from one side to the other to determine what "R-Value" to stamp on the product to be sold. If its not installed in exactly the same way, that R-value has very little meaning.

The third way heat moves is by **radiation**. This happens through space and from a warmer source to cooler surface in visual contact. Think of feeling the warmth of the sun and the immediate difference when a cloud blocks it. The sun still warms the earth surfaces and surrounding air, but direct radiation can be blocked—or shaded. Same thing with a wood stove. A hot stove warms air, but its greatest impact is by radiation which is only felt when one is in visible contact. And the further away, the less heat is felt. Its often tempting to replace windows because we feel so cold when next to them! That's because our body heat radiates to the cold surface. Insulated shades or quilts stops that radiative loss (but also eliminates view and daylight). Interior glazing panels can make a big difference for single pane windows because the air space raises the surface temperature of the inside glass.

In reality, all three mechanisms happen at the same time, though one usually dominates the others in terms of how much heat is moved. The role of heating system is to replace the heat that is lost through the envelope. This is described or measured as replacing BTU per hour (BTU/hr). If the heating system (electric baseboard, heat pump, oil or propane furnace or boiler, etc…) creates or moves more heat (BTU) in an hour than in lost to the outside, the system is considered "over-sized" which can waste energy unnecessarily. On the other hand, if the system cannot generate or move enough heat to replace what is lost in any given hour, the system is "undersized" and will not be able to maintain warm enough inside temperatures for human comfort. So correct sizing is important, most especially in systems which cannot modulate the heat output.

Hopkinton Community Center EXISTING
HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

RHVAC Residential HVAC Loads

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Tuesday, October 31, 2023

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	Hopkinton Community Center EXISTING
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	2,003	CFM Per Square ft.:	0.437
Square ft. of Room Area:	4,585	Square ft. Per Ton:	1,011
Volume (ft³):	60,870		

Building Loads

Total Heating Required Including Ventilation Air:	95,713	Btuh	95.713	MBH
Total Sensible Gain:	43,523	Btuh	80	%
Total Latent Gain:	10,878	Btuh	20	%
Total Cooling Required Including Ventilation Air:	54,401	Btuh	4.53	Tons (Based On Sensible + Latent)

Notes

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Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Miscellaneous Report

System 1 Existing Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	Yes		Yes	
Use Schedule:	Yes		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.108	AC/hr	0.108	AC/hr
	110	CFM	110	CFM
Infiltration Actual:	0.108	AC/hr	0.108	AC/hr
Above Grade Volume:	X 60,870	Cu.ft.	X 60,870	Cu.ft.
	6,600	Cu.ft./hr	6,600	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	110	CFM	110	CFM
Total Building Ventilation:	0	CFM	0	CFM

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.108 AC/hr (110 CFM)
Summer Infiltration Specified: 0.108 AC/hr (110 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	4.53	1,011	4,585	43,523	10,878	54,401	95,713	1,259	2,003	2,003	
System 1	4.53	1,011	4,585	43,523	10,878	54,401	95,713	1,259	2,003	2,003	18x18
Zone 1			4,585	43,523	10,878	54,401	95,713	1,259	2,003	2,003	18x18
1-Upper Meeting Room			2,419	35,688	6,941	42,629	61,070	803	1,642	1,642	15--7
2-Basement Level			2,166	7,835	3,937	11,772	34,643	456	361	361	4--6

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SP with Storm: Glazing-Historic windows refurbished with good exterior storms, U-value 0.78, SHGC 0.65	295.7	16,608	0	18,408	18,408
1A-cw-o: Glazing-Single pane, operable window, clear, wood frame, U-value 0.9, SHGC 0.64	12	778	0	471	471
11G: Door-Wood - Panel, U-value 0.54	37.4	1,454	0	364	364
11N: Door-Metal - Polystyrene Core, U-value 0.35	21.8	548	0	137	137
Metal with glass: Door-Wide metal doors with small window, U-value 0.67	61.2	2,952	0	738	738
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.16	2412.2	27,789	0	3,628	3,628
12B-0bw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, no board insulation, brick finish, wood studs, U-value 0.097	264	1,844	0	120	120
Block with R9: Wall-Block, Custom, Granite foundation steel studs and 3.5 fg batts, U-value 0.12	1334.8	11,532	0	1,505	1,505
R-38 spec.: Roof/Ceiling-Roof Joists Between Roof Deck and Ceiling or Foam Encapsulated Roof Joists, Custom, Blow in over tin ceiling. min R-38, U-value 0.026	1936	3,625	0	856	856
Slopes.Poor: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Slopes Fiberglass, U-value 0.077	600	3,326	0	2,864	2,864
22A-pm: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, heavy dry or light wet soil, U-value 1.18	196	16,652	0	0	0
Subtotals for structure:		87,108	0	29,091	29,091
People:	45		9,000	10,350	19,350
Equipment:			500	125	625
Lighting:	740			2,523	2,523
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 110, Summer CFM: 110		8,605	1,378	1,434	2,812
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Total Building Load Totals:		95,713	10,878	43,523	54,401

Check Figures

Total Building Supply CFM:	2,003	CFM Per Square ft.:	0.437
Square ft. of Room Area:	4,585	Square ft. Per Ton:	1,011
Volume (ft³):	60,870		

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Notes

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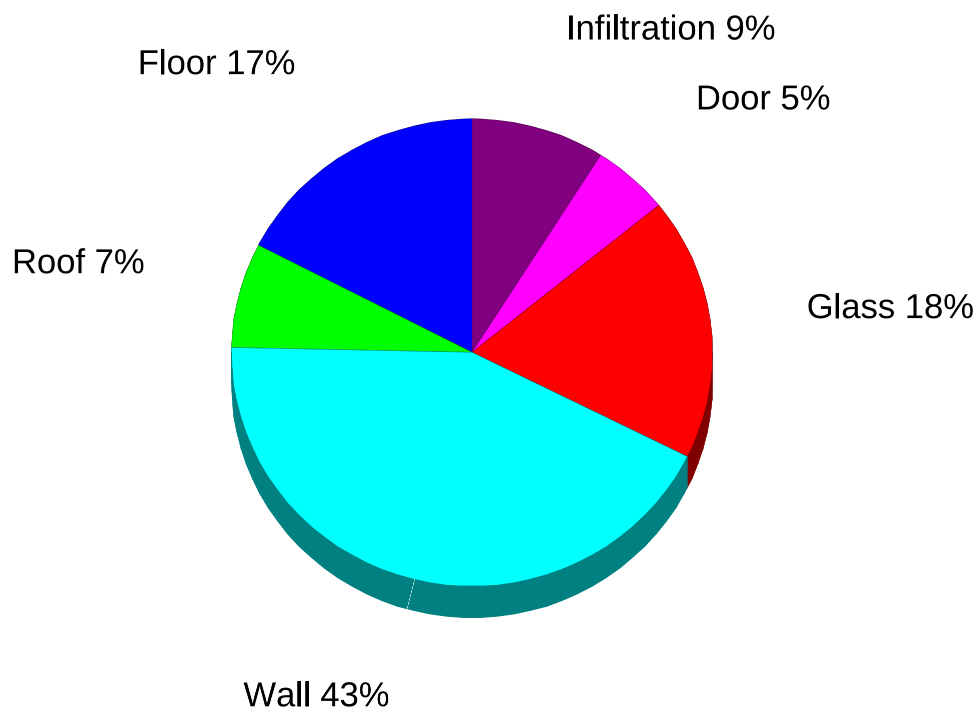
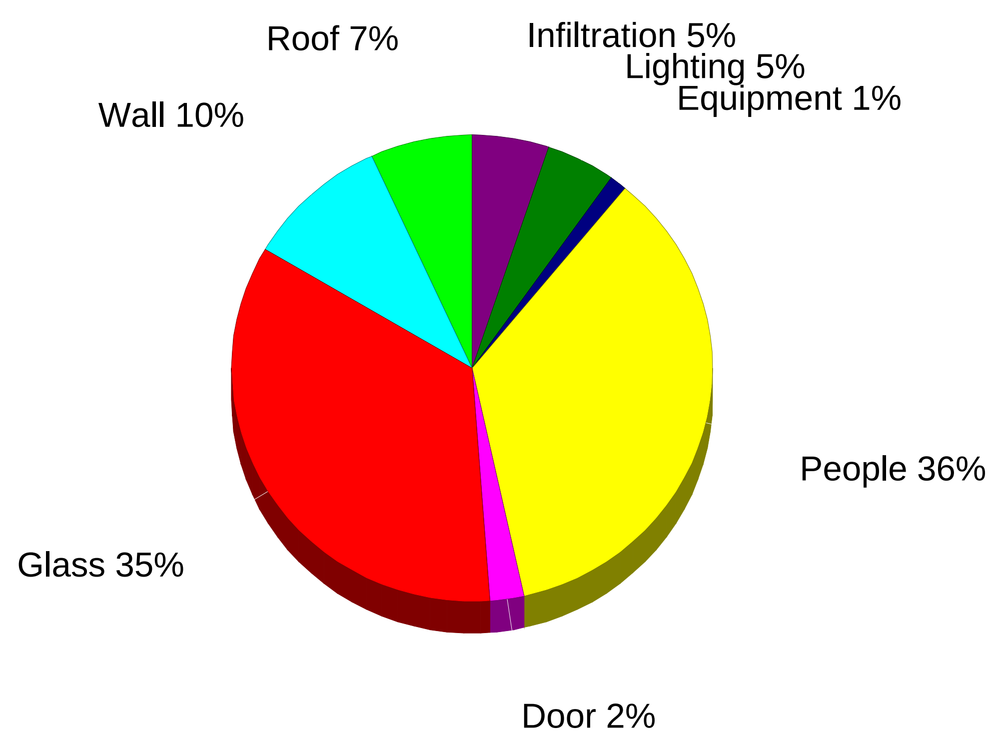
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Detailed Room Loads - Room 1 - Upper Meeting Room (Average Load Procedure)

General

Calculation Mode:	Htg. & clg.		Occurrences:	1	
Room Length:	59.0	ft.	System Number:	1	
Room Width:	41.0	ft.	Zone Number:	1	
Area:	2,419.0	sq.ft.	Supply Air:	1,642	CFM
Ceiling Height:	18.0	ft.	Supply Air Changes:	2.3	AC/hr
Volume:	43,542	cu.ft.	Req. Vent. Clg:	0	CFM
Number of Registers:	15		Actual Winter Vent.:	0	CFM
Runout Air:	109	CFM	Percent of Supply.:	0	%
Runout Duct Size:	7	in.	Actual Summer Vent.:	0	CFM
Runout Air Velocity:	410	ft./min.	Percent of Supply:	0	%
Runout Air Velocity:	410	ft./min.	Actual Winter Infil.:	75	CFM
Actual Loss:	0.087	in.wg./100 ft.	Actual Summer Infil.:	75	CFM

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
E -Wall-Brick 12" 59 X 13	656.1	0.160	11.5	7,559	1.5	0	987
S -Wall-Brick 12" 41 X 16	544.7	0.160	11.5	6,275	1.5	0	819
W -Wall-Brick 12" 59 X 16	833.1	0.160	11.5	9,598	1.5	0	1,253
N -Wall-Brick 12" 25 X 16	378.2	0.160	11.5	4,357	1.5	0	569
N -Wall-12B-0bw 33 X 8	264	0.097	7.0	1,844	0.5	0	120
S -Door-11G 5.5 X 6.8	37.4	0.540	38.9	1,454	9.7	0	364
N -Door-11N 3.2 X 6.8	21.8	0.350	25.2	548	6.3	0	137
E -Gls-SP with Storm shgc-0.65 0%S (3)	110.9	0.780	56.2	6,228	70.3	0	7,791
S -Gls-SP with Storm shgc-0.65 0%S (2)	73.9	0.780	56.2	4,152	38.2	0	2,826
W -Gls-SP with Storm shgc-0.65 0%S (3)	110.9	0.780	56.2	6,228	70.3	0	7,791
UP-Roof-R-38 spec. 60 X 30	1800	0.026	1.9	3,370	0.4	0	796
UP-Ceil-Slopes.Poor 60 X 10	600	0.077	5.5	3,326	4.8	0	2,864
UP-Roof-R-38 spec. 17 X 8	136	0.026	1.9	255	0.4	0	60
Subtotals for Structure:				55,194		0	26,377
Infil.: Win.: 75.1, Sum.: 75.1	3,031		1.939	5,876	0.323	941	979
People: 200 lat/per, 230 sen/per:	30					6,000	6,900
Lighting:	420						1,432
Room Totals:				61,070		6,941	35,688

Detailed Room Loads - Room 2 - Basement Level (Average Load Procedure)

General

Calculation Mode:	Htg. & clg.		Occurrences:	1	
Room Length:	57.0	ft.	System Number:	1	
Room Width:	38.0	ft.	Zone Number:	1	
Area:	2,166.0	sq.ft.	Supply Air:	361	CFM
Ceiling Height:	8.0	ft.	Supply Air Changes:	1.2	AC/hr
Volume:	17,328	cu.ft.	Req. Vent. Clg:	0	CFM
Number of Registers:	4		Actual Winter Vent.:	0	CFM
Runout Air:	90	CFM	Percent of Supply.:	0	%
Runout Duct Size:	6	in.	Actual Summer Vent.:	0	CFM
Runout Air Velocity:	459	ft./min.	Percent of Supply:	0	%
Runout Air Velocity:	459	ft./min.	Actual Winter Infil.:	35	CFM
Actual Loss:	0.134	in.wg./100 ft.	Actual Summer Infil.:	35	CFM

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
E -Wall-Block with R9 40 X 8	289.4	0.120	8.6	2,500	1.1	0	326
S -Wall-Block with R9 38 X 8	261.4	0.120	8.6	2,258	1.1	0	295
W -Wall-Block with R9 40 X 8	320	0.120	8.6	2,765	1.1	0	361
E -Wall-Block with R9 20 X 4	80	0.120	8.6	691	1.1	0	90
W -Wall-Block with R9 20 X 4	80	0.120	8.6	691	1.1	0	90
N -Wall-Block with R9 38 X 8	304	0.120	8.6	2,627	1.1	0	343
E -Door-Metal with glass 4.5 X 6.8	30.6	0.670	48.2	1,476	12.1	0	369
S -Door-Metal with glass 4.5 X 6.8	30.6	0.670	48.2	1,476	12.1	0	369
S -Gls-1A-cw-o shgc-0.64 0%S	12	0.900	64.8	778	39.3	0	471
Floor-22A-pm 196 ft..Per.	196	1.180	85.0	16,652	0.0	0	0
Subtotals for Structure:				31,914		0	2,714
Infil.: Win.: 34.9, Sum.: 34.9	1,408		1.938	2,729	0.323	437	455
People: 200 lat/per, 230 sen/per:	15					3,000	3,450
Equipment:						500	125
Lighting:	320						1,091
Room Totals:				34,643		3,937	7,835

Equipment Cooling Loads

Item Name	Continuous Output Sensible Btuh	Continuous Output Latent Btuh	Average In-Use Output	Percent Used per Hour	Sensible Load Btuh	Latent Load Btuh
Miscellaneous Equipment	125	0	100	100	125	0
Moisture loads	0	500	100	100	0	500
Total					125	500

Hopkinton Community Center IMPROVED
HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Tuesday, October 31, 2023

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	Hopkinton Community Center IMPROVED
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	1,638	CFM Per Square ft.:	0.357
Square ft. of Room Area:	4,585	Square ft. Per Ton:	1,184
Volume (ft³):	60,870		

Building Loads

Total Heating Required Including Ventilation Air:	82,729	Btuh	82.729	MBH
Total Sensible Gain:	35,589	Btuh	77	%
Total Latent Gain:	10,878	Btuh	23	%
Total Cooling Required Including Ventilation Air:	46,467	Btuh	3.87	Tons (Based On Sensible + Latent)

Notes

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Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Miscellaneous Report

System 1 Existing Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	Yes		Yes	
Use Schedule:	Yes		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.108	AC/hr	0.108	AC/hr
	110	CFM	110	CFM
Infiltration Actual:	0.108	AC/hr	0.108	AC/hr
Above Grade Volume:	X 60,870	Cu.ft.	X 60,870	Cu.ft.
	6,600	Cu.ft./hr	6,600	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	110	CFM	110	CFM
Total Building Ventilation:	0	CFM	0	CFM

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.108 AC/hr (110 CFM)
Summer Infiltration Specified: 0.108 AC/hr (110 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	3.87	1,184	4,585	35,589	10,878	46,467	82,729	1,088	1,638	1,638	
System 1	3.87	1,184	4,585	35,589	10,878	46,467	82,729	1,088	1,638	1,638	14x19
Zone 1			4,585	35,589	10,878	46,467	82,729	1,088	1,638	1,638	14x19
1-Upper Meeting Room			2,419	28,021	6,941	34,962	50,139	659	1,290	1,290	12--7
2-Basement Level			2,166	7,568	3,937	11,505	32,590	429	348	348	4--6

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Historic St & IP: Glazing-Historic single pane with exterior storms and interior glazing panels, U-value 0.37, SHGC 0.5	295.7	7,880	0	13,340	13,340
1A-cw-o: Glazing-Single pane, operable window, clear, wood frame, U-value 0.9, SHGC 0.64	12	778	0	471	471
11G: Door-Wood - Panel, U-value 0.54	37.4	1,454	0	364	364
11N: Door-Metal - Polystyrene Core, U-value 0.35	21.8	548	0	137	137
Metal with glass: Door-Wide metal doors with small window, U-value 0.67	61.2	2,952	0	738	738
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.16	2412.2	27,789	0	3,628	3,628
12B-0bw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, no board insulation, brick finish, wood studs, U-value 0.097	264	1,844	0	120	120
Block with R9: Wall-Block, Custom, Granite foundation steel studs and 3.5 fg batts, U-value 0.09	950.8	6,161	0	805	805
Block with R9: Wall-Block, Custom, Granite foundation steel studs and 3.5 fg batts, U-value 0.12	384	3,318	0	433	433
R-38 spec.: Roof/Ceiling-Roof Joists Between Roof Deck and Ceiling or Foam Encapsulated Roof Joists, Custom, Blow in over tin ceiling. min R-38, U-value 0.026	2536	4,748	0	1,121	1,121
22A-pm: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, heavy dry or light wet soil, U-value 1.18	196	16,652	0	0	0
Subtotals for structure:		74,124	0	21,157	21,157
People:	45		9,000	10,350	19,350
Equipment:			500	125	625
Lighting:	740			2,523	2,523
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 110, Summer CFM: 110		8,605	1,378	1,434	2,812
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Total Building Load Totals:		82,729	10,878	35,589	46,467

Check Figures

Total Building Supply CFM:	1,638	CFM Per Square ft.:	0.357
Square ft. of Room Area:	4,585	Square ft. Per Ton:	1,184
Volume (ft³):	60,870		

Building Loads

Total Heating Required Including Ventilation Air:	82,729	Btuh	82.729	MBH
Total Sensible Gain:	35,589	Btuh	77	%
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Total Cooling Required Including Ventilation Air:	46,467	Btuh	3.87	Tons (Based On Sensible + Latent)

Notes

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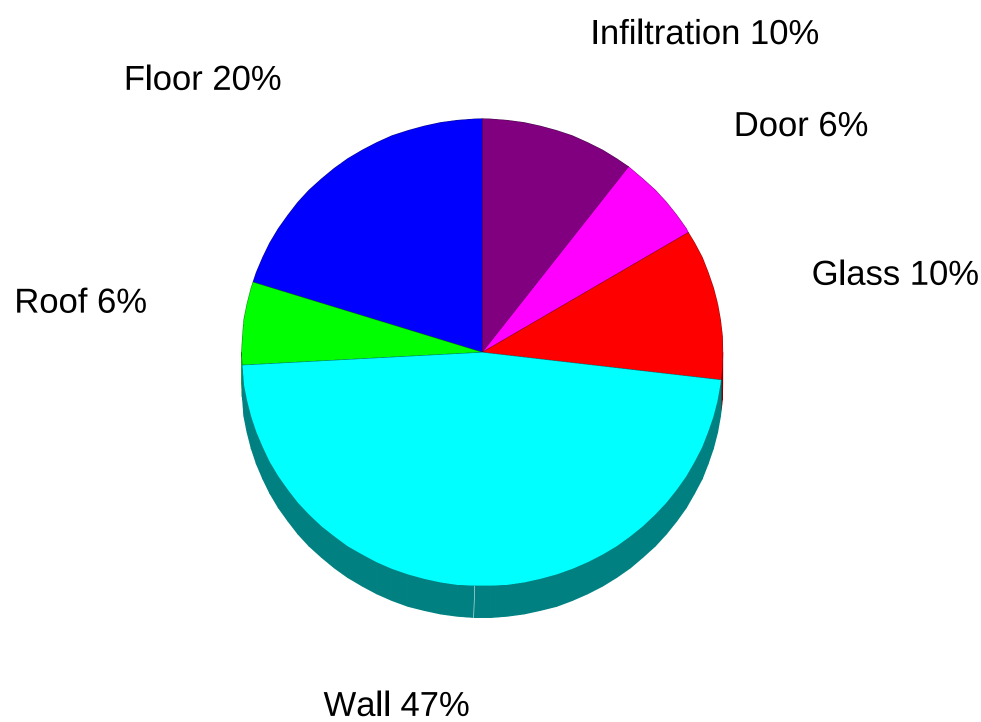
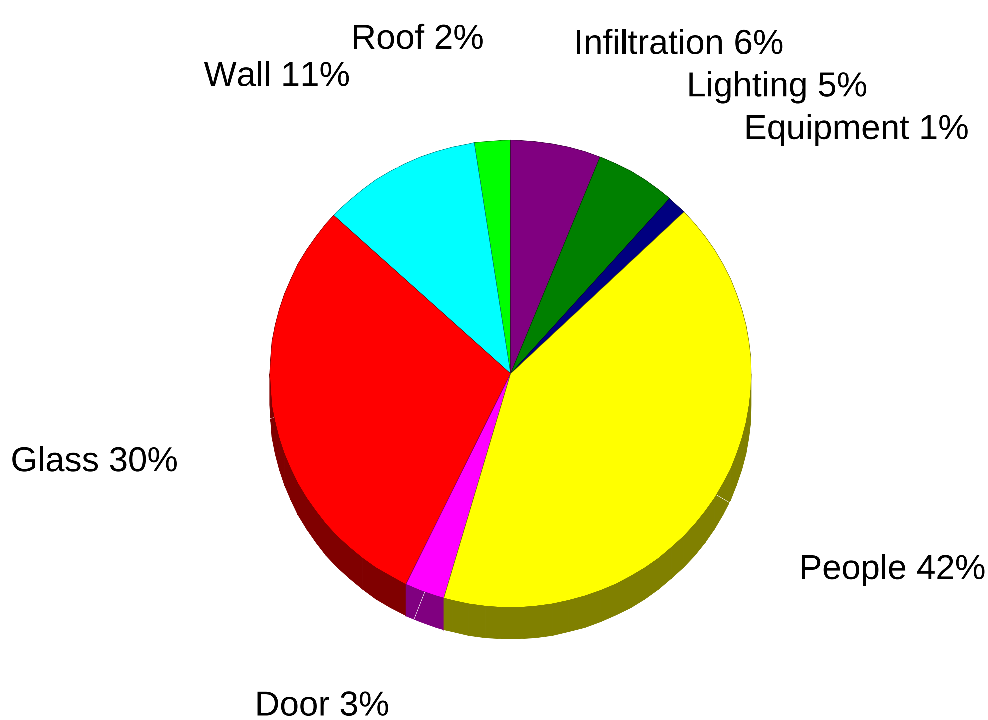
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Detailed Room Loads - Room 1 - Upper Meeting Room (Average Load Procedure)

General

Calculation Mode:	Htg. & clg.		Occurrences:	1	
Room Length:	59.0	ft.	System Number:	1	
Room Width:	41.0	ft.	Zone Number:	1	
Area:	2,419.0	sq.ft.	Supply Air:	1,290	CFM
Ceiling Height:	18.0	ft.	Supply Air Changes:	1.8	AC/hr
Volume:	43,542	cu.ft.	Req. Vent. Clg:	0	CFM
Number of Registers:	12		Actual Winter Vent.:	0	CFM
Runout Air:	107	CFM	Percent of Supply.:	0	%
Runout Duct Size:	7	in.	Actual Summer Vent.:	0	CFM
Runout Air Velocity:	402	ft./min.	Percent of Supply:	0	%
Runout Air Velocity:	402	ft./min.	Actual Winter Infil.:	75	CFM
Actual Loss:	0.083	in.wg./100 ft.	Actual Summer Infil.:	75	CFM

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
E -Wall-Brick 12" 59 X 13	656.1	0.160	11.5	7,559	1.5	0	987
S -Wall-Brick 12" 41 X 16	544.7	0.160	11.5	6,275	1.5	0	819
W -Wall-Brick 12" 59 X 16	833.1	0.160	11.5	9,598	1.5	0	1,253
N -Wall-Brick 12" 25 X 16	378.2	0.160	11.5	4,357	1.5	0	569
N -Wall-12B-0bw 33 X 8	264	0.097	7.0	1,844	0.5	0	120
S -Door-11G 5.5 X 6.8	37.4	0.540	38.9	1,454	9.7	0	364
N -Door-11N 3.2 X 6.8	21.8	0.350	25.2	548	6.3	0	137
E -Gls-Historic St & IP shgc-0.5 0%S (3)	110.9	0.370	26.6	2,955	51.3	0	5,685
S -Gls-Historic St & IP shgc-0.5 0%S (2)	73.9	0.370	26.6	1,970	26.7	0	1,970
W -Gls-Historic St & IP shgc-0.5 0%S (3)	110.9	0.370	26.6	2,955	51.3	0	5,685
UP-Roof-R-38 spec. 60 X 30	1800	0.026	1.9	3,370	0.4	0	796
UP-Roof-R-38 spec. 60 X 10	600	0.026	1.9	1,123	0.4	0	265
UP-Roof-R-38 spec. 17 X 8	136	0.026	1.9	255	0.4	0	60
Subtotals for Structure:				44,263		0	18,710
Infil.: Win.: 75.1, Sum.: 75.1	3,031		1.939	5,876	0.323	941	979
People: 200 lat/per, 230 sen/per:	30					6,000	6,900
Lighting:	420						1,432
Room Totals:				50,139		6,941	28,021

Detailed Room Loads - Room 2 - Basement Level (Average Load Procedure)

General

Calculation Mode:	Htg. & clg.		Occurrences:	1	
Room Length:	57.0	ft.	System Number:	1	
Room Width:	38.0	ft.	Zone Number:	1	
Area:	2,166.0	sq.ft.	Supply Air:	348	CFM
Ceiling Height:	8.0	ft.	Supply Air Changes:	1.2	AC/hr
Volume:	17,328	cu.ft.	Req. Vent. Clg:	0	CFM
Number of Registers:	4		Actual Winter Vent.:	0	CFM
Runout Air:	87	CFM	Percent of Supply.:	0	%
Runout Duct Size:	6	in.	Actual Summer Vent.:	0	CFM
Runout Air Velocity:	443	ft./min.	Percent of Supply:	0	%
Runout Air Velocity:	443	ft./min.	Actual Winter Infil.:	35	CFM
Actual Loss:	0.125	in.wg./100 ft.	Actual Summer Infil.:	35	CFM

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
E -Wall-Block with R9 40 X 8	289.4	0.090	6.5	1,875	0.8	0	245
S -Wall-Block with R9 38 X 8	261.4	0.090	6.5	1,694	0.8	0	221
W -Wall-Block with R9 40 X 8	320	0.090	6.5	2,074	0.8	0	271
E -Wall-Block with R9 20 X 4	80	0.090	6.5	518	0.8	0	68
W -Wall-Block with R9 20 X 4	80	0.120	8.6	691	1.1	0	90
N -Wall-Block with R9 38 X 8	304	0.120	8.6	2,627	1.1	0	343
E -Door-Metal with glass 4.5 X 6.8	30.6	0.670	48.2	1,476	12.1	0	369
S -Door-Metal with glass 4.5 X 6.8	30.6	0.670	48.2	1,476	12.1	0	369
S -Gls-1A-cw-o shgc-0.64 0%S	12	0.900	64.8	778	39.3	0	471
Floor-22A-pm 196 ft..Per.	196	1.180	85.0	16,652	0.0	0	0
Subtotals for Structure:				29,861		0	2,447
Infil.: Win.: 34.9, Sum.: 34.9	1,408		1.938	2,729	0.323	437	455
People: 200 lat/per, 230 sen/per:	15					3,000	3,450
Equipment:						500	125
Lighting:	320						1,091
Room Totals:				32,590		3,937	7,568

Equipment Cooling Loads

Item Name	Continuous Output Sensible Btuh	Continuous Output Latent Btuh	Average In-Use Output	Percent Used per Hour	Sensible Load Btuh	Latent Load Btuh
Miscellaneous Equipment	125	0	100	100	125	0
Moisture loads	0	500	100	100	0	500
Total					125	500

Community Center Energy Analysis
Energy Cost Analysis

for

Town Of Henniker

Henniker NH 03242

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Tuesday, October 31, 2023

Project Information

Project Title:	Community Center Energy Analysis	Company Name:	S.E.E.D.S.
Designed By:		Company Rep.:	Margaret Dillon
Project Date:	Monday, October 30, 2023	Company Address:	
Project Comment:		Company City:	
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client Address:		Company Fax:	
Client City:	Henniker NH 03242	Company Comment:	
Client Phone:			
Client Fax:			
Client Comment:			

Cooling Equipment — System 1

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 16.2 SEER

Heating Equipment — System 1

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 10 HSPF

System Description: Existing BASEMENT

Cooling Equipment — System 2

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 16.2 SEER

Heating Equipment — System 2

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 10 HSPF

System Description: Existing BASEMENT. ER OFF

Cooling Equipment — System 3

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 16.2 SEER

Heating Equipment — System 3

Model Type: Air Source Heat Pump
Model Number:
Capacity: 36,000 Btuh
Efficiency: 10 HSPF

System Description: Improved BASEMENT. ER OFF

Cooling Equipment — System 4

Model Type: Air Source Heat Pump
Model Number:
Capacity: 48,000 Btuh
Efficiency: 18.9 SEER

Heating Equipment — System 4

Heating Equipment	System 4
Model Type:	Air Source Heat Pump
Model Number:	
Capacity:	100,000 Btuh
Efficiency:	11.4 HSPF
System Description:	Existing Community Room

Cooling Equipment	System 5
Model Type:	Air Source Heat Pump
Model Number:	
Capacity:	48,000 Btuh
Efficiency:	18.9 SEER

Heating Equipment	System 5
Model Type:	Air Source Heat Pump
Model Number:	
Capacity:	100,000 Btuh
Efficiency:	11.4 HSPF
System Description:	Improved Community Room

Project Summary

General Project Information

Project Title:	Community Center Energy Analysis	Company Name:	S.E.E.D.S.
Project Date:	Monday, October 30, 2023	Company Rep:	Margaret Dillon
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client City:	Henniker NH 03242	Company E-Mail Address:	[redacted]

Design Data

Building Area:	4,585 sq.ft.	Cooling Load:	58,155 Btuh
People:	45	Heating Load:	95,957 Btuh
Occupancy:	0	Loads Adj. Factor:	0.85
		AC On Temp.:	0 °F
Actual City:	Concord AP, New Hampshire		
Weather Ref. City:	Concord, New Hampshire		
Summer Outdoor:	87 °F	Winter Outdoor:	-3 °F
Summer Indoor:	75 °F	Winter Indoor:	70 °F
Cooling Hours:	775	Degree Days:	7,471

Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Water Heating Cost	Domes. Energy Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
Existing BASEMENT	1	$1,971	$76	$60	$902	$0	$3,010	$251
Existing BASEMENT. ER OFF	1	$1,485	$77	$60	$902	$0	$2,524	$210
Improved BASEMENT. ER OFF	1	$1,384	$74	$11	$831	$0	$2,300	$192
Existing Community Room	1	$2,519	$236	$0	$0	$0	$2,755	$230
Improved Community Room	1	$2,071	$194	$0	$0	$0	$2,264	$189

Monthly Costs - System 1 - Existing BASEMENT

Monthly System Cost

	Cooling		Heating		Appliances		Hot Water		Total
Month	Cost	%	Cost	%	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$466.77	85.3%	$75.18	13.7%	$5.01	0.9%	$546.96
February	$0.00	0.0%	$353.66	81.5%	$75.18	17.3%	$5.01	1.2%	$433.85
March	$0.00	0.0%	$252.18	75.9%	$75.18	22.6%	$5.01	1.5%	$332.37
April	$0.66	0.4%	$100.86	55.5%	$75.18	41.4%	$5.01	2.8%	$181.71
May	$7.06	5.2%	$48.98	36.0%	$75.18	55.2%	$5.01	3.7%	$136.22
June	$17.10	14.4%	$21.15	17.9%	$75.18	63.5%	$5.01	4.2%	$118.45
July	$24.93	21.7%	$9.76	8.5%	$75.18	65.4%	$5.01	4.4%	$114.88
August	$18.98	16.0%	$19.18	16.2%	$75.18	63.5%	$5.01	4.2%	$118.36
September	$6.21	4.9%	$39.96	31.6%	$75.18	59.5%	$5.01	4.0%	$126.36
October	$1.09	0.7%	$81.94	50.2%	$75.18	46.1%	$5.01	3.1%	$163.22
November	$0.00	0.0%	$160.01	66.6%	$75.18	31.3%	$5.01	2.1%	$240.20
December	$0.00	0.0%	$416.93	83.9%	$75.18	15.1%	$5.01	1.0%	$497.12
Total	$76.03	2.5%	$1,971.38	65.5%	$902.18	30.0%	$60.13	2.0%	$3,009.72

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$546.96	4,051.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
February	$433.85	3,213.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
March	$332.37	2,462.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$181.71	1,346.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$136.22	1,009.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$118.45	877.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$114.88	850.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$118.36	876.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$126.36	936.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$163.22	1,209.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$240.20	1,779.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$497.12	3,682.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
Total	$3,009.72	22,294.2	$0.00	0.0	$0.00	0.0	$0.00	0.0

Average Electric Cost Per kWh:	$0.135/kWh
Total annual cooling load energy:	9,123,300 BTU
Total annual heating load energy:	102,687,560 BTU

Monthly Costs - System 2 - Existing BASEMENT. ER OFF

Monthly System Cost

	Cooling		Heating		Appliances		Hot Water		Total
Month	Cost	%	Cost	%	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$299.97	78.9%	$75.18	19.8%	$5.01	1.3%	$380.16
February	$0.00	0.0%	$247.84	75.6%	$75.18	22.9%	$5.01	1.5%	$328.03
March	$0.00	0.0%	$194.60	70.8%	$75.18	27.4%	$5.01	1.8%	$274.79
April	$0.67	0.4%	$97.66	54.7%	$75.18	42.1%	$5.01	2.8%	$178.53
May	$7.12	5.2%	$49.43	36.1%	$75.18	55.0%	$5.01	3.7%	$136.74
June	$17.27	14.5%	$21.35	18.0%	$75.18	63.3%	$5.01	4.2%	$118.81
July	$25.16	21.8%	$9.85	8.5%	$75.18	65.3%	$5.01	4.3%	$115.20
August	$19.16	16.1%	$19.36	16.3%	$75.18	63.3%	$5.01	4.2%	$118.71
September	$6.27	4.9%	$40.33	31.8%	$75.18	59.3%	$5.01	4.0%	$126.79
October	$1.10	0.7%	$82.69	50.4%	$75.18	45.8%	$5.01	3.1%	$163.98
November	$0.00	0.0%	$139.76	63.5%	$75.18	34.2%	$5.01	2.3%	$219.96
December	$0.00	0.0%	$281.82	77.8%	$75.18	20.8%	$5.01	1.4%	$362.01
Total	$76.75	3.0%	$1,484.64	58.8%	$902.18	35.7%	$60.13	2.4%	$2,523.71

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$380.16	2,816.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
February	$328.03	2,429.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
March	$274.79	2,035.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$178.53	1,322.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$136.74	1,012.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$118.81	880.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$115.20	853.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$118.71	879.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$126.79	939.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$163.98	1,214.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$219.96	1,629.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$362.01	2,681.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
Total	$2,523.71	18,694.1	$0.00	0.0	$0.00	0.0	$0.00	0.0

Average Electric Cost Per kWh:	$0.135/kWh
Total annual cooling load energy:	9,210,100 BTU
Total annual heating load energy:	103,633,160 BTU

Monthly Costs - System 3 - Improved BASEMENT. ER OFF

Monthly System Cost

	Cooling		Heating		Appliances		Hot Water		Total
Month	Cost	%	Cost	%	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$279.61	79.9%	$69.28	19.8%	$0.88	0.3%	$349.77
February	$0.00	0.0%	$231.02	76.7%	$69.28	23.0%	$0.88	0.3%	$301.17
March	$0.00	0.0%	$181.39	72.1%	$69.28	27.5%	$0.88	0.3%	$251.55
April	$0.65	0.4%	$91.04	56.3%	$69.28	42.8%	$0.88	0.5%	$161.84
May	$6.90	5.6%	$46.07	37.4%	$69.28	56.3%	$0.88	0.7%	$123.12
June	$16.72	15.7%	$19.90	18.6%	$69.28	64.9%	$0.88	0.8%	$106.77
July	$24.36	23.5%	$9.18	8.9%	$69.28	66.8%	$0.88	0.8%	$103.69
August	$18.55	17.4%	$18.05	16.9%	$69.28	64.9%	$0.88	0.8%	$106.75
September	$6.07	5.3%	$37.59	33.0%	$69.28	60.9%	$0.88	0.8%	$113.81
October	$1.06	0.7%	$77.08	52.0%	$69.28	46.7%	$0.88	0.6%	$148.30
November	$0.00	0.0%	$130.28	65.0%	$69.28	34.6%	$0.88	0.4%	$200.43
December	$0.00	0.0%	$262.70	78.9%	$69.28	20.8%	$0.88	0.3%	$332.85
Total	$74.30	3.2%	$1,383.92	60.2%	$831.30	36.1%	$10.52	0.5%	$2,300.05

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$349.77	2,590.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
February	$301.17	2,230.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
March	$251.55	1,863.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$161.84	1,198.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$123.12	912.0	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$106.77	790.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$103.69	768.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$106.75	790.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$113.81	843.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$148.30	1,098.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$200.43	1,484.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$332.85	2,465.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
Total	$2,300.05	17,037.4	$0.00	0.0	$0.00	0.0	$0.00	0.0

Average Electric Cost Per kWh:	$0.135/kWh
Total annual cooling load energy:	8,916,375 BTU
Total annual heating load energy:	96,602,104 BTU

Monthly Costs - System 4 - Existing Community Room

Monthly System Cost

	Cooling		Heating		Appliances		Hot Water		Total
Month	Cost	%	Cost	%	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$509.43	100.0%	$0.00	0.0%	$0.00	0.0%	$509.43
February	$0.00	0.0%	$416.74	100.0%	$0.00	0.0%	$0.00	0.0%	$416.74
March	$0.00	0.0%	$355.41	100.0%	$0.00	0.0%	$0.00	0.0%	$355.41
April	$2.06	1.3%	$158.96	98.7%	$0.00	0.0%	$0.00	0.0%	$161.02
May	$21.90	22.2%	$76.65	77.8%	$0.00	0.0%	$0.00	0.0%	$98.55
June	$53.09	61.8%	$32.87	38.2%	$0.00	0.0%	$0.00	0.0%	$85.96
July	$77.37	83.5%	$15.30	16.5%	$0.00	0.0%	$0.00	0.0%	$92.67
August	$58.92	66.4%	$29.80	33.6%	$0.00	0.0%	$0.00	0.0%	$88.72
September	$19.27	23.1%	$64.13	76.9%	$0.00	0.0%	$0.00	0.0%	$83.40
October	$3.38	2.4%	$138.18	97.6%	$0.00	0.0%	$0.00	0.0%	$141.56
November	$0.00	0.0%	$244.78	100.0%	$0.00	0.0%	$0.00	0.0%	$244.78
December	$0.00	0.0%	$476.71	100.0%	$0.00	0.0%	$0.00	0.0%	$476.71
Total	$235.98	8.6%	$2,518.97	91.4%	$0.00	0.0%	$0.00	0.0%	$2,754.95

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$35.21	260.8	$0.00	0.0	$474.23	280.6	$0.00	0.0
February	$45.66	338.3	$0.00	0.0	$371.08	219.6	$0.00	0.0
March	$82.63	612.1	$0.00	0.0	$272.77	161.4	$0.00	0.0
April	$118.40	877.0	$0.00	0.0	$42.62	25.2	$0.00	0.0
May	$93.95	695.9	$0.00	0.0	$4.60	2.7	$0.00	0.0
June	$85.96	636.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$92.67	686.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$88.72	657.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$75.91	562.3	$0.00	0.0	$7.49	4.4	$0.00	0.0
October	$100.62	745.4	$0.00	0.0	$40.93	24.2	$0.00	0.0
November	$110.37	817.6	$0.00	0.0	$134.41	79.5	$0.00	0.0
December	$44.86	332.3	$0.00	0.0	$431.84	255.5	$0.00	0.0
Total	$974.97	7,222.0	$0.00	0.0	$1,779.98	1,053.2	$0.00	0.0

Average Electric Cost Per kWh:	$0.135/kWh
Average Propane Cost Per Gallon:	$1.690/Gallon
Total annual cooling load energy:	33,037,476 BTU
Total annual heating load energy:	181,021,552 BTU

Monthly Costs - System 5 - Improved Community Room

Monthly System Cost

	Cooling		Heating		Appliances		Hot Water		Total
Month	Cost	%	Cost	%	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$418.79	100.0%	$0.00	0.0%	$0.00	0.0%	$418.79
February	$0.00	0.0%	$342.63	100.0%	$0.00	0.0%	$0.00	0.0%	$342.63
March	$0.00	0.0%	$292.38	100.0%	$0.00	0.0%	$0.00	0.0%	$292.38
April	$1.69	1.3%	$130.62	98.7%	$0.00	0.0%	$0.00	0.0%	$132.32
May	$17.96	22.2%	$62.95	77.8%	$0.00	0.0%	$0.00	0.0%	$80.91
June	$43.54	61.7%	$26.99	38.3%	$0.00	0.0%	$0.00	0.0%	$70.53
July	$63.45	83.5%	$12.57	16.5%	$0.00	0.0%	$0.00	0.0%	$76.02
August	$48.32	66.4%	$24.47	33.6%	$0.00	0.0%	$0.00	0.0%	$72.79
September	$15.80	23.1%	$52.68	76.9%	$0.00	0.0%	$0.00	0.0%	$68.48
October	$2.77	2.4%	$113.59	97.6%	$0.00	0.0%	$0.00	0.0%	$116.36
November	$0.00	0.0%	$201.31	100.0%	$0.00	0.0%	$0.00	0.0%	$201.31
December	$0.00	0.0%	$391.92	100.0%	$0.00	0.0%	$0.00	0.0%	$391.92
Total	$193.54	8.5%	$2,070.90	91.5%	$0.00	0.0%	$0.00	0.0%	$2,264.44

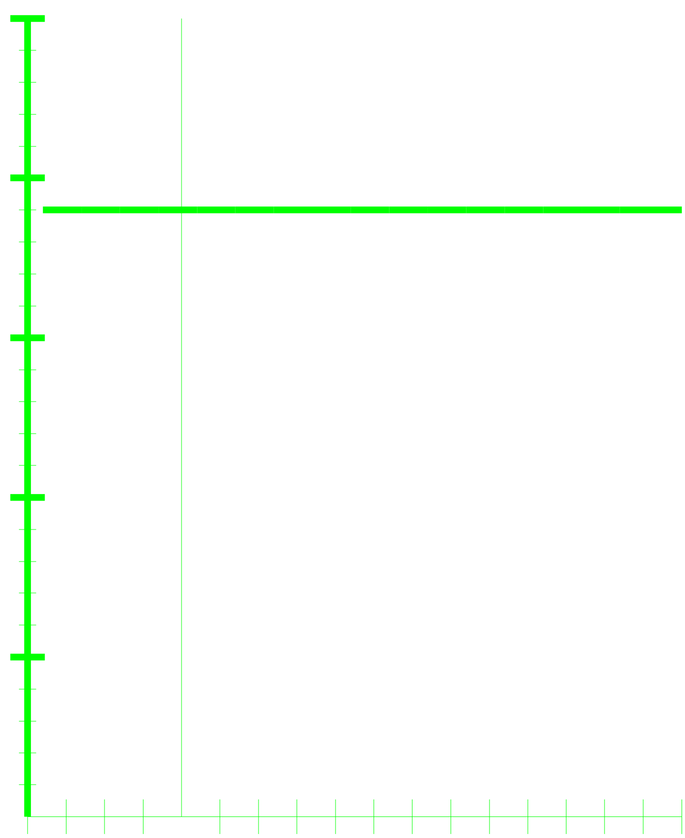
Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$28.90	214.1	$0.00	0.0	$389.89	230.7	$0.00	0.0
February	$37.49	277.7	$0.00	0.0	$305.14	180.6	$0.00	0.0
March	$67.84	502.5	$0.00	0.0	$224.54	132.9	$0.00	0.0
April	$97.20	720.0	$0.00	0.0	$35.11	20.8	$0.00	0.0
May	$77.11	571.2	$0.00	0.0	$3.80	2.2	$0.00	0.0
June	$70.53	522.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$76.02	563.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$72.79	539.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$62.31	461.5	$0.00	0.0	$6.18	3.7	$0.00	0.0
October	$82.61	611.9	$0.00	0.0	$33.75	20.0	$0.00	0.0
November	$90.62	671.2	$0.00	0.0	$110.69	65.5	$0.00	0.0
December	$36.83	272.8	$0.00	0.0	$355.09	210.1	$0.00	0.0
Total	$800.25	5,927.8	$0.00	0.0	$1,464.19	866.4	$0.00	0.0

Average Electric Cost Per kWh:	$0.135/kWh
Average Propane Cost Per Gallon:	$1.690/Gallon
Total annual cooling load energy:	27,095,550 BTU
Total annual heating load energy:	148,620,304 BTU

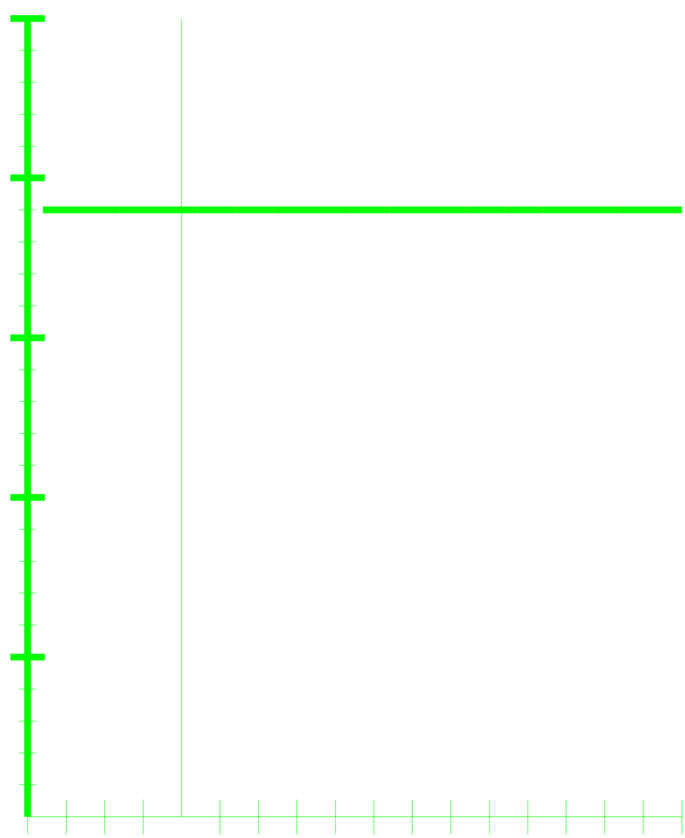
Bin Analysis Report - System 1 - Existing BASEMENT

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	41,761	35,497	0	0.000	35,497	0.00	1.40	1.40
-15 to -10	18	39,389	33,480	0	0.000	33,480	0.00	23.84	23.84
-10 to -5	19	37,016	31,463	0	0.000	31,463	0.00	23.65	23.65
-5 to 0	52	34,643	29,447	0	0.000	29,447	0.00	60.57	60.57
0 to 5	136	32,270	27,430	0	0.000	27,430	0.00	147.56	147.56
5 to 10	154	29,897	25,413	0	0.000	25,413	0.00	154.80	154.80
10 to 15	209	27,525	23,396	0	0.000	23,396	0.00	193.41	193.41
15 to 20	312	25,152	21,379	0	0.000	21,379	0.00	263.84	263.84
20 to 25	385	22,779	19,362	0	0.000	19,362	0.00	294.86	294.86
25 to 30	666	20,406	17,345	17,345	0.456	0	193.04	0.00	193.04
30 to 35	878	18,033	15,328	15,328	0.403	0	204.59	0.00	204.59
35 to 40	650	15,661	13,311	13,311	0.350	0	120.64	0.00	120.64
40 to 45	658	13,288	11,295	11,295	0.297	0	95.69	0.00	95.69
45 to 50	679	10,915	9,278	9,278	0.244	0	75.35	0.00	75.35
50 to 55	619	8,542	7,261	7,261	0.191	0	50.19	0.00	50.19
55 to 60	717	6,169	5,244	5,244	0.138	0	39.38	0.00	39.38
60 to 65	685	3,796	3,227	3,227	0.085	0	21.79	0.00	21.79
Totals:	6,838						$807.46	$1,163.92	$1,971.38



Bin Analysis Report - System 2 - Existing BASEMENT. ER OFF

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	42,146	35,824	0	0.000	35,824	0.00	1.42	1.42
-15 to -10	18	39,751	33,789	33,789	0.534	33,789	10.56	9.62	20.18
-10 to -5	19	37,357	31,753	31,753	0.836	0	16.46	0.00	16.46
-5 to 0	52	34,962	29,718	29,718	0.782	0	39.86	0.00	39.86
0 to 5	136	32,567	27,682	27,682	0.728	0	92.11	0.00	92.11
5 to 10	154	30,173	25,647	25,647	0.675	0	91.90	0.00	91.90
10 to 15	209	27,778	23,611	23,611	0.621	0	109.45	0.00	109.45
15 to 20	312	25,383	21,576	21,576	0.568	0	142.64	0.00	142.64
20 to 25	385	22,989	19,540	19,540	0.514	0	150.15	0.00	150.15
25 to 30	666	20,594	17,505	17,505	0.461	0	194.82	0.00	194.82
30 to 35	878	18,199	15,469	15,469	0.407	0	206.47	0.00	206.47
35 to 40	650	15,805	13,434	13,434	0.354	0	121.75	0.00	121.75
40 to 45	658	13,410	11,399	11,399	0.300	0	96.57	0.00	96.57
45 to 50	679	11,015	9,363	9,363	0.246	0	76.04	0.00	76.04
50 to 55	619	8,621	7,328	7,328	0.193	0	50.65	0.00	50.65
55 to 60	717	6,226	5,292	5,292	0.139	0	39.74	0.00	39.74
60 to 65	685	3,831	3,257	3,257	0.086	0	21.99	0.00	21.99
Totals:	6,838						$1,473.60	$11.04	$1,484.64

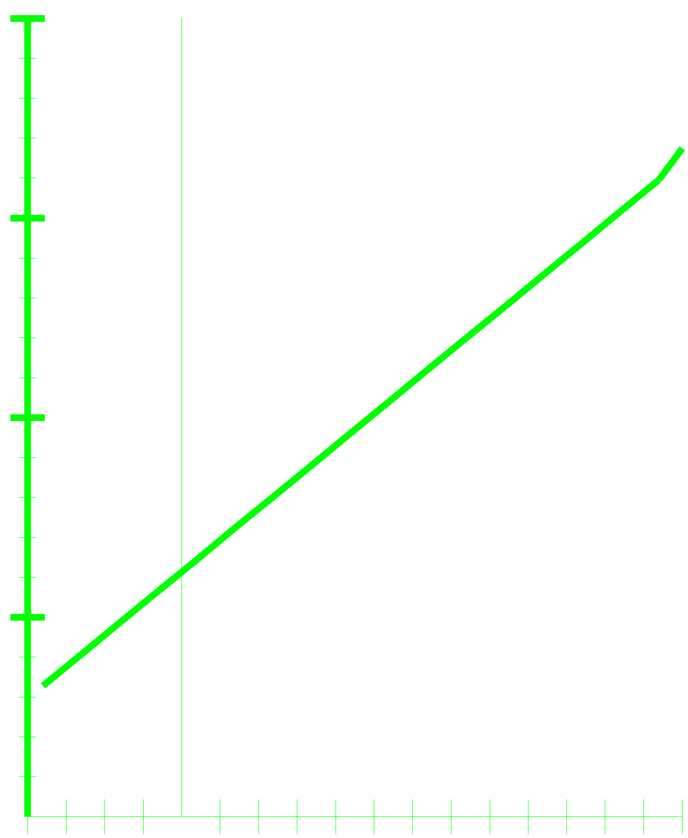


Bin Analysis Report - System 3 - Improved BASEMENT. ER OFF

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	39,287	33,394	0	0.000	33,394	0.00	1.32	1.32
-15 to -10	18	37,054	31,496	31,496	0.497	31,496	9.85	8.97	18.81
-10 to -5	19	34,822	29,599	29,599	0.779	0	15.34	0.00	15.34
-5 to 0	52	32,590	27,702	27,702	0.729	0	37.16	0.00	37.16
0 to 5	136	30,358	25,804	25,804	0.679	0	85.86	0.00	85.86
5 to 10	154	28,126	23,907	23,907	0.629	0	85.66	0.00	85.66
10 to 15	209	25,893	22,009	22,009	0.579	0	102.03	0.00	102.03
15 to 20	312	23,661	20,112	20,112	0.529	0	132.97	0.00	132.97
20 to 25	385	21,429	18,215	18,215	0.479	0	139.96	0.00	139.96
25 to 30	666	19,197	16,317	16,317	0.429	0	181.60	0.00	181.60
30 to 35	878	16,965	14,420	14,420	0.379	0	192.46	0.00	192.46
35 to 40	650	14,732	12,523	12,523	0.330	0	113.49	0.00	113.49
40 to 45	658	12,500	10,625	10,625	0.280	0	90.02	0.00	90.02
45 to 50	679	10,268	8,728	8,728	0.230	0	70.88	0.00	70.88
50 to 55	619	8,036	6,831	6,831	0.180	0	47.22	0.00	47.22
55 to 60	717	5,804	4,933	4,933	0.130	0	37.04	0.00	37.04
60 to 65	685	3,572	3,036	3,036	0.080	0	20.50	0.00	20.50
Totals:	6,838						$1,373.63	$10.29	$1,383.92

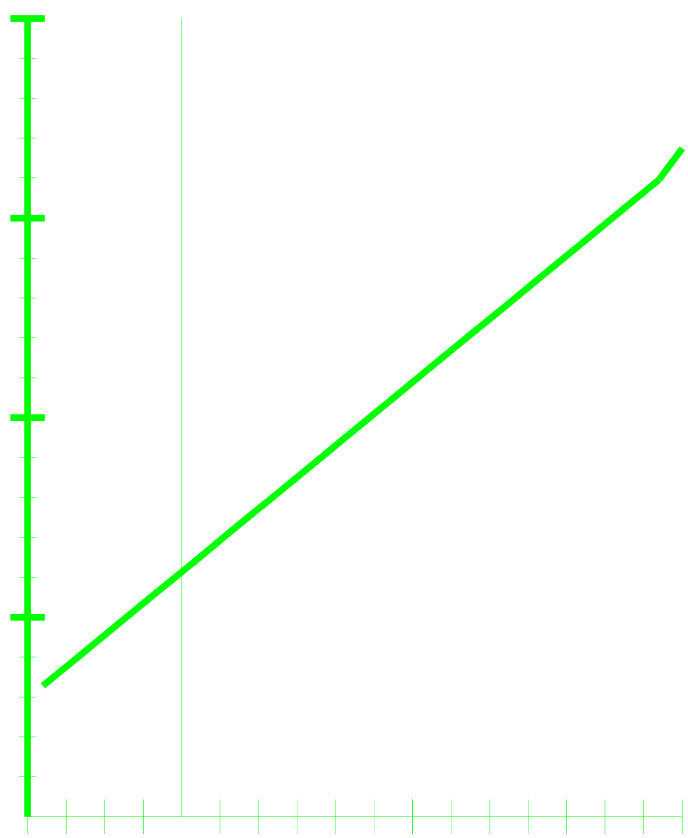
Bin Analysis Report - System 4 - Existing Community Room

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	73,619	62,576	0	0.000	62,576	0.00	1.29	1.29
-15 to -10	18	69,436	59,020	0	0.000	59,020	0.00	21.85	21.85
-10 to -5	19	65,253	55,465	0	0.000	55,465	0.00	21.67	21.67
-5 to 0	52	61,070	51,910	0	0.000	51,910	0.00	55.52	55.52
0 to 5	136	56,887	48,354	0	0.000	48,354	0.00	135.26	135.26
5 to 10	154	52,704	44,799	0	0.000	44,799	0.00	141.90	141.90
10 to 15	209	48,521	41,243	0	0.000	41,243	0.00	177.31	177.31
15 to 20	312	44,338	37,688	0	0.000	37,688	0.00	241.90	241.90
20 to 25	385	40,156	34,132	0	0.000	34,132	0.00	270.42	270.42
25 to 30	666	35,973	30,577	0	0.000	30,577	0.00	419.33	419.33
30 to 35	878	31,790	27,021	27,021	0.239	27,021	119.42	293.54	412.96
35 to 40	650	27,607	23,466	23,466	0.486	0	179.56	0.00	179.56
40 to 45	658	23,424	19,910	19,910	0.387	0	144.89	0.00	144.89
45 to 50	679	19,241	16,355	16,355	0.299	0	115.80	0.00	115.80
50 to 55	619	15,058	12,800	12,800	0.221	0	78.15	0.00	78.15
55 to 60	717	10,875	9,244	9,244	0.152	0	62.03	0.00	62.03
60 to 65	685	6,693	5,689	5,689	0.089	0	34.69	0.00	34.69
Totals:	6,838						$738.99	$1,779.98	$2,518.97



Bin Analysis Report - System 5 - Improved Community Room

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.85)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	60,442	51,375	0	0.000	51,375	0.00	1.06	1.06
-15 to -10	18	57,007	48,456	0	0.000	48,456	0.00	17.94	17.94
-10 to -5	19	53,573	45,537	0	0.000	45,537	0.00	17.80	17.80
-5 to 0	52	50,139	42,618	0	0.000	42,618	0.00	45.58	45.58
0 to 5	136	46,705	39,699	0	0.000	39,699	0.00	111.06	111.06
5 to 10	154	43,271	36,780	0	0.000	36,780	0.00	116.53	116.53
10 to 15	209	39,836	33,861	0	0.000	33,861	0.00	145.64	145.64
15 to 20	312	36,402	30,942	0	0.000	30,942	0.00	198.77	198.77
20 to 25	385	32,968	28,023	0	0.000	28,023	0.00	222.36	222.36
25 to 30	666	29,534	25,104	0	0.000	25,104	0.00	345.24	345.24
30 to 35	878	26,100	22,185	22,185	0.197	22,185	98.04	242.21	340.25
35 to 40	650	22,666	19,266	19,266	0.399	0	147.42	0.00	147.42
40 to 45	658	19,231	16,347	16,347	0.318	0	118.95	0.00	118.95
45 to 50	679	15,797	13,428	13,428	0.246	0	95.07	0.00	95.07
50 to 55	619	12,363	10,509	10,509	0.182	0	64.16	0.00	64.16
55 to 60	717	8,929	7,590	7,590	0.124	0	50.93	0.00	50.93
60 to 65	685	5,495	4,670	4,670	0.073	0	28.48	0.00	28.48
Totals:	6,838						$606.71	$1,464.19	$2,070.90



Appliance Report - System 1 - Existing BASEMENT

Appliance Set 1 - Teen Center

		Estimated Cost
Lighting		
Indoor:	2.5 Watts/Sq.ft.	
Indoor Annual Electrical Usage:	4,183.8 kWh	
Outdoor Lighting:	0.0 Watts	
Outdoor Lighting Use:	0 Hrs/Night	
Outdoor Lighting Annual Use:	0.0 kWh	
Annual Total Lighting Costs:		$564.81
Cooking		
Range Type:	Electricity	
Range Efficiency:	0%	
Range Electricity Usage:	0.00 kWh	
Annual Cooking Costs:		$0.00
Laundry		
Dryer Type:	Electricity	
Dryer Efficiency:	0%	
Dryer Electricity Usage:	0.00 kWh	
Annual Laundry Costs:		$0.00
Hot Water		
Water Heater Type:	Electricity	
Model Number:	Hotpoint Model HE40M1A	
Water Heater Efficiency:	70%	
Water Heater Usage Level:	Calculated	
Water Heater Daily Usage:	5 Gallons	
Water Heater Peak Usage:	0 Gallons	
Temperature Difference:	70°F	
Electricity Usage:	445.42 kWh	
Annual Hot Water Costs:		$60.13
Gas Appliances		
Gas Appliances Annual Cost:		$0.00
Miscellaneous Appliances		
Refrigerator Usage, Cost:	875 kWh, $118.13	
Stereo Usage, Cost:	75 kWh, $10.13	
TV Usage, Cost:	200 kWh, $27.00	
Dehumidifier Usage, Cost:	450 kWh, $60.75	
Microwave Usage, Cost:	200 kWh, $27.00	
Diswasher Usage, Cost:	150 kWh, $20.25	
Hot Plate Usage, Cost:	164 kWh, $22.14	
Coffee Maker Usage, Cost:	200 kWh, $27.00	
Computer Usage, Cost:	185 kWh, $24.98	
Miscellaneous Appliances Annual Cost:		$337.37
Total		
Appliances Plus Hot Water Annual Cost:		$962.31

Appliance Report - System 2 - Existing BASEMENT. ER OFF

Appliance Set 1 - Teen Center

		Estimated Cost
Lighting		
Indoor:	2.5 Watts/Sq.ft.	
Indoor Annual Electrical Usage:	4,183.8 kWh	
Outdoor Lighting:	0.0 Watts	
Outdoor Lighting Use:	0 Hrs/Night	
Outdoor Lighting Annual Use:	0.0 kWh	
Annual Total Lighting Costs:		$564.81
Cooking		
Range Type:	Electricity	
Range Efficiency:	0%	
Range Electricity Usage:	0.00 kWh	
Annual Cooking Costs:		$0.00
Laundry		
Dryer Type:	Electricity	
Dryer Efficiency:	0%	
Dryer Electricity Usage:	0.00 kWh	
Annual Laundry Costs:		$0.00
Hot Water		
Water Heater Type:	Electricity	
Model Number:	Hotpoint Model HE40M1A	
Water Heater Efficiency:	70%	
Water Heater Usage Level:	Calculated	
Water Heater Daily Usage:	5 Gallons	
Water Heater Peak Usage:	0 Gallons	
Temperature Difference:	70°F	
Electricity Usage:	445.42 kWh	
Annual Hot Water Costs:		$60.13
Gas Appliances		
Gas Appliances Annual Cost:		$0.00
Miscellaneous Appliances		
Refrigerator Usage, Cost:	875 kWh, $118.13	
Stereo Usage, Cost:	75 kWh, $10.13	
TV Usage, Cost:	200 kWh, $27.00	
Dehumidifier Usage, Cost:	450 kWh, $60.75	
Microwave Usage, Cost:	200 kWh, $27.00	
Diswasher Usage, Cost:	150 kWh, $20.25	
Hot Plate Usage, Cost:	164 kWh, $22.14	
Coffee Maker Usage, Cost:	200 kWh, $27.00	
Computer Usage, Cost:	185 kWh, $24.98	
Miscellaneous Appliances Annual Cost:		$337.37
Total		
Appliances Plus Hot Water Annual Cost:		$962.31

Appliance Report - System 3 - Improved BASEMENT. ER OFF

Appliance Set 2 - Teen Center

		Estimated Cost
Lighting		
Indoor:	2.5 Watts/Sq.ft.	
Indoor Annual Electrical Usage:	4,183.8 kWh	
Outdoor Lighting:	0.0 Watts	
Outdoor Lighting Use:	0 Hrs/Night	
Outdoor Lighting Annual Use:	0.0 kWh	
Annual Total Lighting Costs:		$564.81
Cooking		
Range Type:	Electricity	
Range Efficiency:	0%	
Range Electricity Usage:	0.00 kWh	
Annual Cooking Costs:		$0.00
Laundry		
Dryer Type:	Electricity	
Dryer Efficiency:	0%	
Dryer Electricity Usage:	0.00 kWh	
Annual Laundry Costs:		$0.00
Hot Water		
Water Heater Type:	Electricity	
Model Number:	Hotpoint Model HE40M1A	
Water Heater Efficiency:	3.20 COP	
Water Heater Usage Level:	Calculated	
Water Heater Daily Usage:	4 Gallons	
Water Heater Peak Usage:	0 Gallons	
Temperature Difference:	70°F	
Electricity Usage:	77.95 kWh	
Annual Hot Water Costs:		$10.52
Gas Appliances		
Gas Appliances Annual Cost:		$0.00
Miscellaneous Appliances		
Refrigerator Usage, Cost:	550 kWh, $74.25	
Stereo Usage, Cost:	75 kWh, $10.13	
TV Usage, Cost:	200 kWh, $27.00	
Dehumidifier Usage, Cost:	250 kWh, $33.75	
Microwave Usage, Cost:	200 kWh, $27.00	
Diswasher Usage, Cost:	150 kWh, $20.25	
Hot Plate Usage, Cost:	164 kWh, $22.14	
Coffee Maker Usage, Cost:	200 kWh, $27.00	
Computer Usage, Cost:	185 kWh, $24.98	
Miscellaneous Appliances Annual Cost:		$266.49
Total		
Appliances Plus Hot Water Annual Cost:		$841.83

SUBMITTAL DATA: PKA-A36KA7 & PUZ-HA36NHA5
36,000 BTU/H WALL-MOUNTED HEAT PUMP SYSTEM

MITSUBISHI ELECTRIC

Job Name:	
System Reference:	Date:

Indoor Unit: PKA-A36KA7	Outdoor Unit: PUZ-HA36NHA5
	

INDOOR UNIT FEATURES

- Sleek, compact design
- Simple installation
- Vane setting for air flow direction control
- Auto fan speed mode
- Ideal for spaces such as server rooms, daycare centers, classrooms, churches, small offices, and more

OUTDOOR UNIT FEATURES

- Variable speed INVERTER-driven compressor
- High heating capacity: flash injection circuit maintains 100% heating capacity at 5°F outdoor temperature
- Wide heating range: heating performance down to -13°F (average of 80% heating capacity)
- High speed heating at start up: Hyper-Heating INVERTER® reduces the time for heating at start up by about half compared to standard models
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft.
- Twinning of two indoor units possible with the 36 kBTU/H model
- High pressure/temperature protection

SPECIFICATIONS: PKA-A36KA7 & PUZ-HA36NHA5

Cooling[1]	Maximum Capacity	BTU/H	33,500
	Rated Capacity	BTU/H	33,500
	Minimum Capacity	BTU/H	18,000
	Maximum Power Input	W	3,130
	Rated Power Input	W	2,790
	Moisture Removal	Pints/h	8.7
	Sensible Heat Factor		0.71
	Power Factor	%	96.3
Heating at 47°F[2]	Maximum Capacity	BTU/H	40,000
	Rated Capacity	BTU/H	38,000
	Minimum Capacity	BTU/H	18,000
	Maximum Power Input	W	4,150
	Rated Power Input	W	3,410
	Power Factor	%	96.3
Heating at 17°F[3]	Maximum Capacity	BTU/H	38,000
	Rated Capacity	BTU/H	25,000
	Maximum Power Input	W	6,010
	Rated Power Input	W	3,330
Heating at 5°F[4]	Maximum Capacity	BTU/H	38,000
	Maximum Power Input	W	6,760
Efficiency	SEER		16.2
	EER[1]		12.0
	HSPF (IV)		10.0
	COP at 47°F[2]		3.26
	COP at 17°F in Maximum Capacity		1.85
	COP at 5°F in Maximum Capacity		1.65
Electrical	Voltage, Phase, Frequency		208 / 230V, 1-phase, 60 Hz
	Guaranteed Voltage Range	V AC	198 – 253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208V / 230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Voltage: Indoor - Remote controller	V DC	12
	Recommended Fuse/Breaker Size (Outdoor)	A	30
	Recommended Wire Size (Indoor - Outdoor)	AWG	14
Indoor Unit	MCA	A	1.00
	Fan Motor Full Load Amperage	A	0.57
	Fan Motor Output	W	56
	Airflow Rate, Dry	CFM	705-810-920
	Airflow Rate, Wet	CFM	635-730-830
	External Static Pressure	in.WG	n/a
	Sound Pressure Level	dB(A)	43-46-49
	Drain Pipe Size	In. (mm)	5/8 (16)
	Condensate Lift Mechanism, Maximum Distance	Ft. (m)	n/a
	Heat Exchanger Type		Plate fin coil
	External Finish Color		White Munsell 1.0Y 9.2/0.2
	Unit Dimensions // Grille Dimensions	W: In. (mm)	46-1/16 (1170)
		D: In. (mm)	11-5/8 (295)
		H: In. (mm)	14-3/8 (365)
	Package Dimensions // Grille Dimensions	W: In. (mm)	51
		D: In. (mm)	18-8/16
		H: In. (mm)	14-4/16

SPECIFICATIONS: PKA-A36KA7 & PUZ-HA36NHA5

	Unit Weight	Lbs. (kg)	46 (21)
	Package Weight	Lbs. (kg)	53
Indoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	90 DB, 73 WB / 66 DB, 59 WB
	Heating Intake Air Temp (Maximum / Minimum)	°F	82 DB / 50 DB
Outdoor Unit	MCA	A	28
	MOCP	A	40
	Fan Motor Full Load Amperage	A	0.4+0.4
	Fan Motor Output	W	86+86
	Airflow Rate	CFM	3,530
	Refrigerant Control		Electronic Expansion Valve
	Defrost Method		Reverse Cycle
	Heat Exchanger Type		Cross fin
	Sound Pressure Level, Cooling[1]	dB(A)	52
	Sound Pressure Level, Heating[2]	dB(A)	53
	Compressor Type		INVERTER-Driven Twin Rotary
	Compressor Model		ANB33FJEMT
	Compressor Rated Load Amps	A	18
	Compressor Locked Rotor Amps	A	27.5
	Compressor Oil Type // Charge	oz.	FV50S // 45
	External Finish Color		Ivory Munsell 3Y 7.8/1.1
	Base Pan Heater		n/a
	Unit Dimensions	W: In. (mm)	37-3/8 (950)
		D: In. (mm)	13 + 1-3/16 (330 + 30)
		H: In. (mm)	53-1/8 (1,350)
	Package Dimensions	W: In. (mm)	40-15/16 (1,040)
		D: In. (mm)	17-11/16 (450)
		H: In. (mm)	56-11/16 (1,440)
	Unit Weight	Lbs. (kg)	265 (120)
	Package Weight	Lbs. (kg)	289 (131)
Outdoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	115 DB / 0* DB
	Heating Intake Air Temp (Maximum / Minimum)	°F	70 DB, 59 WB / -13 DB, -13 WB
	Thermal Lock-out / Re-start Temperatures**	°F	n/a
Refrigerant	Type		R410A
	Charge	Lbs, oz	12
Piping	Gas Pipe Size O.D. (Flared)	In.(mm)	5/8 (15.88)
	Liquid Pipe Size O.D. (Flared)	In.(mm)	3/8 (9.52)
	Maximum Piping Length	Ft. (m)	245 (75)
	Maximum Height Difference	Ft. (m)	100 (30)
	Maximum Number of Bends		15

Notes

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
	[3]Heating at 17°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 17 DB, 15 WB
Conditions	[4]Heating at 5°F (Indoor // Outdoor)	°F	70 DB, 60 WB // -4 DB, -5 WB

*Wind baffles required to operate below 23°F DB in cooling mode. PUZ with wind baffle: 0°F - 115°F.
**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.

SUBMITTAL DATA: MXZ-8C48NA
MULTI-INDOOR INVERTER HEAT-PUMP SYSTEM

MITSUBISHI ELECTRIC

Job Name:

System Reference: Date:

Outdoor Unit: MXZ-8C48NA

GENERAL FEATURES

Quiet Operation
Optional base pan heater to prevent ice in drain pan
Limited warranty: five years parts and seven years compressors

ACCESSORIES

- ☐ Three-port Branch Box (PAC-MKA30BC)
- ☐ Five-port Branch Box (PAC-MKA50BC)
- ☐ Distribution Pipe for Flare Connection
  - (MSDD-50AR; necessary for installing two branch boxes)
- ☐ Distribution Pipe for Brazed Connection
  - (MSDD-50BR; necessary for installing two branch boxes)
- ☐ 3/8” x 1/2” Port Adapter (MAC-A454JP)
- ☐ 1/2” x 3/8” Port Adapter (MAC-A455JP)
- ☐ 1/2” x 5/8” Port Adapter (MAC-A456JP)
- ☐ 1/4” x 3/8” Port Adapter (PAC-493PI)
- ☐ 3/8” x 5/8” Port Adapter (PAC-SG76RJ)
- ☐ Base Heater (PAC-SJ20BH-E)

(For data on specific indoor units, see the MXZ-C Technical and Service Manual.)

Specifications			Model Name
Unit Type			MXZ-8C48NA
Cooling* (Non-ducted / Ducted)	Rated Capacity	Btu/h	48,000 / 48,000
	Capacity Range	Btu/h	15,500 - 48,000
	Rated Total Input	W	4,000 / 5,050
Heating at 47°F* (Non-ducted / Ducted)	Rated Capacity	Btu/h	54,000 / 54,000
	Capacity Range	Btu/h	22,500 - 54,000
	Rated Total Input	W	4,220 / 4,990
Heating at 17°F* (Non-ducted/Ducted)	Rated Capacity	Btu/h	35,000 / 35,000
	Maximum Capacity	Btu/h	36,600 / 36,600
	Rated Total Input	W	3,720 / 4,420
Connectable Capacity		Btu/h	12,000 - 62,400
Electrical Requirements	Power Supply	Voltage, Phase, Hertz	208 / 230V, 1-Phase, 60 Hz
	Recommended Fuse/Breaker Size	A	40
	MCA	A	37
Voltage	Indoor - Outdoor S1-S2	V	AC 208 / 230
	Indoor - Outdoor S2-S3	V	DC ±24
Compressor			Hermetic
Fan Motor (ECM)		F.L.A.	0.4+0.4
Sound Pressure Level	Cooling	dB(A)	51
	Heating	dB(A)	54
External Dimensions (H x W x D)		In mm	52-11/16 x 41-11/32 x 13+1 (1338 x 1050 x 330+25)
Net Weight		Lbs / kg	269 (122)
External Finish			Munsell No. 3Y 7.8/11
Refrigerant Pipe Size O.D.	Liquid (High Pressure)	In / mm	3/8 (9.52)
	Gas (Low Pressure)	In / mm	5/8 (15.88)
Max. Refrigerant Line Length		Ft / m	492 (150)
Max. Piping Length between outdoor unit and branch boxes		Ft / m	180 (55)
Max. Piping Length after branch box		Ft / m	82 (25)
Max. Total Piping Length between branch boxes and indoor units		Ft / m	311 (95)
Max. Refrigerant Pipe Height Difference	If IDU is Above ODU	Ft / m	131 (40)
	If IDU is Below ODU	Ft / m	164 (50)
Connection Method			Flared/Flared
Refrigerant			R410A

* Rating Conditions per AHRI Standard:
Cooling | Indoor: 80° F (27° C) DB / 67° F (19° C) WB
Cooling | Outdoor: 95° F (35° C) DB / 23.9° C (75° F) WB
Heating at 47°F | Indoor: 70° F (21° C) DB / 60° F (16° C) WB
Heating at 47°F | Outdoor: 47° F (8° C) DB / 43° F (6° C) WB
Heating at 17° F | Indoor: 70° F (21° C) DB
Heating at 17° F | Outdoor: 17° F (-8° C) DB / 15° F (-9° C) WB

SPECIFICATIONS: MXZ-8C48NA

OPERATING RANGE:

	Outdoor
Cooling	23 to 115° F (−5 to 46° C) DB*1
Heating	−4 to 59° F (−20 to 15° C) WB

*1. D.B. 5 to 115° F [D.B. −15 to 46° C], when an optional Air Outlet Guide is installed.

ENERGY EFFICIENCIES:

Indoor Unit Type	SEER	EER	HSPF	COP @ 47°F	COP @ 17°F
Non-ducted	18.9	12.00	11.4	3.75	2.60
Ducted and Non-ducted	16.8	10.75	10.8	3.46	2.45
Ducted	14.7	9.50	10.1	3.17	2.30

NOTES:

- Minimum of two Indoor Units must be connected to the MXZ-8C48NA.
- Minimum installed capacity cannot be less than 12,000 Btu/h.
- Total connected capacity must not exceed 130% of outdoor unit capacity.
- System can operate with only one Indoor Unit turned on.
- Information provided at 208/230V.
- For Reference:
  - MXZ-C Technical & Service Manual for detailed specifications and additional information per Indoor Unit Combination.
  - MXZ Series Multi-Zone Indoor/Outdoor Combination Table for allowed unit combinations.

MVZ CONNECTION RULES:

- Up to 2 MVZ's may be connected to this system*.
- When 2 MVZ's are connected, no additional indoor units can be used*.
- When 1 MVZ is connected, additional indoor units can be connected.
- When 1 MVZ is connected, total connected capacity must not exceed 130%.

*No limitation to the number of units connected when the SPTB1 accessory is used, total connected capacity must not exceed 130% (refer to SPTB1 documentation for more information).

NOTES:

8. PERFORMANCE CHART

PKA-A30KA6/PUZ-HA30NHA5

CAPACITY (BTU/H): 30,000 INPUT (kW): 2.50 SHF: 0.70

Indoor intake air D.B.(°C)	Indoor intake air D.B.(°F)	Indoor intake air W.B.(°C)	Indoor intake air W.B.(°F)	Outdoor intake air °C/°F D.B.																	
				20/68			25/77			30/86			35/95			40/104			45/115		
				CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.
20	68	16	61	29,700	18,889	2.02	28,800	18,317	2.12	27,900	17,744	2.24	26,700	16,981	2.40	25,500	16,218	2.58	24,000	15,264	2.82
20	68	18	64	31,800	16,409	2.08	30,900	15,944	2.18	30,000	15,480	2.32	29,100	15,016	2.48	27,900	14,396	2.62	26,100	13,468	2.88
22	72	16	61	29,700	21,265	2.02	28,800	20,621	2.12	27,900	19,976	2.24	26,700	19,117	2.40	25,500	18,258	2.58	24,000	17,184	2.82
22	72	18	64	31,800	18,953	2.08	30,900	18,416	2.18	30,000	17,880	2.32	29,100	17,344	2.48	27,900	16,628	2.62	26,100	15,556	2.88
22	72	20	68	34,200	16,279	2.12	33,600	15,994	2.24	32,700	15,565	2.38	31,500	14,994	2.52	30,300	14,423	2.70	27,900	13,280	2.96
24	75	16	61	29,700	23,641	2.02	28,800	22,925	2.12	27,900	22,208	2.24	26,700	21,253	2.40	25,500	20,298	2.58	24,000	19,104	2.82
24	75	18	64	31,800	21,497	2.08	30,900	20,888	2.18	30,000	20,280	2.32	29,100	19,672	2.48	27,900	18,860	2.62	26,100	17,644	2.88
24	75	20	68	34,200	19,015	2.12	33,600	18,682	2.24	32,700	18,181	2.38	31,500	17,514	2.52	30,300	16,847	2.70	27,900	15,512	2.96
24	75	22	72	36,300	15,827	2.18	35,700	15,565	2.28	34,800	15,173	2.42	33,900	14,780	2.58	32,700	14,257	2.78	30,300	13,211	3.06
26	79	16	61	29,700	26,017	2.02	28,800	25,229	2.12	27,900	24,440	2.24	26,700	23,389	2.40	25,500	22,338	2.58	24,000	21,024	2.82
26	79	18	64	31,800	24,041	2.08	30,900	23,360	2.18	30,000	22,680	2.32	29,100	22,000	2.48	27,900	21,092	2.62	26,100	19,732	2.88
26	79	20	68	34,200	21,751	2.12	33,600	21,370	2.24	32,700	20,797	2.38	31,500	20,034	2.52	30,300	19,271	2.70	27,900	17,744	2.96
26	79	22	72	36,300	18,731	2.18	35,700	18,421	2.28	34,800	17,957	2.42	33,900	17,492	2.58	32,700	16,873	2.78	30,300	15,635	3.06
27	81	16	61	29,700	27,205	2.02	28,800	26,381	2.12	27,900	25,556	2.24	26,700	24,457	2.40	25,500	23,358	2.58	24,000	21,984	2.82
27	81	18	64	31,800	25,313	2.08	30,900	24,596	2.18	30,000	23,880	2.32	29,100	23,164	2.48	27,900	22,208	2.62	26,100	20,776	2.88
27	81	20	68	34,200	23,119	2.12	33,600	22,714	2.24	32,700	22,105	2.38	31,500	21,294	2.52	30,300	20,483	2.70	27,900	18,860	2.96
27	81	22	72	36,300	20,183	2.18	35,700	19,849	2.28	34,800	19,349	2.42	33,900	18,848	2.58	32,700	18,181	2.78	30,300	16,847	3.06
28	82	16	61	29,700	28,393	2.02	28,800	27,533	2.12	27,900	26,672	2.24	26,700	25,525	2.40	25,500	24,378	2.58	24,000	22,944	2.82
28	82	18	64	31,800	26,585	2.08	30,900	25,832	2.18	30,000	25,080	2.32	29,100	24,328	2.48	27,900	23,324	2.62	26,100	21,820	2.88
28	82	20	68	34,200	24,487	2.12	33,600	24,058	2.24	32,700	23,413	2.38	31,500	22,554	2.52	30,300	21,695	2.70	27,900	19,976	2.96
28	82	22	72	36,300	21,635	2.18	35,700	21,277	2.28	34,800	20,741	2.42	33,900	20,204	2.58	32,700	19,489	2.78	30,300	18,059	3.06
30	86	16	61	29,700	29,700	2.02	28,800	28,800	2.12	27,900	27,900	2.24	26,700	26,700	2.40	25,500	25,500	2.58	24,000	24,000	2.82
30	86	18	64	31,800	29,129	2.08	30,900	28,304	2.18	30,000	27,480	2.32	29,100	26,656	2.48	27,900	25,556	2.62	26,100	23,908	2.88
30	86	20	68	34,200	27,223	2.12	33,600	26,746	2.24	32,700	26,029	2.38	31,500	25,074	2.52	30,300	24,119	2.70	27,900	22,208	2.96
30	86	22	72	36,300	24,539	2.18	35,700	24,133	2.28	34,800	23,525	2.42	33,900	22,916	2.58	32,700	22,105	2.78	30,300	20,483	3.06
32	90	16	61	29,700	29,700	2.02	28,800	28,800	2.12	27,900	27,900	2.24	26,700	26,700	2.40	25,500	25,500	2.58	24,000	24,000	2.82
32	90	18	64	31,800	31,673	2.08	30,900	30,776	2.18	30,000	29,880	2.32	29,100	28,984	2.48	27,900	27,788	2.62	26,100	25,996	2.88
32	90	20	68	34,200	29,959	2.12	33,600	29,434	2.24	32,700	28,645	2.38	31,500	27,594	2.52	30,300	26,543	2.70	27,900	24,440	2.96
32	90	22	72	36,300	27,443	2.18	35,700	26,989	2.28	34,800	26,309	2.42	33,900	25,628	2.58	32,700	24,721	2.78	30,300	22,907	3.06
34	93	16	61	29,700	29,700	2.02	28,800	28,800	2.12	27,900	27,900	2.24	26,700	26,700	2.40	25,500	25,500	2.58	24,000	24,000	2.82
34	93	18	64	31,800	31,800	2.08	30,900	30,900	2.18	30,000	30,000	2.32	29,100	29,100	2.48	27,900	27,900	2.62	26,100	26,100	2.88
34	93	20	68	34,200	32,695	2.12	33,600	32,122	2.24	32,700	31,261	2.38	31,500	30,114	2.52	30,300	28,967	2.70	27,900	26,672	2.96
34	93	22	72	36,300	30,347	2.18	35,700	29,845	2.28	34,800	29,093	2.42	33,900	28,340	2.58	32,700	27,337	2.78	30,300	25,331	3.06

PKA-A36KA6/PUZ-HA36NHA5

CAPACITY (BTU/H): 33,500 INPUT (kW): 2.79 SHF: 0.71

Indoor intake air D.B.(°C)	Indoor intake air D.B.(°F)	Indoor intake air W.B.(°C)	Indoor intake air W.B.(°F)	Outdoor intake air °C/°F D.B.																	
				20/68			25/77			30/86			35/95			40/104			45/115		
				CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.	CA	SHC	P.C.
20	68	16	61	33,165	21,425	2.26	32,160	20,775	2.37	31,155	20,126	2.50	29,815	19,260	2.68	28,475	18,395	2.88	26,800	17,313	3.14
20	68	18	64	35,510	18,678	2.33	34,505	18,150	2.44	33,500	17,621	2.59	32,495	17,092	2.77	31,155	16,388	2.92	29,145	15,330	3.21
22	72	16	61	33,165	24,078	2.26	32,160	23,348	2.37	31,155	22,619	2.50	29,815	21,646	2.68	28,475	20,673	2.88	26,800	19,457	3.14
22	72	18	64	35,510	21,519	2.33	34,505	20,910	2.44	33,500	20,301	2.59	32,495	19,692	2.77	31,155	18,880	2.92	29,145	17,662	3.21
22	72	20	68	38,190	18,560	2.37	37,520	18,235	2.50	36,515	17,746	2.66	35,175	17,095	2.81	33,835	16,444	3.01	31,155	15,141	3.30
24	75	16	61	33,165	26,731	2.26	32,160	25,921	2.37	31,155	25,111	2.50	29,815	24,031	2.68	28,475	22,951	2.88	26,800	21,601	3.14
24	75	18	64	35,510	24,360	2.33	34,505	23,670	2.44	33,500	22,981	2.59	32,495	22,292	2.77	31,155	21,372	2.92	29,145	19,993	3.21
24	75	20	68	38,190	21,616	2.37	37,520	21,236	2.50	36,515	20,667	2.66	35,175	19,909	2.81	33,835	19,151	3.01	31,155	17,634	3.30
24	75	22	72	40,535	18,079	2.44	39,865	17,780	2.55	38,860	17,332	2.70	37,855	16,883	2.88	36,515	16,286	3.10	33,835	15,090	3.41
26	79	16	61	33,165	29,384	2.26	32,160	28,494	2.37	31,155	27,603	2.50	29,815	26,416	2.68	28,475	25,229	2.88	26,800	23,745	3.14
26	79	18	64	35,510	27,201	2.33	34,505	26,431	2.44	33,500	25,661	2.59	32,495	24,891	2.77	31,155	23,865	2.92	29,145	22,325	3.21
26	79	20	68	38,190	24,671	2.37	37,520	24,238	2.50	36,515	23,589	2.66	35,175	22,723	2.81	33,835	21,857	3.01	31,155	20,126	3.30
26	79	22	72	40,535	21,321	2.44	39,865	20,969	2.55	38,860	20,440	2.70	37,855	19,912	2.88	36,515	19,207	3.10	33,835	17,797	3.41
27	81	16	61	33,165	30,711	2.26	32,160	29,780	2.37	31,155	28,850	2.50	29,815	27,609	2.68	28,475	26,368	2.88	26,800	24,817	3.14
27	81	18	64	35,510	28,621	2.33	34,505	27,811	2.44	33,500	27,001	2.59	32,495	26,191	2.77	31,155	25,111	2.92	29,145	23,491	3.21
27	81	20	68	38,190	26,198	2.37	37,520	25,739	2.50	36,515	25,049	2.66	35,175	24,130	2.81	33,835	23,211	3.01	31,155	21,372	3.30
27	81	22	72	40,535	22,943	2.44	39,865	22,564	2.55	38,860	21,995	2.70	37,855	21,426	2.88	36,515	20,667	3.10	33,835	19,151	3.41
28	82	16	61	33,165	32,037	2.26	32,160	31,067	2.37	31,155	30,096	2.50	29,815	28,801	2.68	28,475	27,507	2.88	26,800	25,889	3.14
28	82	18	64	35,510	30,041	2.33	34,505	29,191	2.44	33,500	28,341	2.59	32,495	27,491	2.77	31,155	26,357	2.92	29,145	24,657	3.21
28	82	20	68	38,190	27,726	2.37	37,520	27,240	2.50	36,515	26,510	2.66	35,175	25,537	2.81	33,835	24,564	3.01	31,155	22,619	3.30
28	82	22	72	40,535	24,564	2.44	39,865	24,158	2.55	38,860	23,549	2.70	37,855	22,940	2.88	36,515	22,128	3.10	33,835	20,504	3.41
30	86	16	61	33,165	33,165	2.26	32,160	32,160	2.37	31,155	31,155	2.50	29,815	29,815	2.68	28,475	28,475	2.88	26,800	26,800	3.14
30	86	18	64	35,510	32,882	2.33	34,505	31,952	2.44	33,500	31,021	2.59	32,495	30,090	2.77	31,155	28,850	2.92	29,145	26,988	3.21
30	86	20	68	38,190	30,781	2.37	37,520	30,241	2.50	36,515	29,431	2.66	35,175	28,351	2.81	33,835	27,271	3.01	31,155	25,111	3.30
30	86	22	72	40,535	27,807	2.44	39,865	27,347	2.55	38,860	26,658	2.70	37,855	25,969	2.88	36,515	25,049	3.10	33,835	23,211	3.41
32	90	16	61	33,165	33,165	2.26	32,160	32,160	2.37	31,155	31,155	2.50	29,815	29,815	2.68	28,475	28,475	2.88	26,800	26,800	3.14
32	90	18	64	35,510	35,510	2.33	34,505	34,505	2.44	33,500	33,500	2.59	32,495	32,495	2.77	31,155	31,155	2.92	29,145	29,145	3.21
32	90	20	68	38,190	33,836	2.37	37,520	33,243	2.50	36,515	32,352	2.66	35,175	31,165	2.81	33,835	29,978	3.01	31,155	27,603	3.30
32	90	22	72	40,535	31,050	2.44	39,865	30,537	2.55	38,860	29,767	2.70	37,855	28,997	2.88	36,515	27,970	3.10	33,835	25,918	3.41
34	93	16	61	33,165	33,165	2.26	32,160	32,160	2.37	31,155	31,155	2.50	29,815	29,815	2.68	28,475	28,475	2.88	26,800	26,800	3.14
34	93	18	64	35,510	35,510	2.33	34,505	34,505	2.44	33,500	33,500	2.59	32,495	32,495	2.77	31,155	31,155	2.92	29,145	29,145	3.21
34	93	20	68	38,190	36,892	2.37	37,520	36,244	2.50	36,515	35,273	2.66	35,175	33,979	2.81	33,835	32,685	3.01	31,155	30,096	3.30
34	93	22	72	40,535	34,293	2.44	39,865	33,726	2.55	38,860	32,876	2.70	37,855	32,025	2.88	36,515	30,892	3.10	33,835	28,624	3.41

Note: CA : Capacity (Btu/h) SHC : Sensible heat capacity (Btu/h) P.C. : Power consumption (kW)
D.B. : Dry-bulb temperature W.B. : Wet-bulb temperature

Due to continuing improvement, above specification may be subject to change without notice.

Innerglass Window Systems LLC

15 Herman Drive Simsbury, Ct, 06070
800-743-6207 860-651-3951 Fax 860-651-4789

www.stormwindows.com

[redacted]

Price and Order Form

We price the Innerglass Window by the United Inch. The formula is **Width + Height = U.I.**

1. Please round to the nearest whole inch, then **add** the window width and height and write it on the sheet
2. Please write the color, window type code, and glazing code in the box on the measurement worksheet.
3. Square feet for glazing are Width x Height (in inches) divide by 144 to get Ft^2 and round up.

Storm

Window Type	Code	# Of Windows	United Inches	X Price Per U.I.	=	Price
Compression	(CP)			X $3.25	=	$
Double Hung	(DH)			X $3.55	=	$
Double Slider	(SL)			X $3.55	=	$
Triple Slider	(TL)			X $4.15	=	$
Surface Mount	(SM)			X $3.25	=	$
				X	=	$
				X	=	$

Glazing	Code		Square Feet	X Price Per Ft^2	=	Price
1/8 " Clear Glass	(DS)	Standard		X $3.00	=	$
1/8" Low E Glass	(LE)	High Performance		X $6.00	=	$
1/8' Acrylic	(AC)			X $7.00	=	$
Other				X	=	$
Call for price			Connecticut Residents add 6.35% Tax		=	$

Compression Window in Low E glass is Energy Star and qualifies for Tax Credits!

Please call for a truck freight estimate.

Shipping Total $

Total Sale $

You can pick up at the factory and avoid shipping charges.

Terms: 50% Deposit with your order. 50% paid when your windows are ready to ship. We must have full payment in order to ship your windows. We will send an order acknowledgment and the estimated ship date when we receive your order. We accept checks, money orders, VISA, MASTERCARD, AMERICAN EXPRESS and DISCOVER CARD.

ACCEPTANCE- The above prices, specifications and conditions are satisfactory, and are hereby accepted. I agree that I am responsible for correctly measuring my window openings, and that Innerglass Window Systems will not be responsible for any errors in the dimensions I have given them.

If Innerglass Window Systems measures we are responsible. Because these are custom sized, no refunds or returns are possible. Payment will be made as outlined above. When delivery or pickup of completed order is delayed by customer, balance is due. When delay is more than 30 days, storage charges may accrue.

Order Date____________ Signature_______________________ Name____

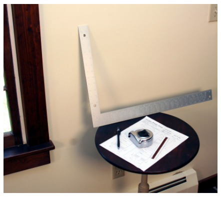
Address____ State____ Zip________

Home Phone______________________________________ Work or Cell_______________________________________

Email address____

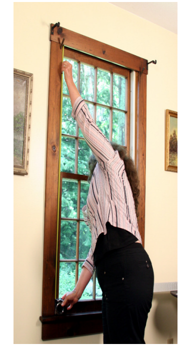
Credit Card # ____ Expiration Date___________ Billing Zip____________

Innerglass Window Systems Measuring Guidelines

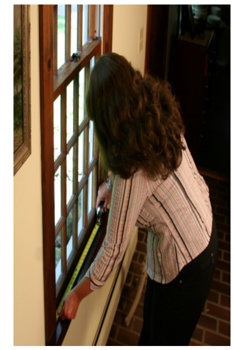


Tools needed

- 3” Case Dimension Locking tape measure
- 16”x 24” framing square (to check for out of square)
- 6” or 12” ruler
- Window Worksheet to record measurements



1. Measure all 4 sides to 1/16” and record the actual measurement. Do not average. Don't bend the tape into the corner. Instead add the tape case dimension to your measurement. Measure exactly where the window will be mounted.



2. The Innerglass Compression-Fit window needs 3/4 "depth in the window opening for mounting, 5/8” is possible but call us. The double hung and horizontal sliding interior storms need 1 1/8” depth in the window opening. Watch for obstructions such as window hardware. Screw heads and recessed pockets for the window stops are generally not a problem if they don't stick out more than 1/16".

3. To check for out of square, notice the framing squares at the left and right bottom corners and the 2 lines under each framing square where you record the gap on the worksheet. Start tight to the left side and slide the 24” side down until it touches the sill at either the corner or the end. The framing square is always held tight against the side so that any gap will show up at the bottom. If the window is square at the bottom you would record a “0” at each of the 4 lines under the framing squares. If the gap is 1/16 or less it is effectively square. For example: If a window sags down to the right the gap measurements could be 0 ¼, 0 ¼. Place the framing square against the right side of window and repeat the procedure. Think of this as a snapshot of each bottom corner. In reality they overlap but for clarity they are separated and are not to scale. Next lay the 24” side of the framing square on the sill to check if the sill is bowed up or down, if so give us a center vertical measurement and draw an arc showing the bow.

4. Innerglass Windows will accommodate 3/16” vertical and ½” horizontal play. On deep openings measure where you want the window to be and measure the opening at the wall to check that is does not get smaller than these tolerances. If the opening is smaller or the bottom of the opening is obstructed call us.

Mullions for dividing up large windows

5. If you are measuring for a double hung storm or are doing a large opening as separate upper & lower windows with a mullion, measure from the sill to the top of the meeting rail. (Where the dust collects.) This is where the top of the mullion will be. A window opening may be done as one window or two windows with a mullion. Generally double hung windows taller than 72" inches should be done as 2 windows with a horizontal mullion. Measure the length for the mullion where it is to be installed. The dimensions of the vinyl covered wood vertical mullions are 1 5/8” deep x 1 1/8" wide. The vinyl color will match the window. The horizontal mullion is ¾” thick x 1" wide. Measure the width and height of the entire opening.

Do not make allowance for the mullion size. We will do that. For pricing purposes, remember that it is one opening but TWO windows, so the width & height of each needs to be added together to come up with the united inch measurement.

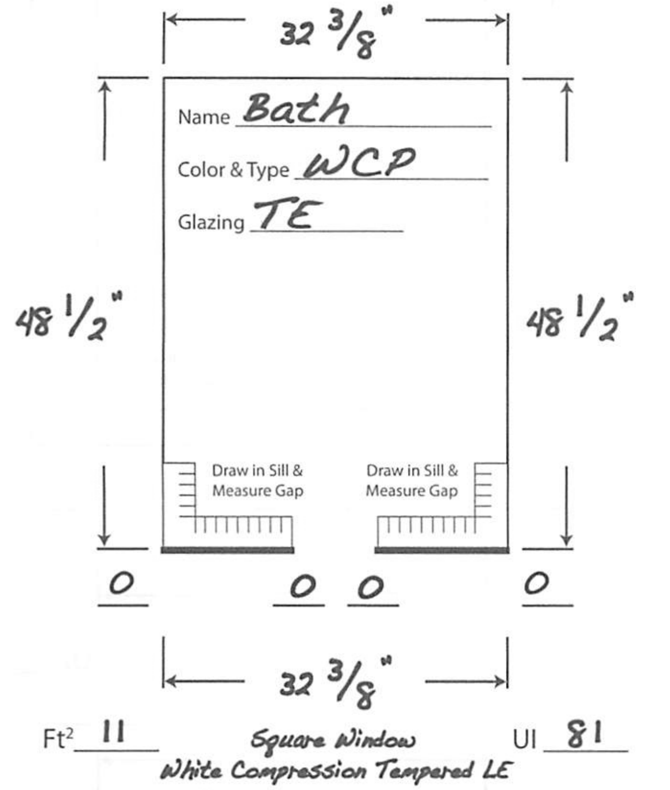
Maximum size for double strength glass is 25 sq ft or 125 united inches.
Larger than that 3/16" or 1/4" laminated or tempered glass will be used at extra cost.
Within 12" of a door or 18" of the floor, Acrylic or tempered glass must be used at extra cost.

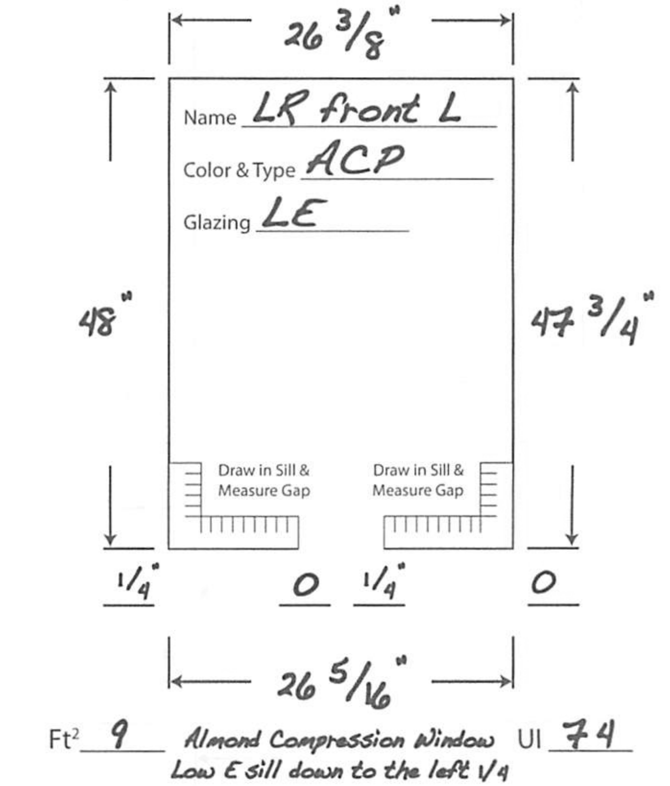
Please call us at 860-651-3951 or 800-743-6207 with any questions.

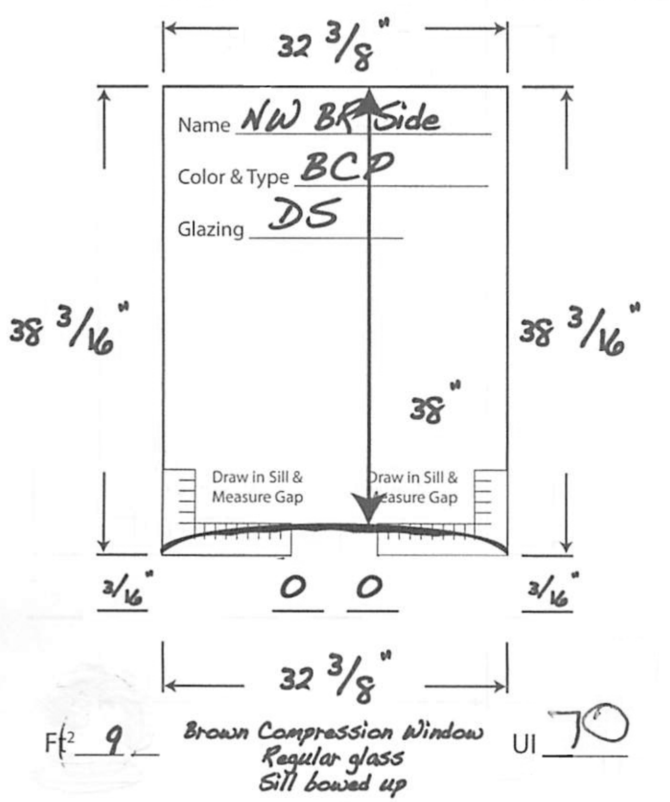
Code Key

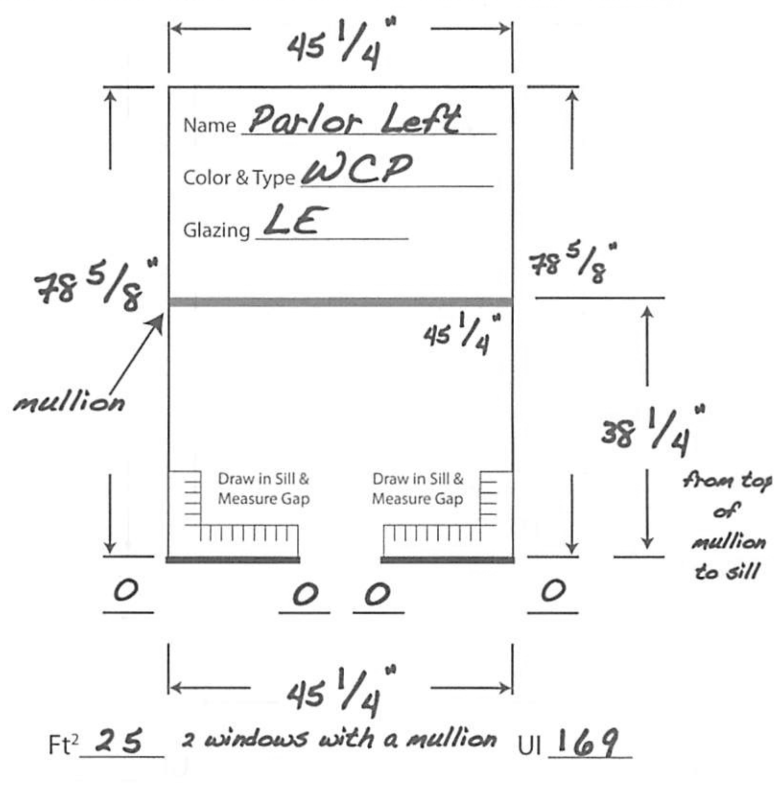
Color	Window Type	Glazing	United Inches = Width + Height
A = Almond B = Brown W = White	CP = Compression DH = Double Hung SL = Sliding TL = Triple Slider SCR = Exterior Screen	DS = Regular LE = Low E LA = Laminated Glass AC = Acrylic TG = Tempered Glass TE = Tempered Low E	• Round to the nearest whole number before **adding** width and height • 1/2" and over, round up • Under 1/2", round down

WORKSHEET EXAMPLES









Innerglass Window Systems

15 Herman Drive, Simsbury, CT 06070

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Fax 860-651-4789

www.stormwindows.com • [redacted]

Customer Name ______________________

Window Worksheet

Page _____ **of** _____

(please make a copy for your use)

Totals This Page

Ft² _______ **UI** _______

Name ______________________

Color & Type __________________

Glazing _______________

Draw in Sill & Measure Gap

Draw in Sill & Measure Gap

Ft² _______ UI _______

Name ______________________

Color & Type __________________

Glazing _______________

Draw in Sill & Measure Gap

Draw in Sill & Measure Gap

Ft² _______ UI _______

Name ______________________

Color & Type __________________

Glazing _______________

Draw in Sill & Measure Gap

Draw in Sill & Measure Gap

Ft² _______ UI _______

Name ______________________

Color & Type __________________

Glazing _______________

Draw in Sill & Measure Gap

Draw in Sill & Measure Gap

Ft² _______ UI _______

Insight
The Perfect Wall

An edited version of this Insight first appeared in the ASHRAE Journal.

By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow ASHRAE

The perfect wall is an environmental separator – it has to keep the outside out and the inside in. In order to do this the wall assembly has to control rain, air, vapor and heat. In the old days we had one material to do this: rocks. We would pile a bunch or rocks up and have the rocks do it all. But over time rocks lost their appeal. They were heavy and fell down a lot. Heavy means expensive and falling down is annoying. So construction evolved. Today walls need four principal control layers – especially if we don't build out of rocks. They are presented in order of importance:

- a rain control layer
- an air control layer
- a vapor control layer
- a thermal control layer

A point to this importance thing here, if you can't keep the rain out don't waste your time on the air. If you can't keep the air out don't waste your time on the vapor.

The best place for the control layers is to locate them on the outside of the structure in order to protect the structure (**Figure 1**). When we built out of rocks the rocks didn't need much protection. When we build out of steel and wood we need to protect the steel and wood. And since most of the bad stuff comes from outside the best place to control the bad stuff is on the outside of the structure before it gets to the structure.

Also, after generations of building out of rocks folks somehow got the idea that they wanted to be comfortable – and they figured out that rocks were not the best insulation. I mean rocks are not that bad compared to windows – memo to architects: you can't build an energy efficient green building out of glass, but you can get design awards and we all know which is more important. Back to rocks, they are heavy and you need a lot of them to make the wall have any decent thermal resistance so we invented thermal insulation.

But where to put the insulation? If we put the insulation on the inside of the structure the insulation does not protect the structure from heat and cold. Remember we really do want to protect that darn structure – especially for the sake of making the structural engineers life more happy. Expansion, contraction, corrosion, decay, ultra violet radiation, and almost all bad things all are functions of temperature. So all the control layers go on the outside. Keep the structure from going through temperature extremes and protect it from water in its various forms and ultra violet radiation and life is good.

What about this air control thing? Well air can carry a lot of water and water is bad for the structure. So we have to keep air out of the structure as well because of the air-water thing – or if we let it get into the structure we have to make sure it does not get cold enough to drop its water. Now, just one other thing, tends to be important if you intend on living in the building or working in the building or keeping things safe in the building, we might want to control the interior environment. We especially ought to be concerned about what is in the interior air because when we are in the interior we tend to breathe it. Well, it turns out that we can't control air until we enclose air. So we need an honest to god airtight enclosure in order to provide conditioning such as filtration and air change and temperature and humidity

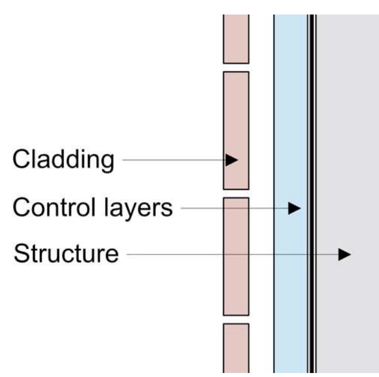

Figure 1: "The Perfect Wall"

In concept the perfect wall has the rainwater control layer, the air control layer, the vapor control layer and the thermal control layer on the exterior of the structure. The claddings function is principally to act a an ultra-violet screen. Oh, and architects might consider the aesthetics of the cladding to be important.

control. And once again the best place to control this air thing is on the outside of the structure – but under the insulation layer so the air does not change temperature. Presto: the perfect wall. A water control layer, air control layer and vapor control layer directly on the structure and a thermal control layer over the top of the other control layers (see **Figure 1** again).

This was figured out long before I was born – I think the Canadians figured it out first (1), but the Norwegians have some claims to this plus the Russians. I am going to go with the Canadians on this one because I am biased and proud of it. Also, I met Professor Hutcheon, and that is a story for the grandkids when I get some – memo to Christy and Andrew: so what's the delay here? For a more detailed discussion of the physics of all of this go to the old masters: Hutcheon and Handegord (2) and the new kids on the block Burnett and Straube (3).

In a beautiful bit of elegance and symmetry if you lie the perfect wall down you get the perfect roof (**Figure 2**) and then when you flip it the other way you get the perfect slab (**Figure 3**). The physics of walls, roofs and slabs are pretty much the same – no surprise (**Figure 4**). This insight was shone into a whole generation of practioners by Max Baker (4) when I was first getting started.

Notice in the perfect roof assembly the critical control layer or membrane for rainwater control and air control and vapor control is located under the thermal insulation layer and the stone ballast (i.e. "roof cladding") so that it is protected from the principle damage functions of water, heat and ultra violet radiation. Arrhanius* would be proud. Why we put the most critical control layers on roofs on the very, very top where they can be trashed by these damage functions never fails to amaze me. Yes, I know, they are easier to replace when they are located there. Standard answer for our disposable, unlimited resource available society.

Most problems in building enclosures occur where roofs meet walls. The classic roof-wall intersection is presented in **Figure 5** (will both credit and apologies to Max Baker). Notice that the control layer for rain on the roof is connected to the control layer for rain on the wall, the control layer for air on the roof is connected to the control layer for air on the wall…..and so it goes. Beautiful. And when it is not so…ugly.

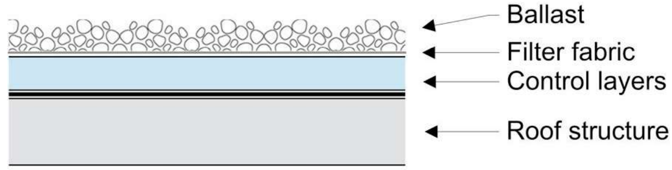

Figure 2: "The Perfect Roof"

The perfect roof is sometime referred to as an "inverted roof" since the rainwater control layer is under the insulation and ballast (i.e. roof cladding). Personally I don't view it as inverted. Those other folks got it wrong by locating the membrane exposed on the top of the insulation – it is they that are inverted.

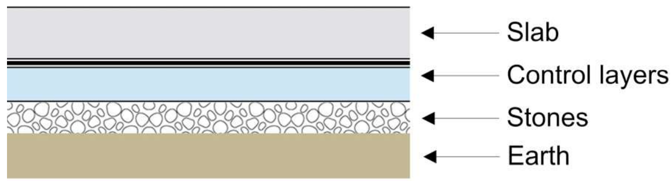

Figure 3: "The Perfect Slab"

The perfect slab has a stone layer that separates it from the earth that acts as a capillary break and a ground water control layer. This stone layer should be drained and vented to the atmosphere – just as you would drain and vent a wall cladding.

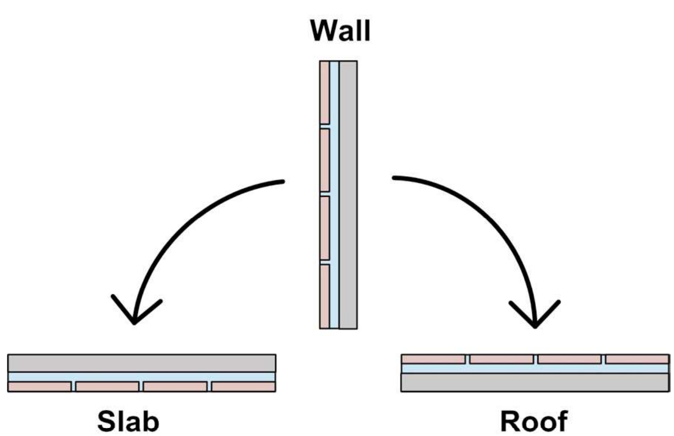

Figure 4: A Wall Is A Roof Is A Slab

The physics of walls, roofs and slabs are conceptually the same.

Time to put some meat on the bones of **Figure 1**. How should this perfect "conceptual" wall actually be built? Three ways. The best of the best of the best

* Dead, Nobel Prize Winner, no longer fashionable to study.

can be found in **Figure 6**. This is a very special wall. I refer to it as the 500-year wall for three reasons:

- it represents 500 years of evolution
- it will last 500 years
- and it will take 500 years for you clients to pay for it

It is the type of wall that you save for special buildings. Buildings that are passed down from one generation to the next. Museums, art galleries, courthouses, libraries. Institutional buildings, because institutions are the only folks that can afford them. I call this wall the "institutional wall." Perhaps once or twice in an entire career you may be fortunate enough to employ it. It is sweet in that it can be constructed in any climate zone. The only thing that may be changed is the level of thermal insulation. My advice here is very simple: what ever you think the right amount of thermal insulation should be double it and shut up. If you love your kids don't argue with me.

The second wall should be the "meat and potatoes" wall for commercial buildings. The wall every commercial building should use. The base wall that our infrastructure should depend on. So, no surprise I call it, yes you guessed it: the "commercial wall." It has a conductive structure – metal studs. All of the insulation should – and must be located on the outside. It is a thermodynamic obscenity to insulate within a conductive structural frame. Again, you can build it anywhere in any climate location. Just consider the insulation levels (see above – particularly the part about loving your kids).

The third wall is the "residential wall." Notice the structural cavity is insulated. That is because we are using a relatively non-conductive structural frame – the structure is wood and wood material based. Wood is not particularly conductive – that is why we do not have wood frying pans.

For this third wall to work almost everywhere (except Alaska and north of Flyn Flon** where we would not insulate even within a relatively non-conductive wood structural frame) we would split the thermal resistance of the insulation on the exterior of the structural frame with this insulation within the structural fame at least 50:50. So in an R-20 wall – at least R-10 or more on the outside of the non-conductive structural frame. And no vapor barrier on the inside of the assembly. Repeat after me, no vapor barrier on the inside of the assembly. We want the assembly to dry inwards from the control layers – and to dry outwards from the control layers. Always. Everywhere.

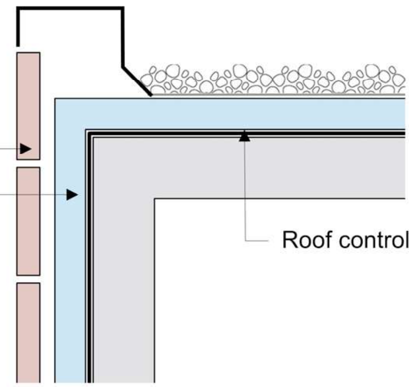

Figure 5: "The Roof-Wall Connection"

Notice that the control layer for rain on the roof is connected to the control layer for rain on the wall, the control layer for air on the roof is connected to the control layer for air on the wall…..and so it goes.

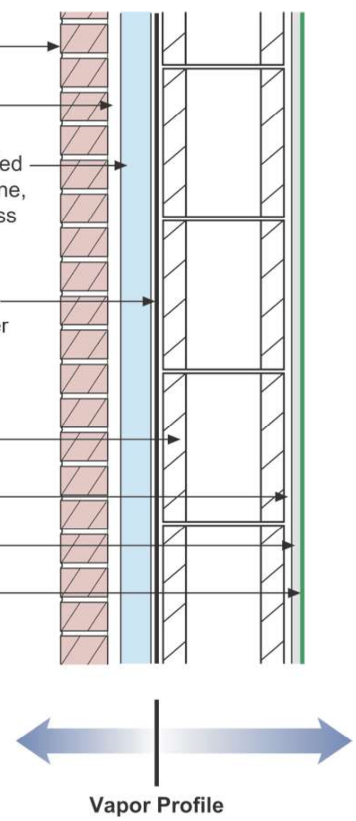

Figure 6: "The Institutional Wall"

The best wall that we know how to construct. Works everywhere in all climate zones.

** Home of Bobby Clark, hockey legend, no teeth

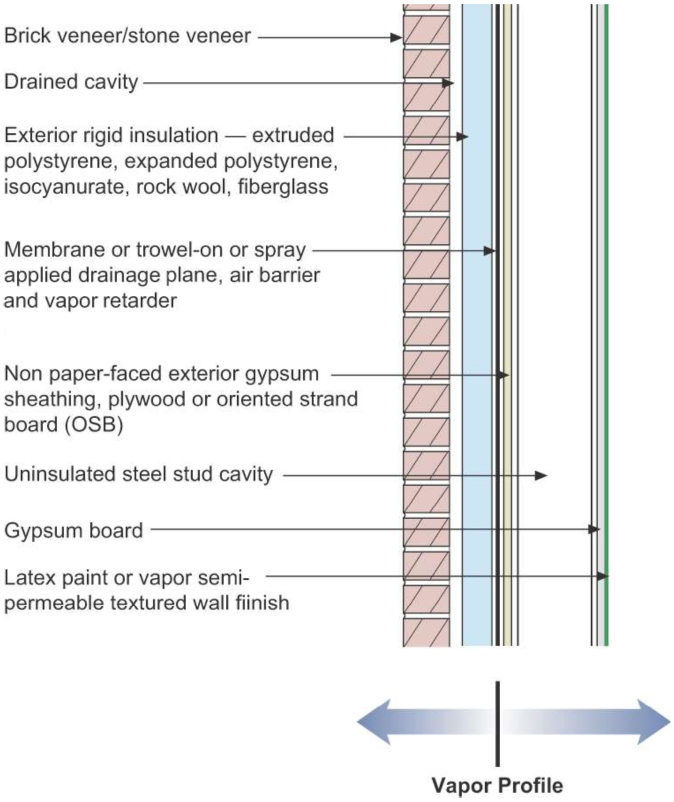

Figure 7: "The Commercial Wall"

The almost best wall we know how to construct. Affordable. Works everywhere in all climate zones.

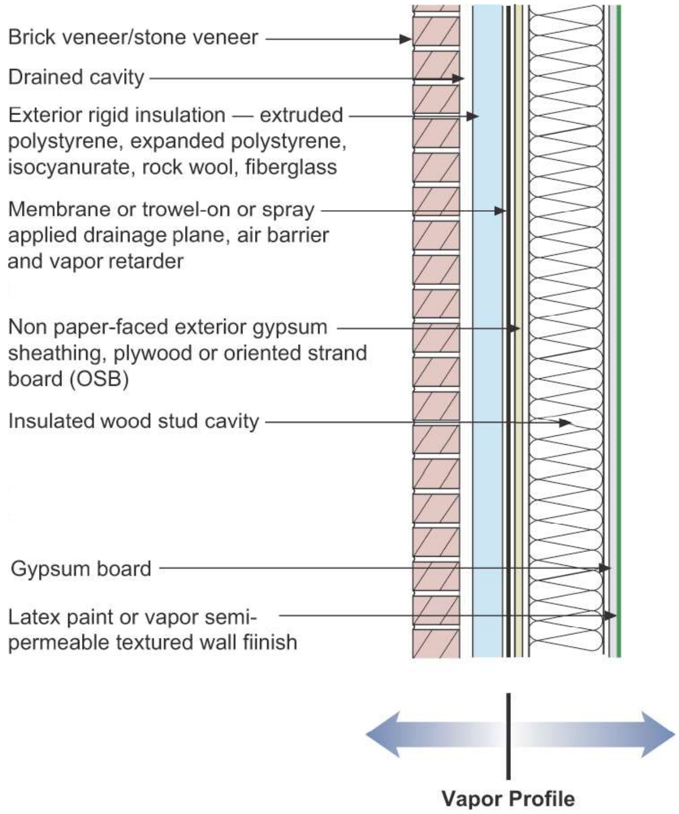

Figure 8: "The Residential Wall"

The best residential wall we know how to construct. Not cheep. Works almost everywhere – except in extreme cold climates where we would not insulate within the wood structural fame.

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(1) Hutcheon, N. B., CBD-50 Principles Applied to an Masonry Wall, Canadian Building Digest, National Research Council Canada, Ottawa, Ontario, Canada, February 1964.

(2) Hutcheon, N.B. and Handegord, G.O.; Building Science for a Cold Climate, National Research Council of Canada, 1983.

(3) J.F. Straube and Burnett, E.F.P.; Building Science for Building Enclosures, Building Science Press, Westford, MA, 2005 (www.buildingsciencepress.com)

(4) Baker, M.; Roofs, Multi-Science Publications, Ltd., Montreal, 1980.

Energy Audit

Funded by

EVERSOURCE ENERGY

The Grange

21 Western Avenue

Henniker, NH

October 22, 2023

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE

S.E.E.D.S.

SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES

Margaret Dillon—603-532-8979—MDILLON@myfairpoint.net

Table of Contents

Introduction

This Energy Audit has been funded by Eversource. Funds may, or may not, also be available to help reduce cost for eligible Energy Saving Measures (ESM) including weatherization efforts and equipment upgrades.

The purpose of an energy audit is to identify energy saving measures (ESM) in a building. Computer simulated energy models are developed to estimate energy consumption based on the local climate conditions, physical dimensions and characteristics of a building, mechanical systems, presumed lighting, equipment, and occupancy patterns, in addition to a number of other variables.

With the building modeled in existing conditions, energy savings can be estimated for improvements to the thermal envelope and/or more efficient mechanical systems. The cost of those measures can then be analyzed in terms of predicted energy saved and savings potential from converting to different sources of energy. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures.

This audit has been prepared with the best of intentions to assist the Town of Henniker make informed decisions regarding energy saving improvements in keeping with long term goals for the property. We do not make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed.

Executive Summary

The Grange is an historic wood framed structure with a meeting room, office, and small restrooms on the first floor. The basement is unfinished, but fully used as a food pantry with refrigeration and dry goods storage.

As shown in the historic energy usage on page 7, the cost to heat the building in 2022 was $1765 for propane and an estimated $212 for electric resistance heating in the office. A portable air conditioner in the small office is the only cooling available at this time. While there are definitely opportunities to improve the thermal envelope to conserve heat, the costs for substantial improvements cannot be easily justified when the annual heating costs are relatively low, ie under $2000 at current energy prices.

Therefore, recommended ESM have been organized into three tiers, representing different levels of investments and benefits. Tier one includes four ESM with an estimated total cost of $1,820 and estimated annual savings of $166 for a simple payback of 11 years. Tiers two and three reflect a more comprehensive upgrade to the thermal envelope, at an total estimated cost of $22,232 (for all three tiers) and annual savings of $1040 from existing equipment and current energy prices. A cost/savings analysis of all three is on the next page.

The predicted savings from this more comprehensive approach does not appear to be financially appealing at today's energy prices, but it reduces the heating loads enough to make converting to electric heat pumps more affordable with increased annual savings and offering summer cooling. It also has a more dramatic reduction of carbon emissions, improves comfort, and the ability for the building to 'coast' through power outages while conserving heat.

Other recommendations from this study include:

- Install new, Energy Star, bath fans on timers and vent to the outside to eliminate the risk of condensation in attic
- Convert all lighting (14 fixtures with 32 tubes) to LED,
- Replace a gasket on one of the freezers, defrost all of them, and plan on replacing oldest refrigeration units in the near term.

Summary of Energy Saving Envelope Measures

The recommended ESM are described in more detail later in this report.

The chart below summarizes the cost of each ESM in the fairly cost effective Tier One, estimated annual dollar savings, a simple payback in years, and return on investment (ROI) of each measure based on the service life of the improvement.

An investment of an estimated $1,820 is predicted to save at least $166 in energy costs at the three year average propane cost per gallon, and $0.16 per kWh. This would result in a simple payback within 11 years. Since ESM continue to save energy for the life of each measure, this also results in a minimum annual return on investment (ROI) of 2.8% over each of the next 25 years. Again, the savings are based on recent average energy prices. If (when) prices increase, so too will the ROI.

Tier One	Cost of Measure	Annual Savings	Simple Payback Years	Life of Measure	Investment Gain	ROI	Annual ROI
Replace Thermostat	$70	n/a					
Weatherstrip Doors	$165	$28	5.9	10	$115	69.7%	5.4%
Air Seal Ceiling	$650	$63	10.3	25	$925	142.3%	3.6%
Rim Joists	$1,005	$75	13.4	25	$870	86.6%	2.5%
	$1,820	$166	11.0	22	$1,795	100.7%	2.8%

This next chart presents the same Tier One ESM with resulting annual energy savings from each implemented measure and the annual reduction of CO2 emissions. Potential Eversource incentives are based on energy saved for the cost of the measures. Contact your Eversource representative, Jack Paloulek, to determine if the project is eligible for incentives. [redacted]

Tier One	Cost of Measure	Lp Gallons Saved	kWh Saved	Site Energy Reduction MMBTU	Source Energy Reduction	Tons CO2 Reductions Annually
Replace Thermostat	$70					
Weatherstrip Doors	$165	16		1.5	1.7	0.1
Air Seal Ceiling	$650	37	162	3.9	5.7	0.3
Rim Joists	$1,005	44	45	4.2	5.1	0.3
	$1,820	98	207	9.6	12.6	0.7

Note: Replacing the main room thermostat with a programmable unit, with auto set back, will likely save measurable heating energy. But saving estimates are not included because they would depend on how the dial thermostats are operated now—which is not available. Programming for nighttime set back with an auto set back feature would allow people to turn the thermostats up as needed, but then automatically return to nighttime setbacks, without having to remember to do so.

"Going Deeper"

The chart below summarizes the cost of each ESM in a Tier Two and Tier Three which includes insulating the above grade walls, estimated annual dollar savings, a simple payback in years, and return on investment (ROI) of each measure based on the service life of the improvement.

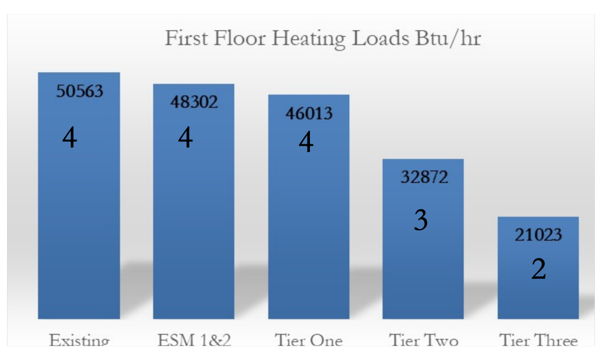
In this case, pursuing a "deeper" energy retrofit by investing a total of $22,232 (incudes Tier One costs) is predicted to save $1,040 in annual energy costs. This would result in a simple payback of over 20 years, but a positive annual ROI each of those years of just under 1%. Again, this is based on stagnant energy prices. While price increases are likely, no one has a crystal ball on future energy prices, so the financial analysis is likely conservative. Costs are estimated and would need a contractor proposal for actual costs.

Tier Two	Cost of Measure	Annual Savings	Simple Payback Years	Life of Measure	Invest-ment Gain	ROI	Annual ROI
Insulate Foundation Walls	$2,970						
Innerglass on Windows	$3,960						
Ceiling Insulation Upgrade to R50	$3,749						
Total Tier 2	$10,679	$525	20.3	25	$2,447	22.9%	0.8%
DP AG Walls	$9,734	$349	27.9	25	-$1,009	-10.4%	-0.4%
Totals For All Three Tiers	$22,232	$1,040	21.4	25	$3,768	17.0%	0.6%

This next chart presents the same ESM with resulting annual energy savings from each implemented measure and the annual reduction of CO2 emissions. Potential Eversource incentives are based on energy saved for the cost of the measures.

Tier Two	Cost of Measure	LP Gallons Saved	kWh Saved	Site Energy Reduction MMBTU	Source Energy Reduction MMBTU	Tons CO2 Reductions Annually
Total Tier One	$1820	98	207	9.6	12.6	.7
Total Tier Two	$10,679	309		28.2	32.4	1.9
Insulate AG Walls	$9,734	205	312	19.8	25.1	1.4
Total All ESM	$22,232	612	519	57.6	70.1	4.0

Based on the articulated interest in converting to air source heat pumps for more efficient heating and adding summer cooling, the chart to the right shows the reductions in heating loads for each ESM group. Numbers indicate the heat pump capacity in tons for each condition, also indicating potential first cost reductions.



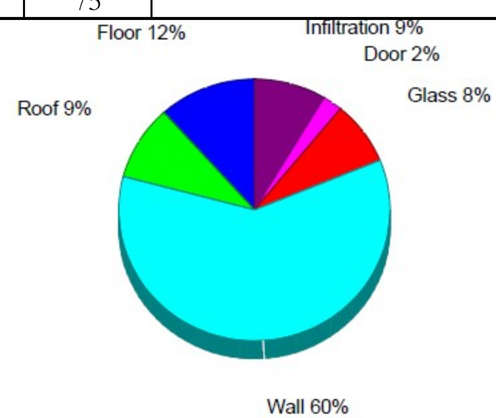
Assessed Values for The Grange and Other Model Inputs

The thermal envelope is the assembly of materials which form the barrier between inside conditioned space and outdoor weather and climate. Its ability to conserve heat and manage moisture determines, primarily, the heating load or demand of a building. Continuity and thickness of insulation, in direct contact with air barrier, is key to an effective thermal barrier.

Square Feet Area (whole)	3090	
Volume (ft3) (whole)	23,636	
Design Temps	Outdoor Dry	Indoor Dry
Winter	2	70
Summer	87	75
Reference City	Concord NH	

Summary reports for load calculations of the existing and retrofitted condition has been included at the end of this study. Below is a summary of values for existing and improved envelope components.

Envelope Component	Surface Area FT2	Assessed Effective R-Value	U-Factor	Improved U-factor	Improvement
DH Stained Glass Windows	192	1.75	0.57	0.37	Weather-Strip and Interior glaz-
Exterior Entry Doors	59	1.78	0.56	n/a	Weather-Strip
Wood Framed Walls	1952	6	0.167	0.083	Exterior Insulation
Rim Joists	165	2	0.5	0.056	Three inches SPF
Foundation Walls to 2' below grade	620	2	0.5	0.083	2" FF Thermax OR
Foundation Walls to Floor	160	8	0.13		
South Foundation	61	1.7	0.61	.083	
Flat Ceiling	1470	16	0.063	0.02	Air Seal and add 12" cellulose
Slopes and Flat above Storage	310	10	0.100	0.05	Dense Pack Slopes and Blow in
Floor Over basement	1350	2.7	0.37		Bring foundation walls into ther-
Volume: 12,000 ft3 Above Grade		Exist		Improved	
CFM Air Leakage Winter/Summer		110/59		75	



Heat loss by the thermal envelope component

Other formulas used in this analysis:

Propane: 91,300 Btu per gallon for site energy
Source energy: 104,995 Btu per gallon (1.15xSite)

Electric: 3412 Btu per kWh site energy.
Source energy: 11,361 Btu per kWh

CO_2 Emissions:

Propane: 12.35 lbs per gallon

Electric: CO_2 lbs = kWh X .89

Historic Energy Use Analysis

The energy analysis below is based on an average of the energy data provided for 2021 and 2022.

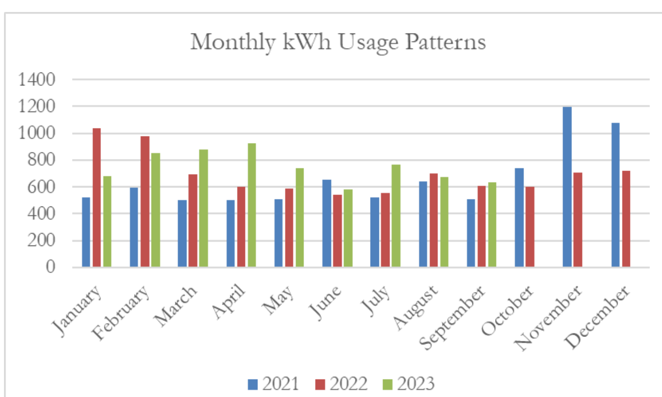
Energy	Units	Site Btus	Source Btus	$Cost
Electric kWh	8324	28,401,488	94,568,964	$1,253
Propane	1039	94,860,700	109,089,805	$1,765
Totals		123,262,188	203,658,769	$3,018
EUI KBtu/FT2	1323	93.2	153.9	$2.28
EUI with basement	2646	46.6	77.0	$1.14

The Energy Utilization Index (EUI) offers a simple snapshot analysis of a building's energy use by looking at total amount of energy input (converted to Btu's) divided by the floor area of conditioned space. "Site Energy" refers to units of energy delivered to a site. Source energy includes transmission and some allowance for off site generation and other considerations.

Based on the information provided the Site EUI for 2021 and 2022 averaged 46.6 KBtu/ft2 for the whole building. Source EUI is 77.7 KBtu/ft2, with a cost per square foot of $1.14 per ft2 based on current energy prices. Since the per unit cost for energy can vary greatly over time, converting all forms of energy to Btus is a more useful way of looking at a building's energy demands and potential reductions from energy saving measures.

An EUI of 46.6 is not considered very high, even for a building without central air conditioning, but it is notable that only the first floor is 'intentionally heated'. The basement is heated through the ceiling (conditioned floor above), from uninsulated ducts, and from heat generated from the refrigeration units.

Monthly patterns of electric consumption can sometimes tell a useful story, though assumptions are never as useful as hard facts. Still, it is likely that the peak consumption pattern in the winter is due to heating the office with electric resistance (ER) baseboard. While ER is technically more efficient than even the condensing furnace, it is also by far the most expensive way to heat a space. Electric heat pumps are two to over four times more efficient than ER, (or any other existing technology), so can compete with fossil fuels on a cost per million Btu basis. However, at the 2023/2024 contracted price of $1.439 per gallon of propane, the existing furnace isa more cost effective system. The financial advantage of converting to heat pumps is that it offers the option to offset with on-site generation of clean, renewable, and "free" solar energy.



KW Demand and the Cost of Supply

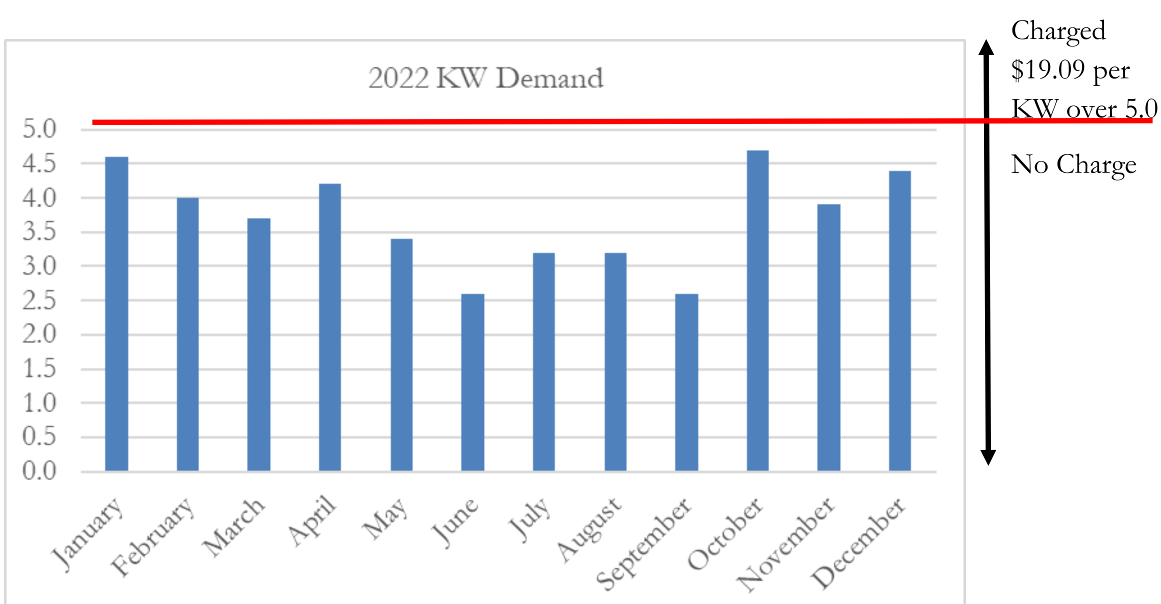
The KW Demand is determined each month by the peak call for power during any 30 minute window within a billing cycle. There were no Demand Charges in 2022 since the peak demand never exceeded 5.0 in any of the 12 months.

While its not a concern now, demand for power would increase when converting to electric heat pumps though could be mitigated by not using nighttime set backs. Heat pumps operate most efficiently when left at a stable thermostat setting.

Reducing electric usage saves energy and monthly costs in both the supply side (actual electricity used) and the delivery side (the very real transmission costs of delivering kWh to the meter, maintaining lines, etc).

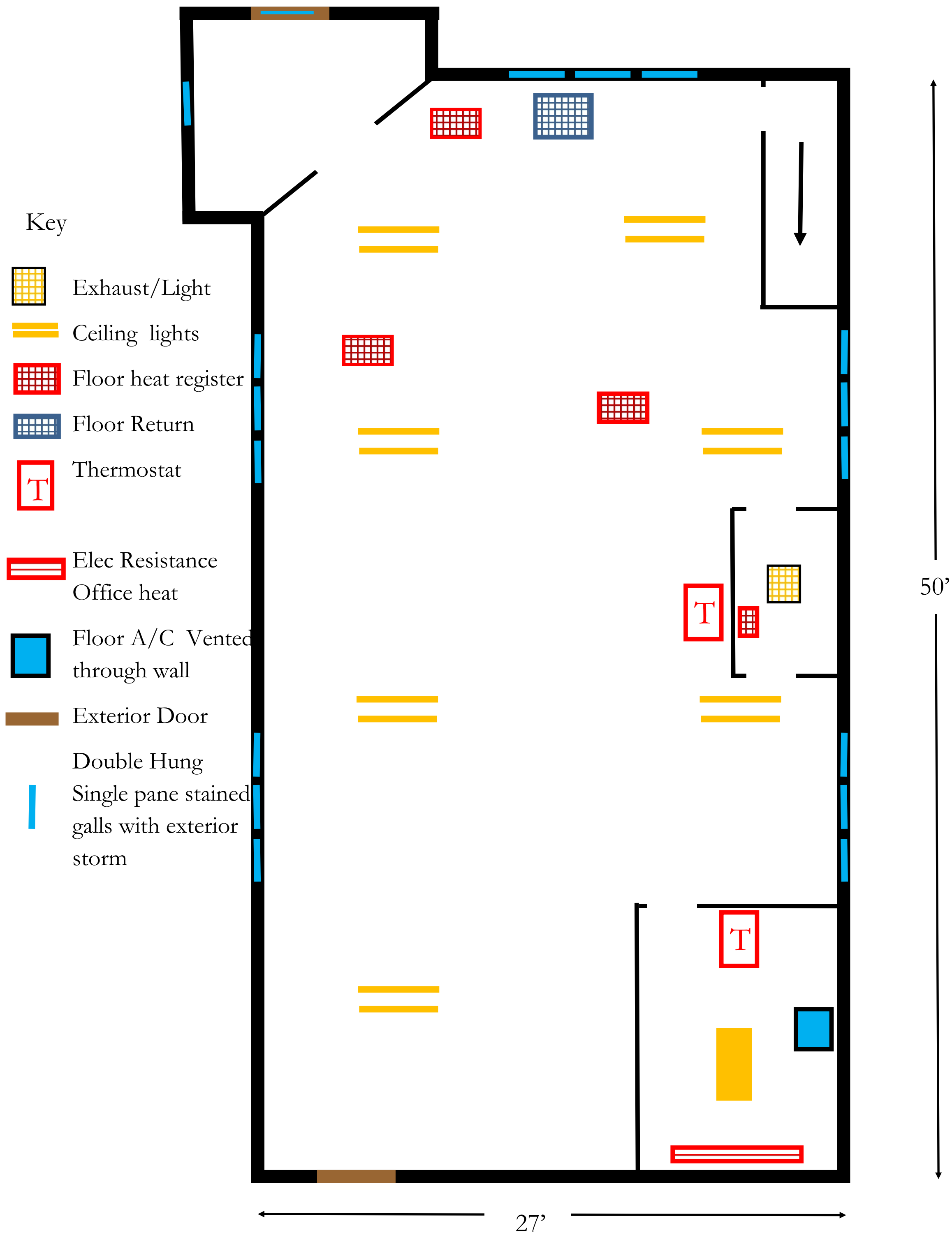
Lowering peak demand on the regional grid plays a critical part in reducing the need to build more generation plants. It may be impacted by a reduction in kWh consumption, but is mostly determined by time and the appliance used. Customers are allowed a peak use of 5.0KW each month before incurring charges.

A good explanation about Demand Charges can be found at [Making Sense of Demand Charges: What Are They and How Do They Work? - Renewable Energy World]



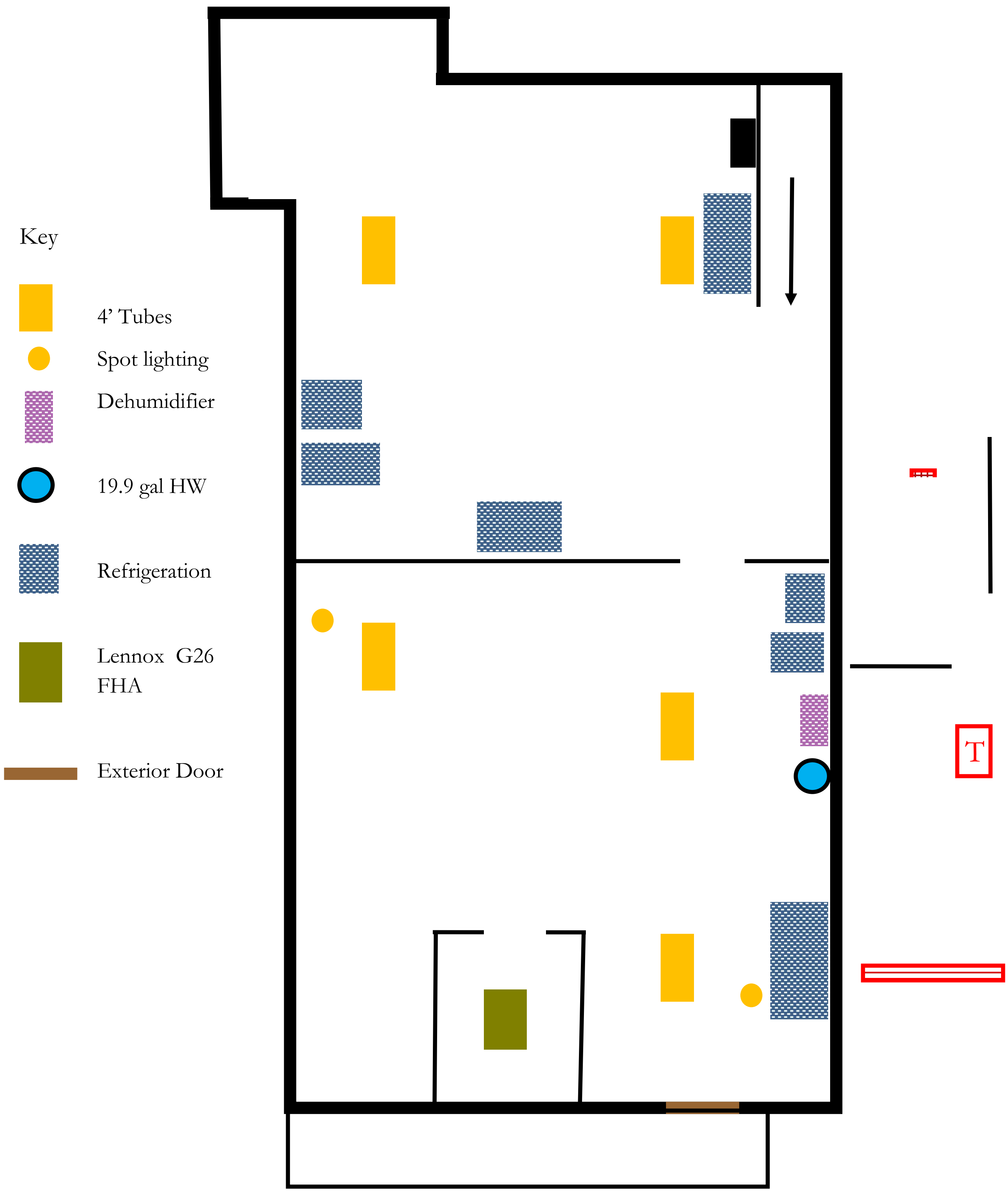
First Floor

Graphic roughly to scale.



Basement

Graphic only roughly to scale.



Description of Energy Saving Measures

Replacing the main room thermostat with a programmable unit, with auto set back, will likely save measurable heating energy. But saving estimates are not included because they would depend on how the dial thermostats are operated now—which is not available. Programming for nighttime set back with an auto set back feature would allow people to turn the thermostats up as needed, but then automatically return to nighttime setbacks, without having to remember to do so.

One good option: Honeywell Home RTH6580
W-Fi 7-Day Programmable Thermostat $70

Air Sealing

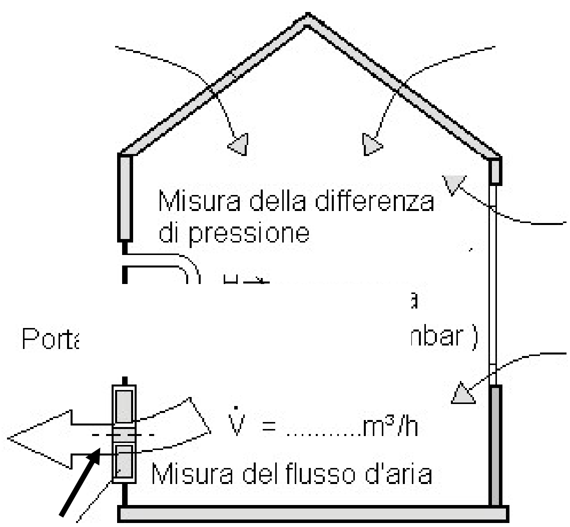
The objective of this measure is to reduce uncontrolled air leakage. Weather-stripping exterior doors, windows, and the hatch to the attic, are all recommended steps.

But the recommendation is also to hire an insulation contractor who uses a blower door assembly to slightly depressurize the building in order to locate—and seal—air leakage sites.

NOTE: The building should not be put under pressure if the ceiling tiles are deemed to be asbestos!

A blower door consists of a large fan, capable of moving 6000 cubic feet of air per minute (CFM), an adjustable door frame, and a nylon skirt to seal off the exterior door, much like how a skirt on a kayak keeps a paddler dry below the waist.

BD's are often used to measure how much is pulled through cracks and gaps at a standardized pressure differential of 50pascals. Actual air leakage under natural conditions can be (sort of) guesstimated from that measurement, but many argue, including this consultant, that the best reason to put the building under pressure is to locate leakage sites.

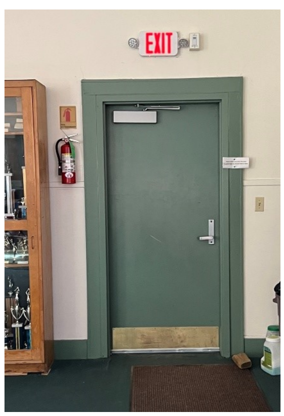


fan

Air Sealing: Weather-stripping Doors

Thermographic (aka Infra Red or IR) images depict differences in surface temperatures. Darker colors indicate cooler surfaces than brighter colors. Dark “blobs” or streaks can indicate cold air leaking into the building on a cold day, or washing through low density insulation such as fiberglass.

Air leakage around the three exterior doors offer a cost effective opportunity to reduce air filtration though installing professional quality weather stripping.



Interior Glazing Units

Exterior storm windows do reduce the amount of heat loss through windows to a certain extent, by adding an air space between the single pane of glass and storm. Importantly, they also serve to protect historic window frames and glass. But they do not stop air infiltration because they need 'weep holes' to allow drainage of condensation that forms.

As restoring historic wood windows becomes increasingly popular, many companies now offer a variety of interior options which are less expensive than full replacements and often as, or more, effective at reducing heat loss.

Interior glazing panels are a very effective option. They can be custom made with wood for $800-$1200, OR a non wood unit can be custom ordered on line and easily installed for less than $300. In this case, a compression fitting unit is estimated to cost $264 per window.

They can be single units and easily removed, or double hung, and left in place.

The statements below were copied in part from stormwindows.com and reference Innerglass Windows specifically, though many of the statements describe any quality interior glazing panel. Advantages include:

- Uses a concealed stainless steel springing system that requires no all-around track. It conforms to the window opening, automatically compensating for most out of square conditions.
- Custom made to your window dimensions, we can fit any window, no matter how crooked!
- Significantly more effective at insulating your home and lowering your heating and cooling bills than traditional exterior storm windows.
- Much tighter than exterior storms, because outside storm windows must be ventilated (you know, the weep holes) to get rid of the condensation that has already happened.
- So tight it provides a vapor barrier on the warm side that stops condensation in the first place.

Innerglass Window Systems pioneered the use of high performance Low-E glass in our interior storm windows. Low-E glass doubles the R value of regular glass making you warmer in the winter and cooler in the summer. It also cuts out 2/3 of the ultra-violet rays that damage your rugs and furniture.

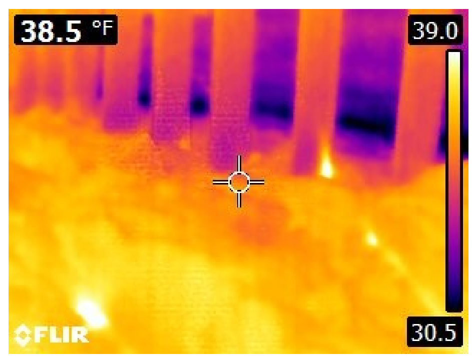
https://stormwindows.com/index.php/storm-windows-how-to-order/

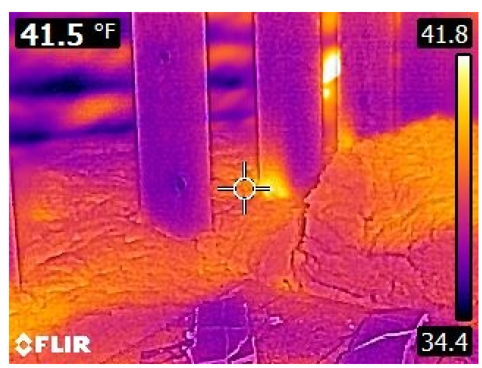
Innerglass	U.I / FT2	Per	Per Unit	# Units	Cost
Compression Unit	96	$2.75	$264.00	15	$3,960

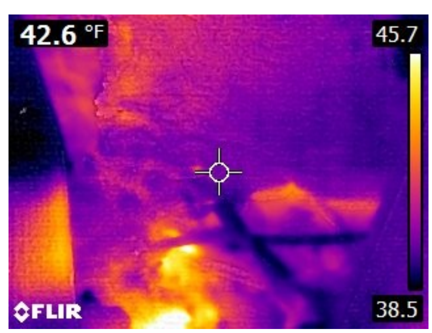
Ceiling Plane

Stairs lead up to a finished storage area with an access hatch to above the ceiling in the wall. It is apparent that the room below was (presumably a Church) and open to a vaulted roof as remnants of plaster ceiling remain at the roof plane. The new ceiling structure has an old layer of fiberglass with facing disintegrated and a newer layer of 10” fiberglass batt laid on top. In all, there is a lot of insulation material, but much of it in poor condition and not in contact with an air barrier, thus diminishing its thermal performance.

ESM two calls for ‘surgical air sealing’ of gaps and penetrations as located from using a blower door. Ideally, ESM #7 would be approved at the same time so that during the air sealing, degraded insulation could be removed, good material positioned, and an additional 12” cellulose blown on top. Note: integrity of ceiling tiles should be assessed to carry the extra weight.



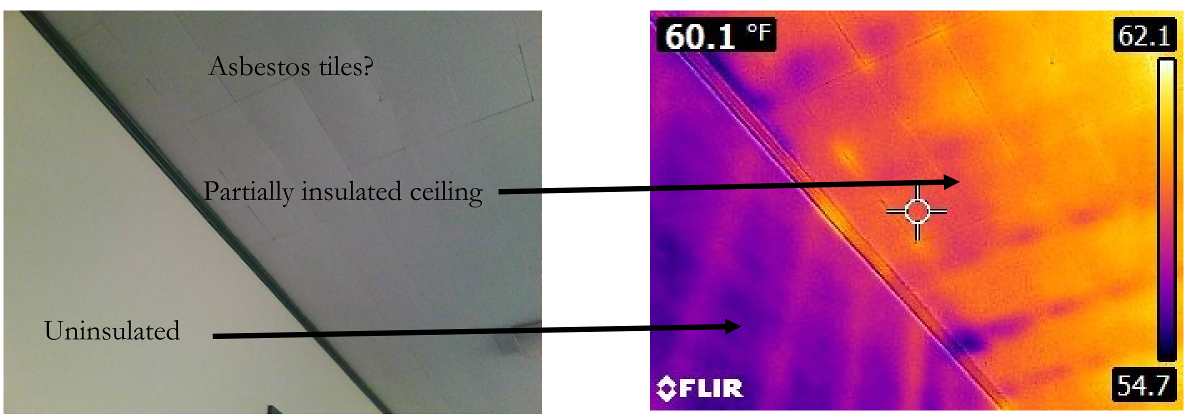


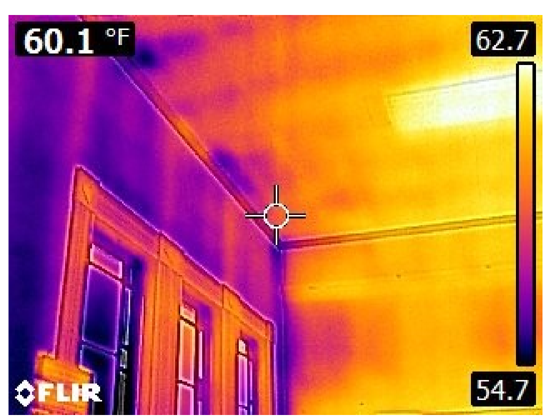


Ceiling Plane

Approximately 3' wall inside the storage attic. Note the appearance of insulation above the lower ceiling, that does not extend up the wall.

The middle image was taken from inside the storage attic, below the hatch, with the image on the right taken from inside the room below.



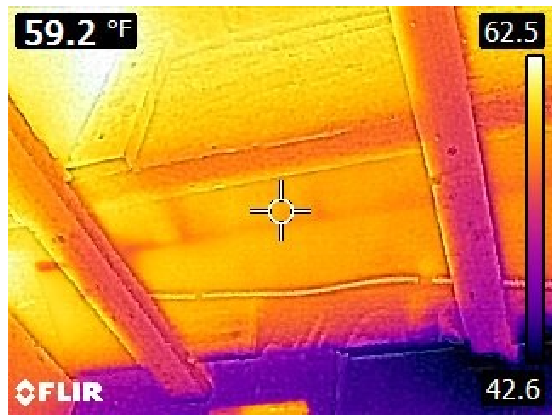


Basement and Foundation Walls

Though the basement doesn't (appear to) have a thermostat to be actively heated, it is heated by three sources:

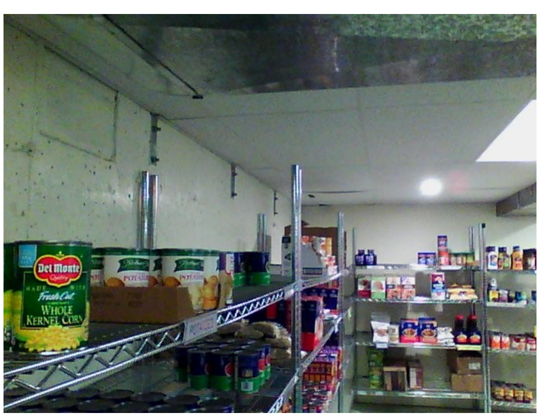
1. Heat conducting from the conditioned floor above
2. "Distribution losses" through the uninsulated metal ductwork
3. Heat expelled from the seven refrigeration units

To conserve that heat inside the building, ESM #4 focuses on insulating the rim and band joists and making a continuous air seal to the top of the foundation. ESM#II-5 suggests investing in insulating the block walls, at least the top 3-4', with either 2" foil faced foam board (Thermax has a 15 minute flame rating) or spraying closed cell foam followed by an intumescent paint to meet the fire code.



Insulating the whole foundation wall—from the rim joists down to the floor—is ideal, but in terms of "bang for the buck", the greatest heat loss occurs down to about two feet below grade, at which point the earth offers insulating value while also staying above ambient air temperatures during the coldest hours of winter.

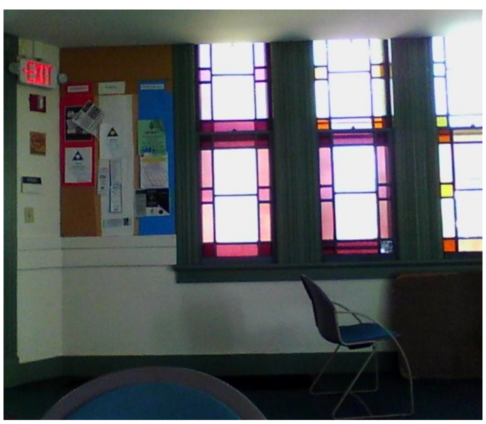
But the other advantage to insulating the walls with a vapor impermeable material is to reduce moisture migration and therefore reduce hours needing dehumidification.

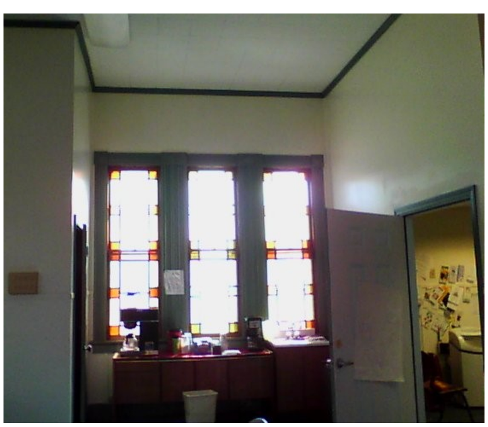


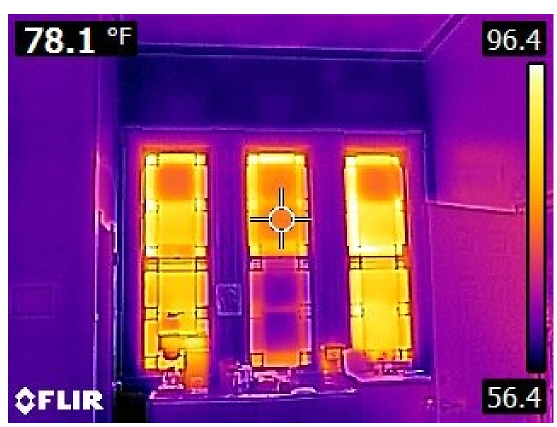
Above Grade Framed Walls

The brighter/lighter vertical lines shows that the surfaces to the inside of the wood stud framing is warmer than the cavity (stud bay) on either side, indicating that the wall cavities do not have insulation in them because the heat is moving to the outside more rapidly in between the studs. The Grange's walls account for an estimated 60% of all heat loss to the outside, mostly through the above grade framed walls, and the colder surfaces can be a source of discomfort as body heat radiates to both cold glass and walls.

The recommendation is to insulate the cavities by removing a clapboard on the outside, drilling a 2" hole in the wood sheathing, and blowing cellulose into each four inch cavity bay before sealing the hole and re-installing the clapboard.







Equipment Inventory

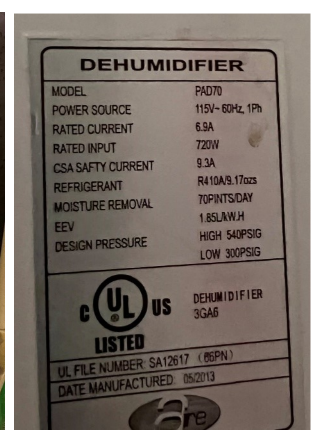
Appliance	Brand	Model	Serial	Manufact. Date		Efficiency	Refrigerant
First Floor							
Portable Air Conditioner	Maytag	M6P09S2A*B	MR 773013 357W		9000 Btu	9.5 EER	R-22
Paper Shredder	Staples						
Copier	HP						
Small Fridge							
Coffee Makers (2)	Bunn						
Restroom Exhaust Fans							
Basement							
SS Refrigerator	Intertek	R23-S	R23S 19060031		7.5 Amps		R-290
Refrigerator	Electrolux	FKCH17F7HWD	WB34280576	Oct 2013	5.0 Amps		134-A
	Sears	253.1654211	WB94237194	Oct 2009	5.0 Amps		134-A
GlassTop Freezer	Avantco						
B Series Glass Door Fridge	Miagali Ind.	C-10RM-HC	HC00318101600920004	Oct 2018	2.1 A 250W		R-290
Commerical Freezer	Sears	253.145921	WB53224952	Aug 2005	5.0 A		134-A
	Kelvinator	KCCf170WH	738231 0292		1.9 A		R-290
Dehumidifier	Aire	PAD 70		May 2013	6.9 A 720 W	70pints/day	R410
Electric Water Heater	State Ind.	PV 20 10MSB KZ	J95924589		19.9 gallons 1650		
Copier							
Furnace- Single Stage	Lennox	G26Q3/4	5802L 45012	Nov 2002	Output 125,000	91% AFUE	


AVANTCO
Veggies
Juice

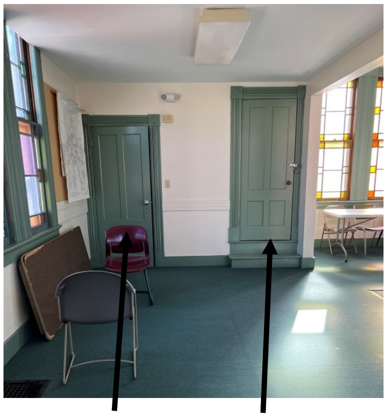

Butter - 2 for 1
1 Cheese Only


LENNOX


DANGER
state

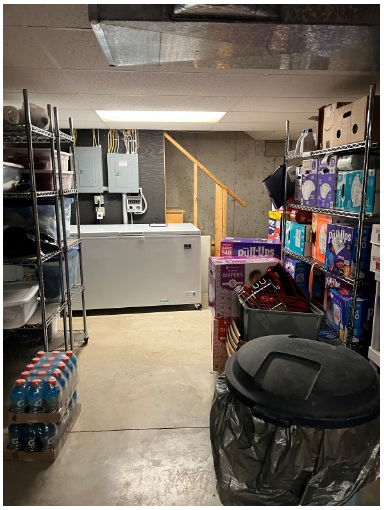

DEHUMIDIFIER
MODEL PAD70
POWER SOURCE 115V~ 60Hz, 1Ph
RATED CURRENT 6.9A
RATED INPUT 720W
CSA SAFTY CURRENT 9.3A
REFRIGERANT R410A/9.17ozs
MOISTURE REMOVAL 70PINTS/DAY
EEV 1.85L/kW.H
DESIGN PRESSURE HIGH 540PSIG LOW 300PSIG
DEHUMIDIFIER 3GA6
LISTED
UL FILE NUMBER SA12617 (86PN)
DATE MANUFACTURED 05/2013

Interior Photos



To basement attic

Restroom Office

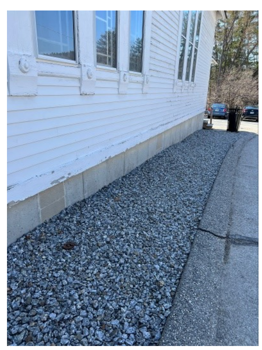


Exterior Photos

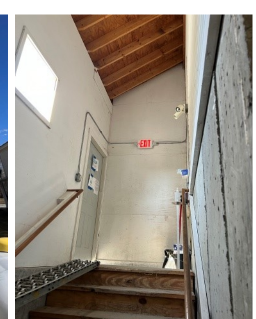
North facing

East facing

West facing



A shed roof south facing addition provides covered but unconditioned (exterior to the thermal envelope) stair access to the basement and main floor.



The Basics of Heat Transfer in a Building

Heat moves in three basic ways in a building: Conduction, convection, and radiation.

Heat **conducts** to coolth or cold in any direction and through physical contact of materials. Insulation can slow the rate of heat loss to the outside. The rate at which it moves is determined by the type and thickness of material and the temperature difference between inside and outside. Compare holding a ceramic mug of hot water vs a glass of hot water, vs a glass of cold water. The skin of your hand will be heated—or cooled—based on the conductivity of the mug, glass, and the temperature difference of the water and your hand.

In a building in our climate, heat moves, or 'is lost' to the outside as it moves from inside heated space to the colder outside through an assembly of materials. For the walls, the assembly may consist of plaster or sheet-rock, brick, or wood framing with insulation in cavities (or not), exterior board sheathing, wood clapboards, or perhaps a thin layer of insulation and vinyl siding. The rate of heat loss varies with the difference between the inside temperature and outside temperature. That is why setting the thermostat back to 55 degrees when the building is unoccupied saves energy; because the rate of heat loss is slowed.

Heat can also be transferred through air or water by **convection.** While heat moves to cold via conduction, warmer air rises because it is lighter, or less dense, than cooler air. This means that insulation can only work well if it doesn't allow air to pass through it. The other way to say it is: Insulation needs to be in contact with an air barrier on all sides to perform as expected. Weatherstripping around doors and windows, for example, can stop cold air infiltration which, when warmed, rises to the ceiling and exfiltrates through any cracks or gaps in the ceiling material.

Insulation is usually described by its R-value, or resistance to allow heat transfer. But R-value doesn't tell the whole story because it only refers to conductive heat loss and doesn't consider convection. Manufactures of insulation test their products in a laboratory by placing it, fully lofted, in a perfectly sealed box, and measure the rate that heat moves from one side to the other to determine what "R-Value" to stamp on the product to be sold. If its not installed in exactly the same way, that R-value has very little meaning.

The third way heat moves is by **radiation**. This happens through space and from a warmer source to cooler surface in visual contact. Think of feeling the warmth of the sun and the immediate difference when a cloud blocks it. The sun still warms the earth surfaces and surrounding air, but direct radiation can be blocked—or shaded. Same thing with a wood stove. A hot stove warms air, but its greatest impact is by radiation which is only felt when one is in visible contact. And the further away, the less heat is felt. Its often tempting to replace windows because we feel so cold when next to them! That's because our body heat radiates to the cold surface. Insulated shades or quilts stops that radiative loss (but also eliminates view and daylight). Interior glazing panels can make a big difference for single pane windows because the air space raises the surface temperature of the inside glass.

In reality, all three mechanisms happen at the same time, though one usually dominates the others in terms of how much heat is moved.

The role of heating equipment is to replace the heat that is lost through the envelope. This is described or measured as replacing BTU per hour (BTU/hr). If the heating system (electric baseboard, oil or propane furnace or boiler, etc…) creates or moves more heat (BTU) in an hour than in lost to the outside, the system is considered "over-sized" which can waste energy unnecessarily. On the other hand, if the system cannot generate or move enough heat to replace what is lost in any given hour, the system is "undersized" and will not be able to maintain warm enough inside temperatures for human comfort. So correct sizing is important!

Innerglass Window Systems LLC

www.stormwindows.com

[redacted]

15 Herman Drive Simsbury, Ct, 06070

800-743-6207 860-651-3951 Fax 860-651-4789

Price and Order Form

We price the Innerglass Window by the United Inch. The formula is **Width + Height = U.I.**

1. Please round to the nearest whole inch, then **add** the window width and height and write it on the sheet
2. Please write the color, window type code, and glazing code in the box on the measurement worksheet.
3. Square feet for glazing are Width x Height (in inches) divide by 144 to get Ft^2 and round up.

Storm Window Type	**Code**	**# Of Windows**	**United Inches**	**X Price Per U.I.**	**=**	**Price**
Compression	(CP)			X $3.25	=	$
Double Hung	(DH)			X $3.55	=	$
Double Slider	(SL)			X $3.55	=	$
Triple Slider	(TL)			X $4.15	=	$
Surface Mount	(SM)			X $3.25	=	$
				X	=	$
				X	=	$

Glazing	**Code**		**Square Feet**	**X Price Per Ft^2**		**Price**
1/8 " Clear Glass	(DS)	Standard		X $3.00	=	$
1/8" Low E Glass	(LE)	High Performance		X $6.00	=	$
1/8' Acrylic	(AC)			X $7.00	=	$
Other				X	=	$
Call for price			Connecticut Residents add 6.35% Tax		=	$

Compression Window in Low E glass is Energy Star and qualifies for Tax Credits!

Please call for a truck freight estimate.

Shipping Total $ ________

Total Sale $ ________

You can pick up at the factory and avoid shipping charges.

Terms: 50% Deposit with your order. 50% paid when your windows are ready to ship. We must have full payment in order to ship your windows. We will send an order acknowledgment and the estimated ship date when we receive your order. We accept checks, money orders, VISA, MASTERCARD, AMERICAN EXPRESS and DISCOVER CARD.

ACCEPTANCE- The above prices, specifications and conditions are satisfactory, and are hereby accepted. I agree that I am responsible for correctly measuring my window openings, and that Innerglass Window Systems will not be responsible for any errors in the dimensions I have given them.

If Innerglass Window Systems measures we are responsible. Because these are custom sized, no refunds or returns are possible. Payment will be made as outlined above. When delivery or pickup of completed order is delayed by customer, balance is due. When delay is more than 30 days, storage charges may accrue.

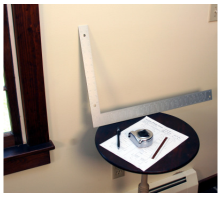
Order Date__________ Signature__________________ Name______________________________

Address____ State___ Zip______

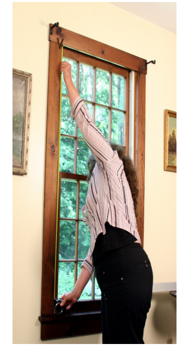
Home Phone___________________________ Work or Cell___________________________

Email address__________________________________

Credit Card # ______________________________ Expiration Date_______ Billing Zip________



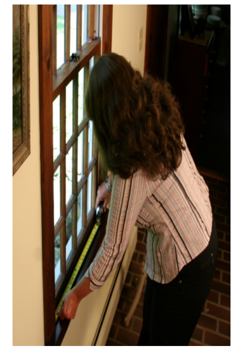
Innerglass Window Systems Measuring Guidelines



Tools needed

- 3” Case Dimension Locking tape measure
- 16”x 24” framing square (to check for out of square)
- 6” or 12” ruler
- Window Worksheet to record measurements

1. Measure all 4 sides to 1/16” and record the actual measurement. Do not average. Don't bend the tape into the corner. Instead add the tape case dimension to your measurement. Measure exactly where the window will be mounted.



2. The Innerglass Compression-Fit window needs 3/4 "depth in the window opening for mounting, 5/8” is possible but call us. The double hung and horizontal sliding interior storms need 1 1/8” depth in the window opening. Watch for obstructions such as window hardware. Screw heads and recessed pockets for the window stops are generally not a problem if they don't stick out more than 1/16".

3. To check for out of square, notice the framing squares at the left and right bottom corners and the 2 lines under each framing square where you record the gap on the worksheet. Start tight to the left side and slide the 24” side down until it touches the sill at either the corner or the end. The framing square is always held tight against the side so that any gap will show up at the bottom. If the window is square at the bottom you would record a “0” at each of the 4 lines under the framing squares. If the gap is 1/16 or less it is effectively square. For example: If a window sags down to the right the gap measurements could be 0 ¼, 0 ¼. Place the framing square against the right side of window and repeat the procedure. Think of this as a snapshot of each bottom corner. In reality they overlap but for clarity they are separated and are not to scale. Next lay the 24” side of the framing square on the sill to check if the sill is bowed up or down, if so give us a center vertical measurement and draw an arc showing the bow.

4. Innerglass Windows will accommodate 3/16” vertical and ½” horizontal play. On deep openings measure where you want the window to be and measure the opening at the wall to check that is does not get smaller than these tolerances. If the opening is smaller or the bottom of the opening is obstructed call us.

Mullions for dividing up large windows

5. If you are measuring for a double hung storm or are doing a large opening as separate upper & lower windows with a mullion, measure from the sill to the top of the meeting rail. (Where the dust collects.) This is where the top of the mullion will be. A window opening may be done as one window or two windows with a mullion. Generally double hung windows taller than 72" inches should be done as 2 windows with a horizontal mullion. Measure the length for the mullion where it is to be installed. The dimensions of the vinyl covered wood vertical mullions are 1 5/8” deep x 1 1/8" wide. The vinyl color will match the window. The horizontal mullion is ¾” thick x 1" wide. Measure the width and height of the entire opening.

Do not make allowance for the mullion size. We will do that. For pricing purposes, remember that it is one opening but TWO windows, so the width & height of each needs to be added together to come up with the united inch measurement.

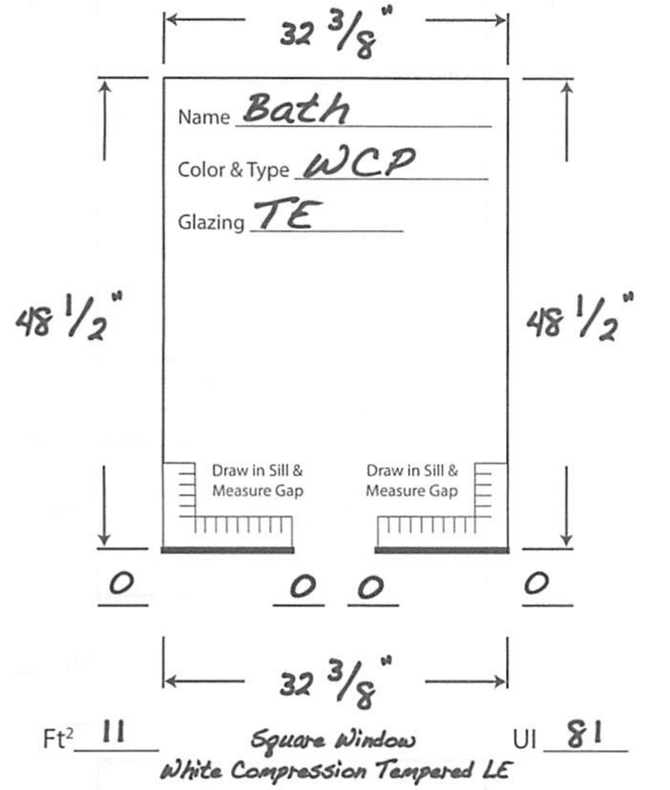
Maximum size for double strength glass is 25 sq ft or 125 united inches.
Larger than that 3/16" or 1/4" laminated or tempered glass will be used at extra cost.
Within 12" of a door or 18" of the floor, Acrylic or tempered glass must be used at extra cost.

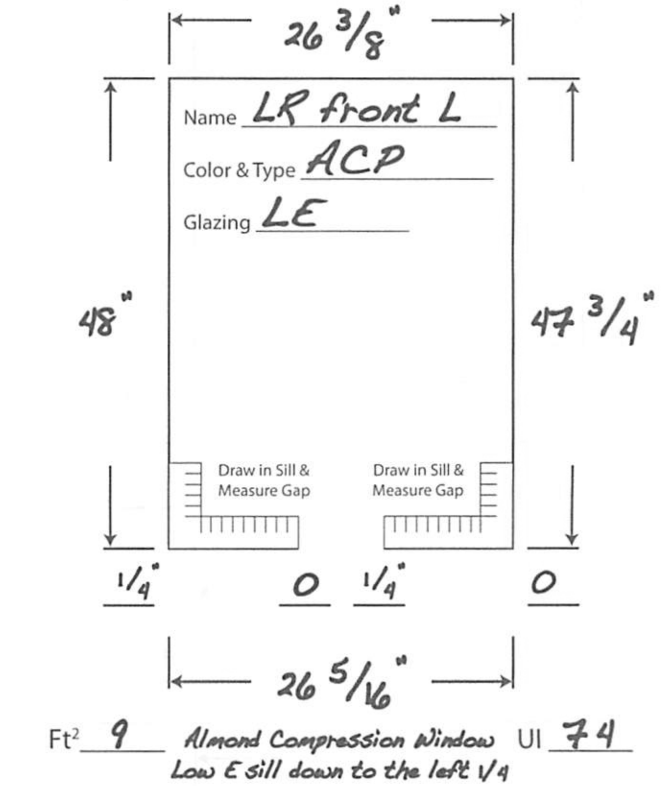
Please call us at 860-651-3951 or 800-743-6207 with any questions.

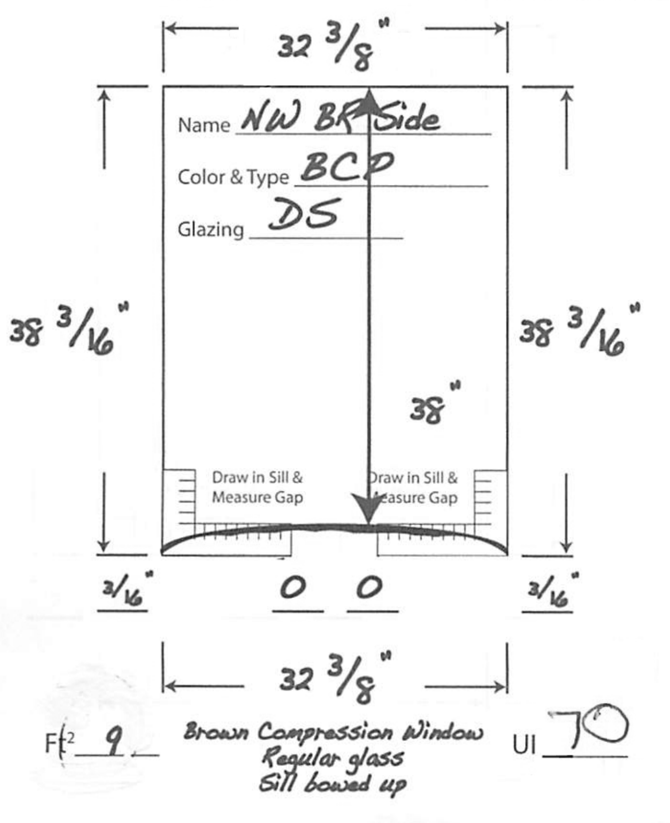
Code Key

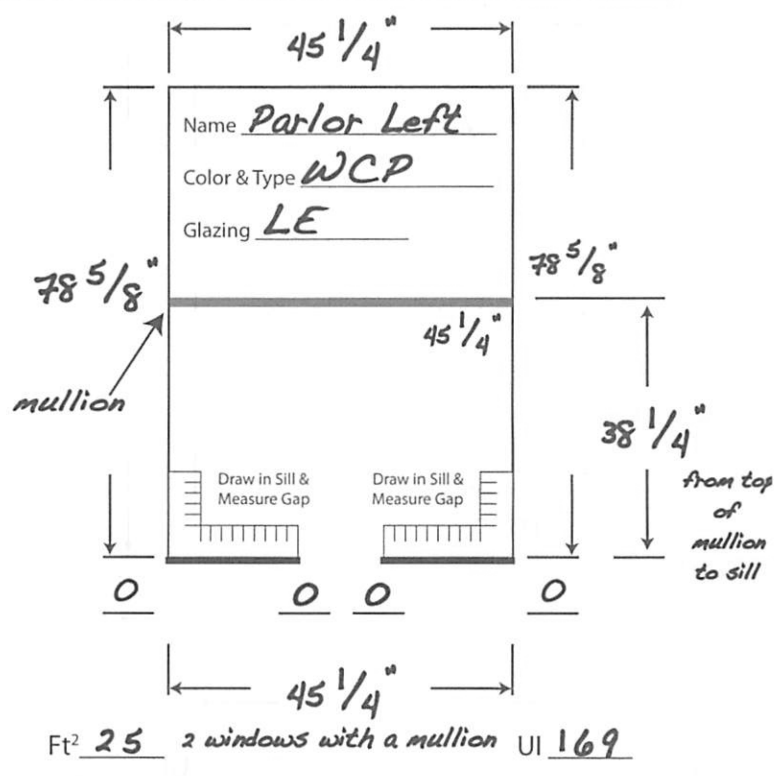
Color	Window Type	Glazing	United Inches = Width + Height
A = Almond B = Brown W = White	CP = Compression DH = Double Hung SL = Sliding TL = Triple Slider SCR = Exterior Screen	DS = Regular LE = Low E LA = Laminated Glass AC = Acrylic TG = Tempered Glass TE = Tempered Low E	• Round to the nearest whole number before **adding** width and height • 1/2" and over, round up • Under 1/2", round down

WORKSHEET EXAMPLES









Innerglass Window Systems

15 Herman Drive, Simsbury, CT 06070

Telephone 800-743-6207 • 860-651-3951

Fax 860-651-4789

www.stormwindows.com • [redacted]

Customer Name ______________________

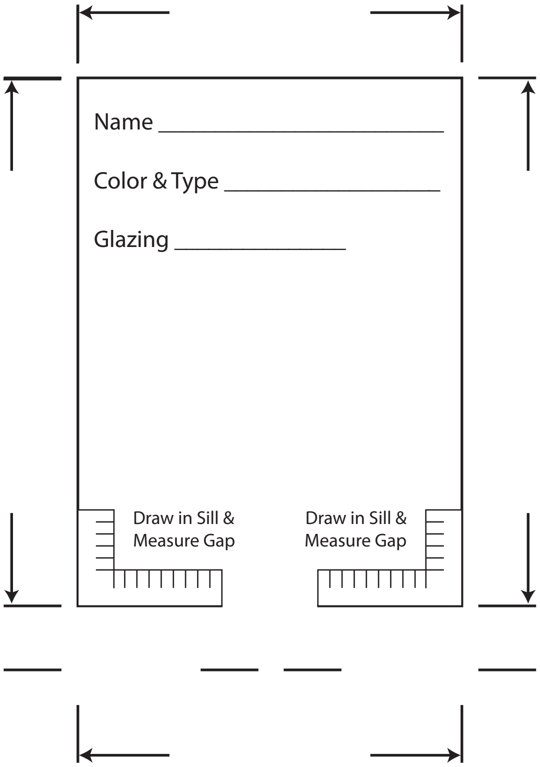
Window Worksheet

Page _____ **of** _____

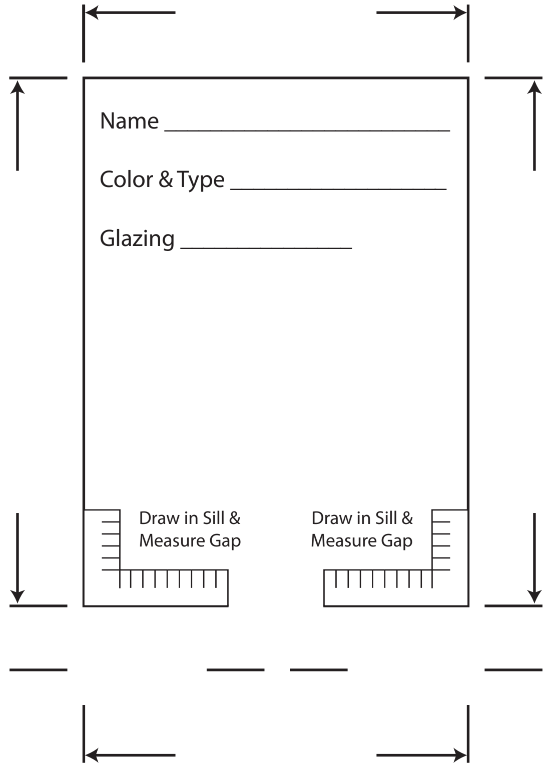
(please make a copy for your use)

Totals This Page

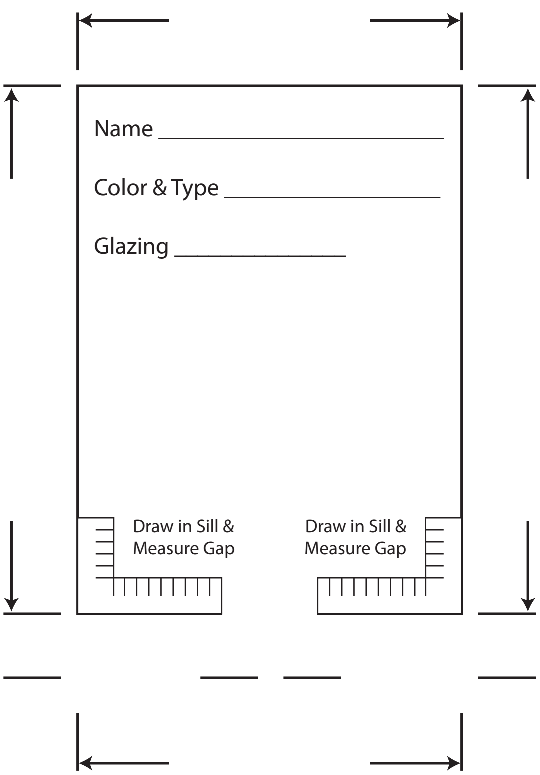
Ft² _______ **UI** _______



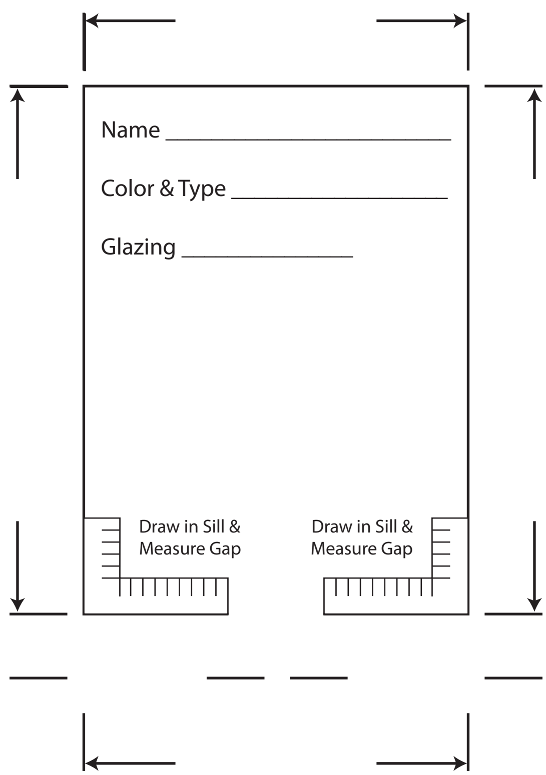
Ft² _______ UI _______



Ft² _______ UI _______



Ft² _______ UI _______



Ft² _______ UI _______

Hopkinton Grange EXISTING With Floor
HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Saturday, October 21, 2023

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	Hopkinton Grange EXISTING With Floor
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	2,000	CFM Per Square ft.:	0.647
Square ft. of Room Area:	3,090	Square ft. Per Ton:	694
Volume (ft³):	12,000***		

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air:	100,130	Btuh	100.130	MBH
Total Sensible Gain:	43,448	Btuh	81	%
Total Latent Gain:	9,977	Btuh	19	%
Total Cooling Required Including Ventilation Air:	53,425	Btuh	4.45	Tons (Based On Sensible + Latent)

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Miscellaneous Report

System 1 Existing Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	Yes		Yes	
Use Schedule:	Yes		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.550	AC/hr	0.550	AC/hr
	110	CFM	110	CFM
Infiltration Actual:	0.550	AC/hr	0.550	AC/hr
Building Volume:	X 12,000*	Cu.ft.	X 12,000*	Cu.ft.
	6,600	Cu.ft./hr	6,600	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	110	CFM	110	CFM
Total Building Ventilation:	0	CFM	0	CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.550 AC/hr (110 CFM)
Summer Infiltration Specified: 0.550 AC/hr (110 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	4.45	694	3,090	43,448	9,977	53,425	100,130	1,317	2,000	2,000	
System 1	4.45	694	3,090	43,448	9,977	53,425	100,130	1,317	2,000	2,000	18x18
Zone 1			3,090	43,448	9,977	53,425	100,130	1,317	2,000	2,000	18x18
1-First Floor			1,350	26,843	4,849	31,692	50,563	665	1,235	1,235	12--7
2-Office First Floor			120	1,951	307	2,258	3,859	51	90	90	1--6
3-Storage Room			270	7,347	4,108	11,455	6,054	80	338	338	4--6
4-Basement			1,350	7,308	713	8,021	39,654	521	336	336	4--6

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Stained Glass: Glazing-Historic stained glass with exterior storms, U-value 0.57, SHGC 0.6	192	7,872	0	10,318	10,318
11L: Door-Metal - Paper Honeycomb Core, U-value 0.56	58.5	2,358	0	590	590
Uninsulated: Wall-Frame, Custom, Unisulated 2x4 historic, U-value 0.167	1951.6	23,466	0	3,748	3,748
12A-0bw: Wall-Frame, no insulation in stud cavity, no board insulation, brick finish, wood studs, U-value 0.5	165	5,940	0	775	775
13AA-0oc: Wall-Block, no blanket or board insulation, open core, U-value 0.584	620	26,070	0	3,404	3,404
15A-2s3oc-4: Wall-Basement, concrete block wall, R-2 foam board to 3', no framing, no interior finish, open core, 4' floor depth, U-value 0.128	160	2,287	0	202	202
13AA-0oc: Wall-Block, no blanket or board insulation, open core, U-value 0.6	61	2,633	0	344	344
Layered FG Batts: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Two haphazzard layes of fg batts with voids, U-value 0.063	1470	6,668	0	5,742	5,742
slopes. Eaves-ad: Roof/Ceiling-Roof Joists Between Roof Deck and Ceiling or Foam Encapsulated Roof Joists, Custom, FG in eaves Slopes, dark asphalt, U-value 0.125	200	1,800	0	925	925
Flat Blown In.Poor: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, fiberglass.Poor, U-value 0.1	110	792	0	682	682
19A-0tp: Floor-Over enclosed crawl space, No insulation on exposed walls, sealed or vented space, passive, no floor insulation, tile or vinyl, U-value 0.368	1350	11,639	0	1,940	1,940
Subtotals for structure:		91,525	0	28,670	28,670
People:	43		8,600	9,890	18,490
Equipment:			0	1,100	1,100
Lighting:	650			2,217	2,217
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 110, Summer CFM: 110		8,605	1,377	1,435	2,812
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
AED Excursion:		0	0	137	137
Total Building Load Totals:		100,130	9,977	43,448	53,425

Check Figures

Total Building Supply CFM:	2,000	CFM Per Square ft.:	0.647
Square ft. of Room Area:	3,090	Square ft. Per Ton:	694
Volume (ft³):	12,000***		

***Indicated volume is based on custom building volume.

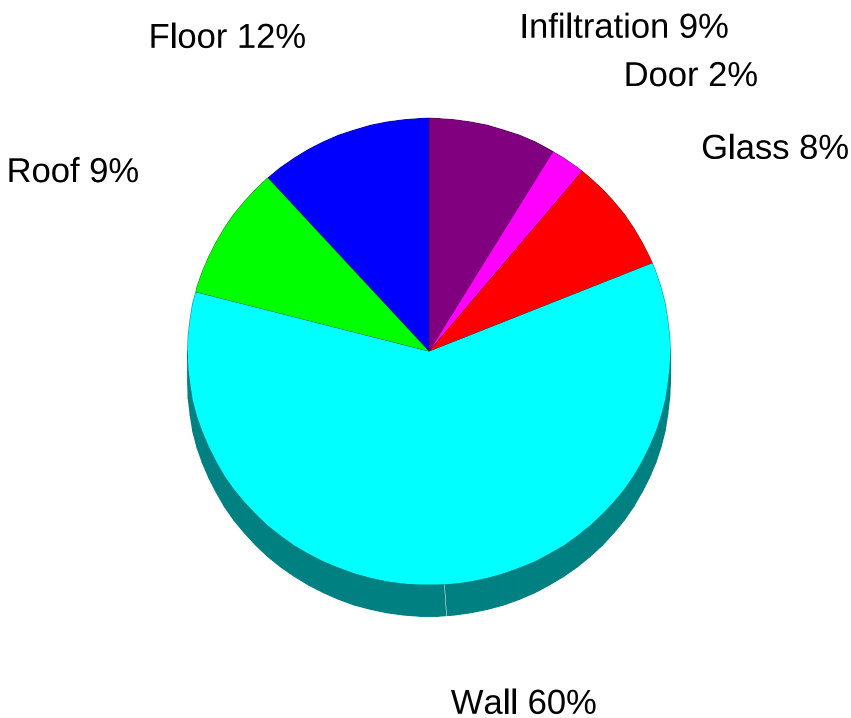
Building Loads

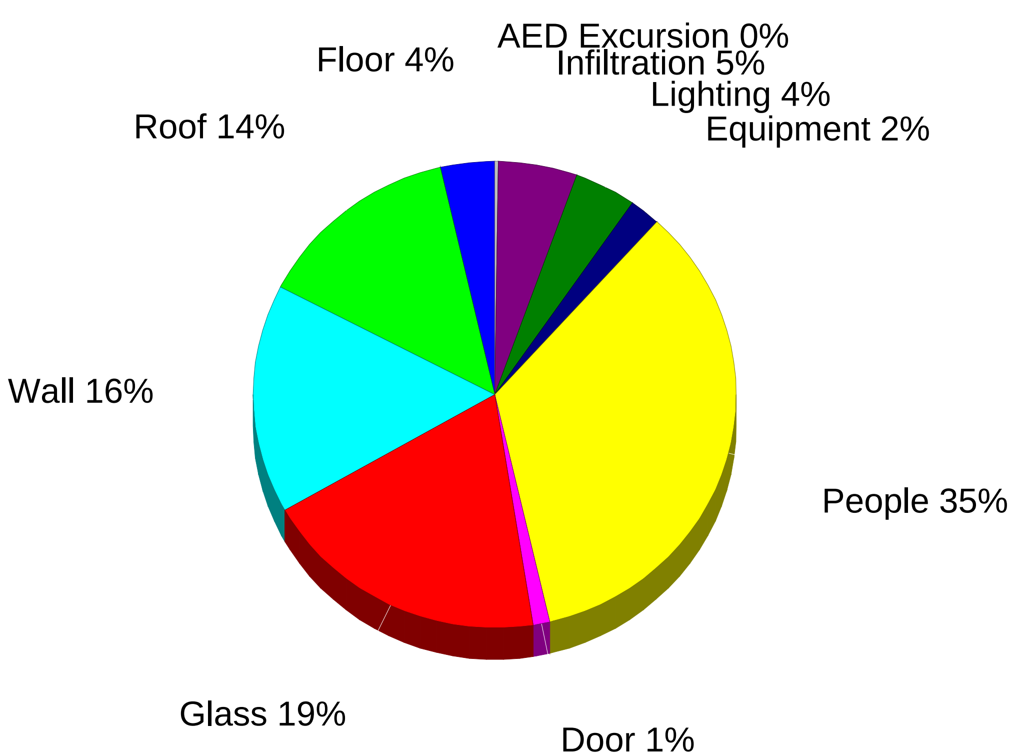
Total Heating Required Including Ventilation Air:	100,130	Btuh	100.130	MBH
Total Sensible Gain:	43,448	Btuh	81	%
Total Latent Gain:	9,977	Btuh	19	%
Total Cooling Required Including Ventilation Air:	53,425	Btuh	4.45	Tons (Based On Sensible + Latent)

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Hopkinton Grange Tier Three
HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Sunday, October 22, 2023

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	Hopkinton Grange Tier Three
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	1,273	CFM Per Square ft.:	0.412
Square ft. of Room Area:	3,090	Square ft. Per Ton:	995
Volume (ft^3):	12,000***		

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air:	34,963	Btuh	34.963	MBH
Total Sensible Gain:	27,662	Btuh	74	%
Total Latent Gain:	9,601	Btuh	26	%
Total Cooling Required Including Ventilation Air:	37,264	Btuh	3.11	Tons (Based On Sensible + Latent)

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Miscellaneous Report

System 1 Existing Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	Yes		Yes	
Use Schedule:	Yes		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.400	AC/hr	0.400	AC/hr
	80	CFM	80	CFM
Infiltration Actual:	0.400	AC/hr	0.400	AC/hr
Building Volume:	X 12,000*	Cu.ft.	X 12,000*	Cu.ft.
	4,800	Cu.ft./hr	4,800	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	80	CFM	80	CFM
Total Building Ventilation:	0	CFM	0	CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.400 AC/hr (80 CFM)
Summer Infiltration Specified: 0.400 AC/hr (80 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	3.11	995	3,090	27,662	9,601	37,264	34,963	460	1,273	1,273	
System 1	3.11	995	3,090	27,662	9,601	37,264	34,963	460	1,273	1,273	12x18
Zone 1			3,090	27,662	9,601	37,264	34,963	460	1,273	1,273	12x18
1-First Floor			1,350	16,990	4,549	21,539	21,023	276	782	782	8--7
2-Office First Floor			120	1,327	269	1,596	1,922	25	61	61	1--5
3-Storage Room			270	6,147	4,070	10,217	3,157	42	283	283	3--6
4-Basement			1,350	3,198	713	3,911	8,861	117	147	147	2--6

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Historic St & IP: Glazing-Historic single pane with exterior storms and interior glazing panels, U-value 0.37, SHGC 0.5	192	5,120	0	8,347	8,347
11L: Door-Metal - Paper Honeycomb Core, U-value 0.56	58.5	2,358	0	590	590
DP cellulose 4": Wall-Frame, Custom, Dense Pack Cellulose, U-value 0.083	1951.6	11,662	0	1,864	1,864
12D1-0bw: Wall-Frame, R-21 closed cell 2 lb. spray foam insulation in 2 x 4 stud cavity, no board insulation, brick finish, wood studs, U-value 0.083	165	986	0	55	55
Thermax or SPF: Wall-Block, Custom, Insulate Rim Joists, U-value 0.056	620	2,500	0	326	326
15A-2s3oc-4: Wall-Basement, concrete block wall, R-2 foam board to 3', no framing, no interior finish, open core, 4' floor depth, U-value 0.128	160	2,287	0	202	202
Thermax or SPF: Wall-Block, Custom, Insulate Rim Joists, U-value 0.083	61	364	0	48	48
16B-50: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-50 insulation, U-value 0.02	1580	2,275	0	1,327	1,327
slopes. Eaves-ad: Roof/Ceiling-Roof Joists Between Roof Deck and Ceiling or Foam Encapsulated Roof Joists, Custom, FG in eaves Slopes, dark asphalt, U-value 0.08	200	1,152	0	592	592
Subtotals for structure:		28,704	0	13,351	13,351
People:	43		8,600	9,890	18,490
Equipment:			0	1,100	1,100
Lighting:	650			2,217	2,217
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 80, Summer CFM: 80		6,259	1,001	1,043	2,044
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
AED Excursion:		0	0	62	62
Total Building Load Totals:		34,963	9,601	27,662	37,264

Check Figures

Total Building Supply CFM:	1,273	CFM Per Square ft.:	0.412
Square ft. of Room Area:	3,090	Square ft. Per Ton:	995
Volume (ft³):	12,000***		

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air:	34,963	Btuh	34.963	MBH
Total Sensible Gain:	27,662	Btuh	74	%
Total Latent Gain:	9,601	Btuh	26	%
Total Cooling Required Including Ventilation Air:	37,264	Btuh	3.11	Tons (Based On Sensible + Latent)

Notes

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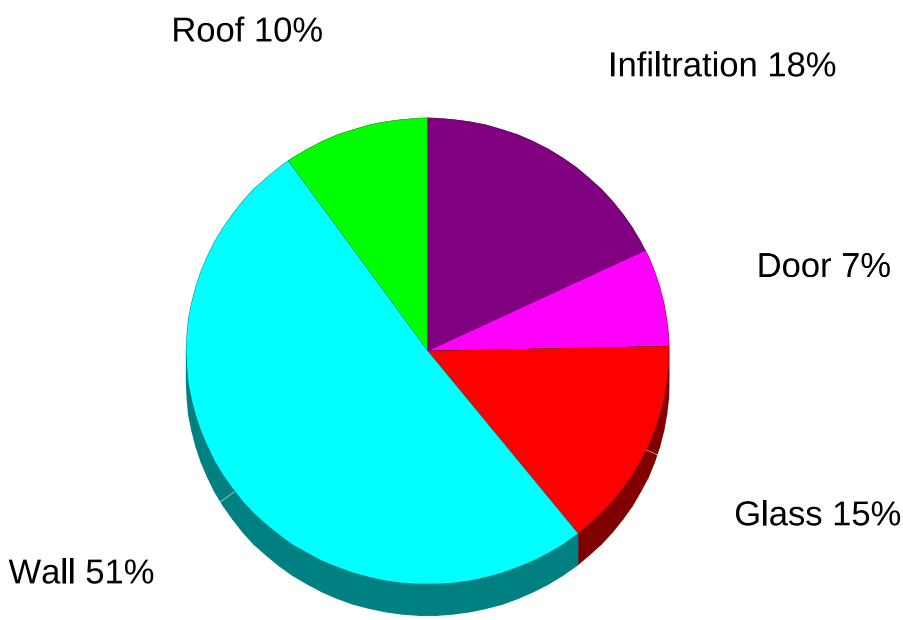
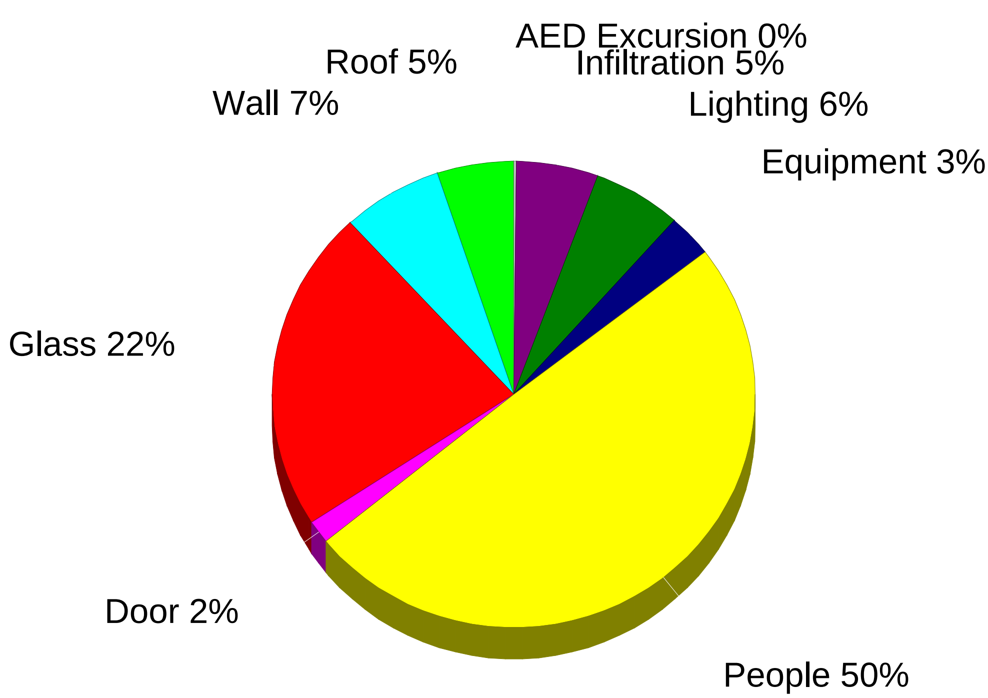
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





LENNOX®
Service Literature

UNIT INFORMATION

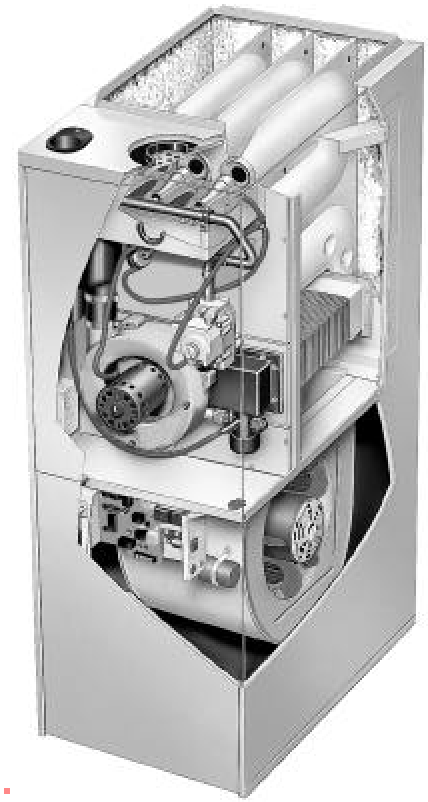
G26
Corp. 9721-L11
Revised 07-2001

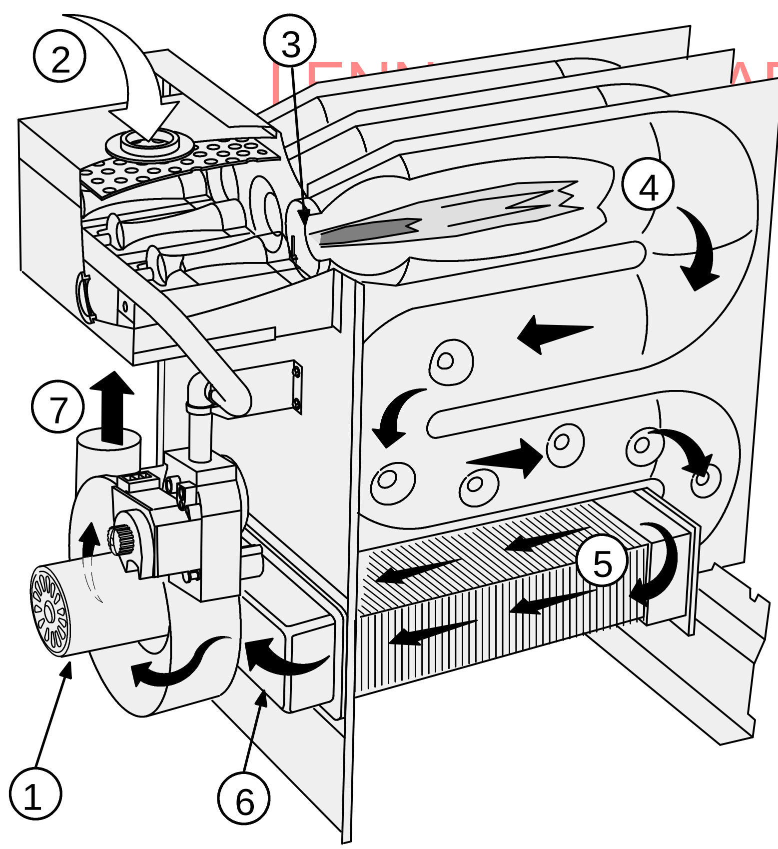
G26 SERIES UNITS

G26 series units are high-efficiency upflow gas furnaces manufactured with DuralokPlus™ aluminized steel clamshell-type heat exchangers. G26 units are available in heating capacities of 50,000 to 125,000 Btuh and cooling applications up to 5 tons. Refer to Engineering Handbook for proper sizing.

Units are factory equipped for use with natural gas. A kit is available for conversion to LPG operation. G26-1 and -2 model units use electronic (intermittent pilot) ignition. G26-3, -4, -5 and -6 model units feature the Lennox SureLight™ silicon nitride ignition system. Each unit meets the California Nitrogen Oxides (NO_X) Standards and California Seasonal Efficiency requirements without modification. All units use a redundant gas valve to assure safety shut-off as required by A.G.A. or C.G.A.

Information contained in this manual is intended for use by qualified service technicians only. All specifications are subject to change. Procedures outlined in this manual are presented as a recommendation only and do not supersede or replace local or state codes. In the absence of local or state codes, the guidelines and procedures outlined in this manual (except where noted) are recommended only.





G26 FURNACE▲
◀G26 HEAT EXCHANGE ASSEMBLY

Combustion Process:

1. A call for heat starts the combustion air blower.
2. Outdoor air is drawn through pipe into the burner compartment where it mixes with gas in a conventional style inshot burner.
3. The SureLight ignition system lights the burners.
4. Combustion products are drawn downward through the heat exchanger. Heat is extracted as indoor air passes across the outside surface of the metal.
5. Latent heat is removed from the combustion products as air passes through the coil. Condensate (water) is formed as the combustion products cool.
6. As the combustion products exit the coil, condensate is collected and drained away.
7. Combustion products are pulled from the heat exchanger and forced into the flue.

Technical Publications

SPECIFICATIONS

Model No.		G26Q3/4-100	G26Q4/5-100	G26Q3/4-125	G26Q4/5-125
Input Btuh (kW)		100,000 (29.3)		125,000 (36.6)	
Output Btuh (kW)		91,000 (26.7)	93,000 (27.2)	115,000 (33.7)	116,000 (34.0)
☆A.F.U.E.		92.0%	92.0%	91.0%	92.0%
California Seasonal Efficiency		86.6%	85.8%	87.5%	87.0%
1 Exhaust pipe connection (PVC) diameter— in. (mm)		2 (51)			
1 Intake pipe connection (PVC) diameter— in. (mm)		3 (76)			
Condensate drain connection (PVC)— in. (mm)		1/2 (12.7)			
Temperature rise range — °F (°C)		50-80 (28-44)	40-70 (22-39)	55-85 (31-47)	50-80 (28-44)
High static certified by (A.G.A./C.G.A.) — in. wg. (Pa)		.50 (125)			
Gas Piping Size I.P.S. Natural or LPG/propane	in.	1/2			
	mm	12.7			
Blower wheel nominal diameter x width	in.	10 x 10	11-1/2 x 9	10 x 10	11-1/2 x 9
	mm	254 x 254	292 x 229	254 x 254	292 x 229
Blower motor output — hp (W)		1/2 (373)	3/4 (560)	1/2 (373)	3/4 (560)
Nominal cooling that can be added	Tons	2 to 4	3-1/2 to 5	2 to 4	3-1/2 to 5
	kW	7.0 to 14.1	12.3 to 17.6	7.0 to 14.1	12.3 to 17.6
Shipping weight — lbs. (kg) 1 package		186 (84)	198 (90)	218 (99)	218 (99)
Electrical characteristics		120 volts — 60 hertz — 1 phase (all models) (less than 12 amps)			
Optional Accessories (Must Be Ordered Extra)					
LPG/Propane kit (optional)		**65K27** (all models)			
Filter and Filter Rack Kits ‡No. & size of filters - in. (mm)		Single **(44J21)** Ten Pack **(66K62)** (1) 20 x 25 x 1 (508 x 635 x 25)			
Concentric Vent/Intake Air/Roof Termination Kit (optional)		**33K97** — 2 inch (51 mm)			
1 Vent/Intake Air Roof Termination Kit (optional) — vent size	2 inch (51 mm)	**15F75**			
	3 inch (76 mm)	**44J41**			
1 Vent/Intake Air Wall Termination Kit (optional) — vent size	2 inch (51 mm)	**15F74** (ring kit) — **22G44** (close couple) — **30G28** (WTK close couple) **30G79** (WTKX close couple with extension riser)			
	3 inch (76 mm)	**44J40** (close couple) — **81J20** (WTK close couple)			
Twinning Kits (optional)	Non-continuous low speed	**64H88** (all models)			
	Continuous low speed	**35J93** (all models)			
Continuous Low Speed Blower Switch (optional)		**44J06** (-1 and -2 models) Not used with Twinning Kits			

☆Annual Fuel Utilization Efficiency based on U.S. DOE test procedures and FTC labeling regulations. Isolated combustion system rating for non-weatherized furnaces.
‡Polyurethane frame type filter.
1 Determine from venting tables proper intake and exhaust pipe size and termination kit required.
NOTE - 2 inch x 3 inch (51 mm x 76 mm) adaptor is furnished with -100 and -125 furnaces for exhaust pipe connection.

BLOWER PERFORMANCE DATA

FILTER AIR RESISTANCE

cfm (L/s)	in. w.g. (Pa)
0 (0)	0.00 (0)
200 (95)	0.01 (0)
400 (190)	0.03 (5)
600 (285)	0.04 (10)
800 (380)	0.06 (15)
1000 (470)	0.09 (20)
1200 (565)	0.12 (30)
1400 (660)	0.15 (35)
1600 (755)	0.19 (45)
1800 (850)	0.23 (55)
2000 (945)	0.27 (65)
2200 (1040)	0.33 (80)
2400 (1130)	0.38 (95)
2600 (1225)	0.44 (110)

BLOWER PERFORMANCE DATA

G26Q3/4-100 BLOWER PERFORMANCE

External Static Pressure		Air Volume and Motor Watts at Specific Blower Taps											
		High			Medium-High			Medium-Low			Low		
in. w.g.	Pa	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts
0	0	2065	975	920	1760	830	735	1570	740	655	1245	590	520
.10	25	2000	945	875	1730	815	705	1550	730	625	1240	585	490
.20	50	1925	910	845	1685	795	675	1515	715	590	1225	580	470
.30	75	1840	870	800	1625	765	630	1475	695	565	1210	570	455
.40	100	1740	820	760	1550	730	595	1415	670	535	1165	550	430
.50	125	1650	780	730	1460	690	560	1335	630	500	1110	525	405
.60	150	1545	730	700	1370	645	530	1260	595	475	1045	495	385
.70	175	1420	670	660	1250	590	495	1170	550	445	950	450	355
.80	200	1270	600	620	1110	525	445	1025	485	395	825	390	325
.90	225	1045	495	560	965	455	405	885	420	360	700	330	290

NOTE — All air data is measured external to unit with 1 in. (25 mm) cleanable foam filter (not furnished) in place. Also see Filter Air Resistance table.

G26Q4/5-100 BLOWER PERFORMANCE

External Static Pressure		Air Volume and Motor Watts at Specific Blower Taps														
		High			Medium-High			Medium			Medium-Low			Low		
in. w.g.	Pa	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts
0	0	2400	1135	1255	2185	1030	1070	1940	915	905	1740	820	765	1570	740	665
.10	25	2350	1110	1230	2150	1015	1055	1920	905	885	1710	805	755	1525	720	645
.20	50	2290	1080	1185	2105	995	1025	1875	885	865	1685	795	740	1505	710	640
.30	75	2225	1050	1170	2060	970	1005	1845	870	850	1655	780	730	1485	700	630
.40	100	2165	1020	1130	2010	950	985	1805	850	835	1620	765	720	1450	685	620
.50	125	2105	995	1115	1950	920	960	1755	830	810	1585	750	700	1415	670	605
.60	150	2040	965	1080	1895	895	940	1700	800	790	1540	725	690	1380	650	595
.70	175	1955	925	1045	1820	860	915	1640	775	775	1475	695	670	1340	630	590
.80	200	1850	875	1005	1730	815	885	1580	745	755	1430	675	660	1290	610	580
.90	225	1770	835	985	1650	780	855	1505	710	740	1370	645	645	1225	580	565

NOTE — All air data is measured external to unit with 1 in. (25 mm) cleanable foam filter (not furnished) in place. Also see Filter Air Resistance table.

G26Q3/4-125 BLOWER PERFORMANCE

External Static Pressure		Air Volume and Motor Watts at Specific Blower Taps											
		High			Medium-High			Medium-Low			Low		
in. w.g.	Pa	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts
0	0	2070	975	920	1735	820	725	1555	735	640	1235	585	500
.10	25	2010	950	885	1710	805	700	1535	725	625	1225	580	490
.20	50	1950	920	850	1675	790	680	1500	710	600	1210	570	470
.30	75	1975	930	820	1620	765	645	1465	690	575	1185	560	455
.40	100	1785	840	775	1560	735	615	1415	670	545	1140	540	435
.50	125	1700	800	745	1475	695	575	1345	635	520	1090	515	415
.60	150	1585	750	705	1410	665	555	1275	600	490	1035	490	390
.70	175	1475	695	675	1310	620	515	1185	560	460	975	460	370
.80	200	1350	635	640	1200	565	485	1090	515	425	865	410	340
.90	225	1200	565	595	1080	510	445	965	455	385	715	335	300

NOTE — All air data is measured external to unit with 1 in. (25 mm) cleanable foam filter (not furnished) in place. Also see Filter Air Resistance table.

G26Q4/5-125 BLOWER PERFORMANCE

External Static Pressure		Air Volume and Motor Watts at Specific Blower Taps														
		High			Medium-High			Medium			Medium-Low			Low		
in. w.g.	Pa	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts
0	0	2400	1135	1210	2175	1025	1040	1965	925	895	1790	845	780	1610	760	670
.10	25	2315	1090	1175	2125	1005	1025	1930	910	875	1760	830	770	1580	745	660
.20	50	2255	1065	1150	2080	980	1000	1880	885	860	1740	820	755	1550	730	645
.30	75	2195	1035	1130	2030	960	975	1840	870	835	1710	805	750	1520	715	635
.40	100	2120	1000	1100	1970	930	960	1790	845	815	1665	785	730	1495	705	630
.50	125	2050	965	1080	1910	900	934	1745	825	800	1620	765	715	1460	690	620
.60	150	1985	935	1050	1840	870	905	1685	795	785	1565	740	705	1415	670	610
.70	175	1885	890	1020	1770	835	890	1635	765	775	1515	715	685	1370	645	595
.80	200	1815	855	1005	1690	800	860	1570	740	750	1450	685	670	1315	620	580
.90	225	1735	820	980	1615	760	835	1485	700	725	1385	655	655	1245	590	565

NOTE — All air data is measured external to unit with 1 in. (25 mm) cleanable foam filter (not furnished) in place. Also see Filter Air Resistance table.

Energy Audit

Funded by

EVERSOURCE ENERGY

Town Hall

18 Depot

Henniker, NH

November 15, 2023

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE

S.E.E.D.S.

SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES

Margaret Dillon—603-532-8979—MDILLON@myfairpoint.net

Table of Contents

Introduction

This Energy Audit has been funded by Eversource. Funds may, or may not, also be available to help reduce cost for eligible Energy Saving Measures (ESM) including weatherization efforts and equipment upgrades.

The purpose of an energy audit is to identify energy saving measures (ESM) in a building. Computer simulated energy models are developed to estimate energy consumption based on the local climate conditions, physical dimensions and characteristics of a building, mechanical systems, presumed lighting, equipment, and occupancy patterns, in addition to a number of other variables.

With the building modeled in existing conditions, energy savings can be estimated for improvements to the thermal envelope and/or more efficient mechanical systems. The cost of those measures can then be analyzed in terms of predicted energy saved and savings potential from converting to different sources of energy. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures.

This audit has been prepared with the best of intentions to assist the Town of Henniker make informed decisions regarding energy saving improvements in keeping with long term goals for the property. We do not make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed.

Executive Summary

Henniker's Town Offices are located in the fist floor of the Henniker Meeting House. Constructed in 1787 as a wood framed structure on a granite and rubble stone foundation. Though now on the National Register of Historic Places, all but three of the original wood windows on the first floor had been replaced with double pane glass and vinyl or aluminum frames. The second floor meeting hall remains original, unconditioned and used for storage. At some point it was heated via two propane fired Modine units. They remain attached to the ceiling but not used and no known propane tank exists anymore.

The first floor is heated primarily by a cast iron oil fired boiler and hydronic baseboard, with one main circulator pump and three zone valves. In the Fall of 2022, four outdoor heat pump condensers were installed serving both non-ducted wall units and ducted ceiling units. The primary objective was to provide cooling with only supplemental heating. Based on the assessed values of the envelope and rated capacities of the installed heat pump, this study suggests that the heat pumps could serve as primary heating more efficiently and cost effectively than the oil fired hydronic system. Testing this theory will take some experimenting, but changes to the thermostatic controls is discussed on pages seven and eight, as is the potential for using the heat pumps for primary heating.

This would be especially possible after implanting the seven recommended envelope ESM, described briefly on the next page with estimated energy and dollar savings.

Summary of Energy Saving Envelope Measures

The recommended ESM are described in more detail later in this report.

The chart below summarizes the estimated cost of each ESM. Estimating contractor costs has become more challenging in this era of supply chain shortages and hard-to-find labor. Contacting a reliable insulation and air sealing contractor is recommended for a cost proposal for the recommended measures.

ESM #	Envelope Condition / ESM	Estimated Cost of Measure
1	Double Wood Doors	$325
2	Weather-Stripping	$450
3	Cellular Shades	$1,260
4	Insulate Entry Walls	$1,675
5	Limited Ceiling Insulation	$1,768
6	Insulate FND and Door	$2,325
7	Dense Pack Walls	$10,517
	Total Estimated Cost	$18,320

An investment of an estimated $18,320 is predicted to save at least $1,437 in energy (oil) costs at the two year average cost of $3.17 per gallon, and $0.13 per kWh. This would result in a simple payback within 12.7 years. Since ESM continue to save energy for the life of each measure, this also results in a minimum annual return on investment (ROI) of 2.7% over each of the next 25 years. Again, the savings are based on recent average energy prices. If (when) prices increase, so too will the ROI.

The ESM are presented as a whole package, because savings if completed as a package will be greater than the sum of implementing individual in a piece meal fashion.

Annual $ Savings	$1,437	
Simple Payback	12.7	Years
Life of Measure	25	Years
Investment Gain	$17,605	
ROI	96.1%	At end of 25 years
Annualized ROI	2.7%	For each of 25 years
Annual Oil Savings	540	Gallons
Annual Electric Savings	1094	kWh
Site Energy Saved	78.6	Million Btu
Source Energy Saved	98.5	Million Btu
CO_2 Emissions Reduction	6.79	Tons, Annually
CO_2 Emissions Reduction	169.8	Tons, 25 Years

Potential Eversource incentives are based on energy saved for the cost of the measures. Contact your Eversource representative, Jack Paloulek, to determine if the project is eligible for incentives. [redacted]

Assessed Values for Town Offices and Other Model Inputs

The thermal envelope is the assembly of materials which form the barrier between inside conditioned space and outdoor weather and climate. Its ability to conserve heat and manage moisture determines, primarily, the heating load or demand of a building. Continuity and thickness of insulation, in direct contact with air barrier, is key to an effective thermal barrier.

Square Feet Area (whole)	2802	
Volume (ft3) (whole)	29,910	
Design Temps	Outdoor Dry	Indoor Dry
Winter	-2	70
Summer	87	75
Reference City	Concord NH	

Summary reports for load calculations of the existing and retrofitted condition has been included at the end of this study. Below is a summary of values for existing and improved envelope components.

Envelope Component	Surface Area FT2	Assessed Effective R-Value	U-Factor	Improved U-factor	Improvement	ESM #
Single Pane Windows	28	1.27	0.79			
Double Pane Windows SHGC 0.49	326	2.6	0.38		Weather-Strip as needed	2
Glass Entry Doors	57	1.15	0.87		Weather-Strip as needed	2
Double Wood Doors 2nd floor	39	1.15	0.87	0.09	Foam board & seal	1
Lounge Entry Door	16	1.8	0.56		Weather-Strip as needed	2
Historic Frame Walls	2090	8.5	0.12		Blow in Cellulose	7
Uninsulated Walls - Entrance	200	3	0.33	0.071	Blow in cellulose	4
Slopes over Entrance	280	10	0.10	0.060	Blow in cellulose	5
FG Batts on Suspended Tiles	2110	15.5	0.06		(TBD if possible)	
Voids over Sheetrock Ceilings	272	5	0.20	0.038	Blow in cellulose	5
Floor over Crawlspace Walls SPF	2328	3	0.333			
Floor over Uninsulated Basement	474	2.0	0.50	0.083	Insulate Walls and Door	6
Air Leakage - Winter		Exist		Improved		
Volume	29910	295		195		

Other formulas used in this analysis:

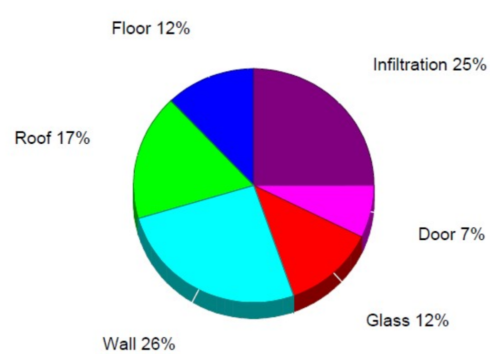
Oil: 138,500 Btu per gallon for site energy
Source energy: 159,275 Btu per gallon (1.15xSite)

Electric: 3412 Btu per kWh site energy.
Source energy: 11,361 Btu per kWh

CO_2 Emissions:

Oil: 23.25 lbs per gallon

Electric: CO_2 lbs = kWh X .89



Heat loss by the thermal envelope component

Heating and Cooling Loads for Existing & Improved Conditions

	Existing Heating	Btu/hr Cooling	ESM 1-7 Heating	Btu/hr Cooling
Main Entrance	36381		23869	
Lobby	5210	2346	4893	2241
Town Clerk / Tax Collector	6043	4482	5567	4325
Assessing Office	4817	2818	4409	2683
Finance	7803	4150	5765	3682
Small RR	1499	1170	1088	1084
Large RR	3497	1955	1742	1287
Staff Lounge & Kitchen	8378	4837	7663	4599
Town Administrator	3338	2079	3065	1989
Conference Room	9150	8769	8537	8566
Planning & Selectmen	4453	2901	4090	2779
	90569	35507	70688	33235

Descriptions of ESM

ESM 1: Seal and insulate this double door. Adhere 2", min R10 rigid foam board to this side of the door in such a way that it can be removed without (much) damage and add thick weatherstripping. The result should be a tight and insulated but fully functional doorway. See Page 12.

ESM 2: Add weather-stripping to all (other) exterior doors. See page 14.

ESM 3: Replace existing blinds on south facing windows with tracked cellular shades to 1) eliminate drafts, 2) reduce heat loss, and 3) reduce summer heating and glare. See page 16.

ESM 4: Blow in cellulose or mineral wool to wall cavities in the entrance. Refer to photos on pages 16 & 17.

ESM 5: Blow cellulose into floor over lounge area. Ask contractor to explore the viability of drilling holes into floor to dense pack walls from above (ESM 7) as well as rest of floor, with fee proposal for both options. See Page 18.

ESM 6: Insulate foundation walls in the basement with two inch, foil faced, polyisocyanurate. Spray closed cell foam from foam board to under floor decking for a continuous air, vapor, and thermal barrier. Attach same foam board to access door and weather-strip. If at all possible, drill holes through concrete blocks on the south wall and inject foam to air seal the original sill/granite connection. (Office above can use the floor to keep lunch cold). Other option would be to remove the cementitious ceiling and all fiberglass—spray foam rim joists, then add mineral wool (roxul rock wool) to ceiling cavity bays and replace fire-proof barrier.

ESM 7: If impossible from floor above, remove exterior clapboard at top of 1st floor wall, drill two inch holes, and dense pack cellulose (or mineral wool) into wall cavities. SEAL holes and replace clapboards.

Cost estimates are based on other projects but need a contractor's fee proposal to verify potential incentives.

Heating Cost From Oil VS Installed Air Source Heat Pumps

A gallon of oil contains (approximate average) 138,500 Btu. Based on that average, it takes about 7.25 gallons of oil to equal one million Btu of heat. At $2.49 a gallon and 100% efficiency, it would cost just over $18.00 to deliver one million Btu for space heating. When factoring in the efficiency of the existing boiler, the cost to deliver one million btu about $21.15. At $3.17 per gallon, the cost goes up to $26.31 per MMBTU.

Cost of Oil in existing Boiler	
Cost per MMBtu @ $2.49/gal	$21.15
Cost per MMBtu @ $3.17/gal	$26.31

We can use similar calculations to compare the cost to deliver heat from other energy sources. It's a little more complicated with electric heat pumps because the efficiency varies based on outdoor temperature and the specific heat pump equipment. The chart below offers a summary snap shot of the cost to heat with the installed heat pumps (based on published capacity and COP ratings) at three outdoor temperatures (OAT). Note that at $0.13 per kWh, heating with ASHP is less expensive per million Btu down to 5ºOAT, compared to heating with oil at $2.49 per gallon.

Estimated Zone Loads	11716	11253	13603	24620	Average $
Heat per kWh @ 47º OAT	13409	12420	13614	11089	
Cost per MMBtu @ $0.13/kWh	$9.69	$10.47	$9.55	$11.72	$10.36
Heat per kWh @ 17º OAT	8871	8018	7813	7506	
Cost per MMBtu @ $0.13/kWh	$14.65	$16.21	$16.64	$17.32	$16.21
Heat per kWh @ 5º OAT	6926	6415	8257	7404	
Cost per MMBtu @ $0.13/kWh	$18.77	$20.27	$15.74	$17.56	$18.08

However, to rely on ASHP for heating a space, it is also important to note whether the heat capacity at low temperatures is adequate to maintain indoor comfort. With one exception, the estimated heating loads per zone (above) exceed the heating capacity of the installed equipment (matching color below) at 5ºOAT.

	MXZ-2C20NA3 Wall Unit	MXZ-2C20NA3	MXZ-3C24NA3	MXZ-4C36NA3	Totals
Cooling Btu/hr	20000	20000	22000	36400	98400
SEER / SEER2	20/18	16/20	16/20	17.6/16	
Heating at 47ºF Btu/hr	25500	25500	30600	43000	99100
Heating at 17ºF Btu/hr	15000	14500	19600	26600	61200
Heating at 5ºF Btu/hr	11000	10900	18200	24000	53200
COP at 47ºF	3.93	3.64	3.99	3.25	3.72
COP at 17ºF	2.60	2.35	2.29	2.20	2.36
COP at 5ºF	2.03	1.88	2.42	2.17	2.21
Energy Star	Yes	No	No	No	
Compressor Type	DC Inverter	DC Inverter	DC Inverter	DC Inverter	
Heating Air Intake Max	5º	5º	5º	5º	
Heating Thermal Lock	-1.4	-1.4	-1.4	-1.4	
Re-start Temp	5º	5º	5º	5º	

Load Reductions Following Implementing ESM 1-7

Room Areas	Existing Heating	Btu/hr Cooling	ESM 1-7 Heating	Btu/hr Cooling
Main Entrance	36381		23869	
Lobby	5210	2346	4893	2241
Town Clerk / Tax Collector	6043	4482	5567	4325
Assessing Office	4817	2818	4409	2683
Finance	7803	4150	5765	3682
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Town Administrator	3338	2079	3065	1989
Conference Room	9150	8769	8537	8566
Planning & Selectmen	4453	2901	4090	2779
Totals	90569	35507	70688	33235

Keep doors open to main entrance and restrooms (when not in use).

Completing all seven recommended ESM is predicted to reduce the whole building's heating load by an estimated 20,000 Btu/hr and each zone's load enough that the published heating capacity at 5ºOAT may be adequate to maintain indoor comfort. The hydronic baseboard would still be available as back as needed, but potentially only when the OAT drops below 5ºOAT. The premise is that in addition to saving energy, the ESM would result in being able to use the lower cost heating source.

Estimated Reduced Zone Loads	10728	10460	12627	22174	Average $
Heat per kWh @ 47º OAT	13409	12420	13614	11089	
Cost per MMBtu @ $0.13/kWh	$9.69	$10.47	$9.55	$11.72	$10.36
Heat per kWh @ 17º OAT	8871	8018	7813	7506	
Cost per MMBtu @ $0.13/kWh	$14.65	$16.21	$16.64	$17.32	$16.21
Heat per kWh @ 5º OAT	6926	6415	8257	7404	
Cost per MMBtu @ $0.13/kWh	$18.77	$20.27	$15.74	$17.56	$18.08

	MXZ-2C20NA3 Wall Unit	MXZ-2C20NA3	MXZ-3C24NA3	MXZ-4C36NA3	Totals
Cooling Btu/hr	20000	20000	22000	36400	98400
SEER / SEER2	20/18	16/20	16/20	17.6/16	
Heating at 47ºF Btu/hr	25500	25500	30600	43000	99100
Heating at 17ºF Btu/hr	15000	14500	19600	26600	61200
Heating at 5ºF Btu/hr	11000	10900	18200	24000	53200
COP at 47ºF	3.93	3.64	3.99	3.25	3.72
COP at 17ºF	2.60	2.35	2.29	2.20	2.36
COP at 5ºF	2.03	1.88	2.42	2.17	2.21
Energy Star	Yes	No	No	No	
Compressor Type	DC Inverter	DC Inverter	DC Inverter	DC Inverter	

Historic Energy Use Analysis

The energy analysis below is based on the energy data provided for 2022.

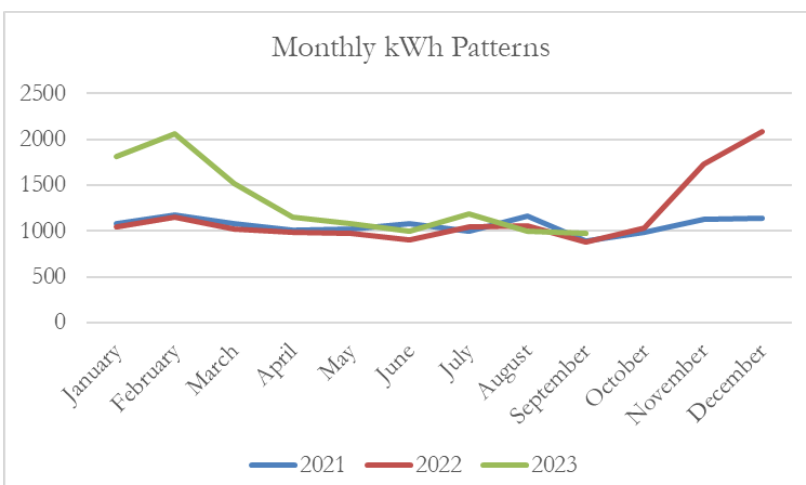
Energy	Units	Site Btus	Source Btus	$Cost
Electric - kWh	13914	47,474,568	158,076,954	$2,017
Oil - Gallons	1864	258,164,000	296,888,600	$5,916
Totals		305,638,568	454,965,554	$7,933
EUI KBtu/FT2	2802	109.1	162.4	$2.83

The Energy Utilization Index (EUI) offers a simple snapshot analysis of a building's energy use by looking at total amount of energy input (converted to Btu's) divided by the floor area of conditioned space. "Site Energy" refers to units of energy delivered to a site. Source energy includes transmission and some allowance for off site generation and other considerations.

Based on the information provided the Site EUI for 2022 was 109.1 KBtu/ft2 for the whole building. Source EUI was 162.4 KBtu/ft2, with a cost per square foot of $2.83 per ft2 based on current energy prices. Since the per unit cost for energy can vary greatly over time, converting all forms of energy to Btus is a more useful way of looking at a building's energy demands and potential reductions from energy saving measures.

Monthly patterns of electric consumption can sometimes tell a useful story, though assumptions are never as useful as hard facts. Still, it is likely that the peak consumption pattern in the winter is due to the use of electric heating, especially in the basement where electric resistance (ER) baseboards are used to supplement the one indoor heat pump unit.

Another financial advantage of converting to heat pumps is that it offers the option for an annual offset with on-site generation of clean, renewable, and "free" solar energy.



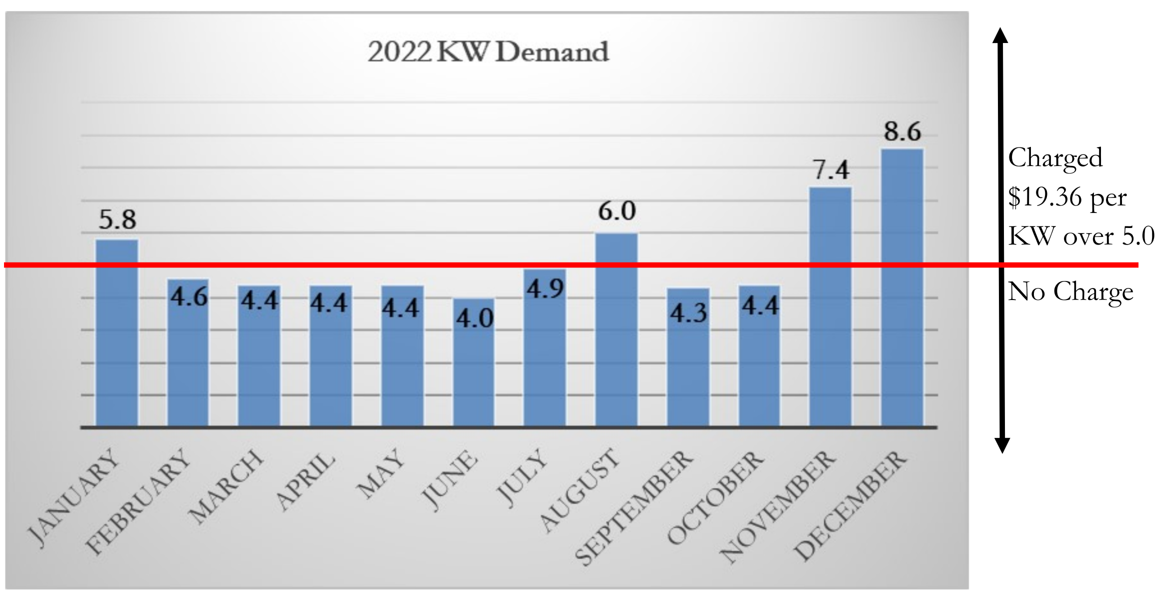
KW Demand and the Cost of Supply

The KW Demand is determined each month by the peak call for power during any 30 minute window within a billing cycle. The total charges for KW Demand in 2022 was $159, or just under 8% of the total cost for electricity in 2022.

Corresponding with the highest usage of kWh, demand for power was highest in the coldest and hottest months of the year, most likely due to space conditioning. As noted elsewhere, heat pumps operate most efficiently when left at a stable thermostat setting. In other words: don't use setbacks for the heat pumps. (And do use deeper set backs at night and weekends when running the boiler).

Reducing electric usage saves energy and monthly costs in both the supply side (actual electricity used) and the delivery side (the very real transmission costs of delivering kWh to the meter, maintaining lines, etc).

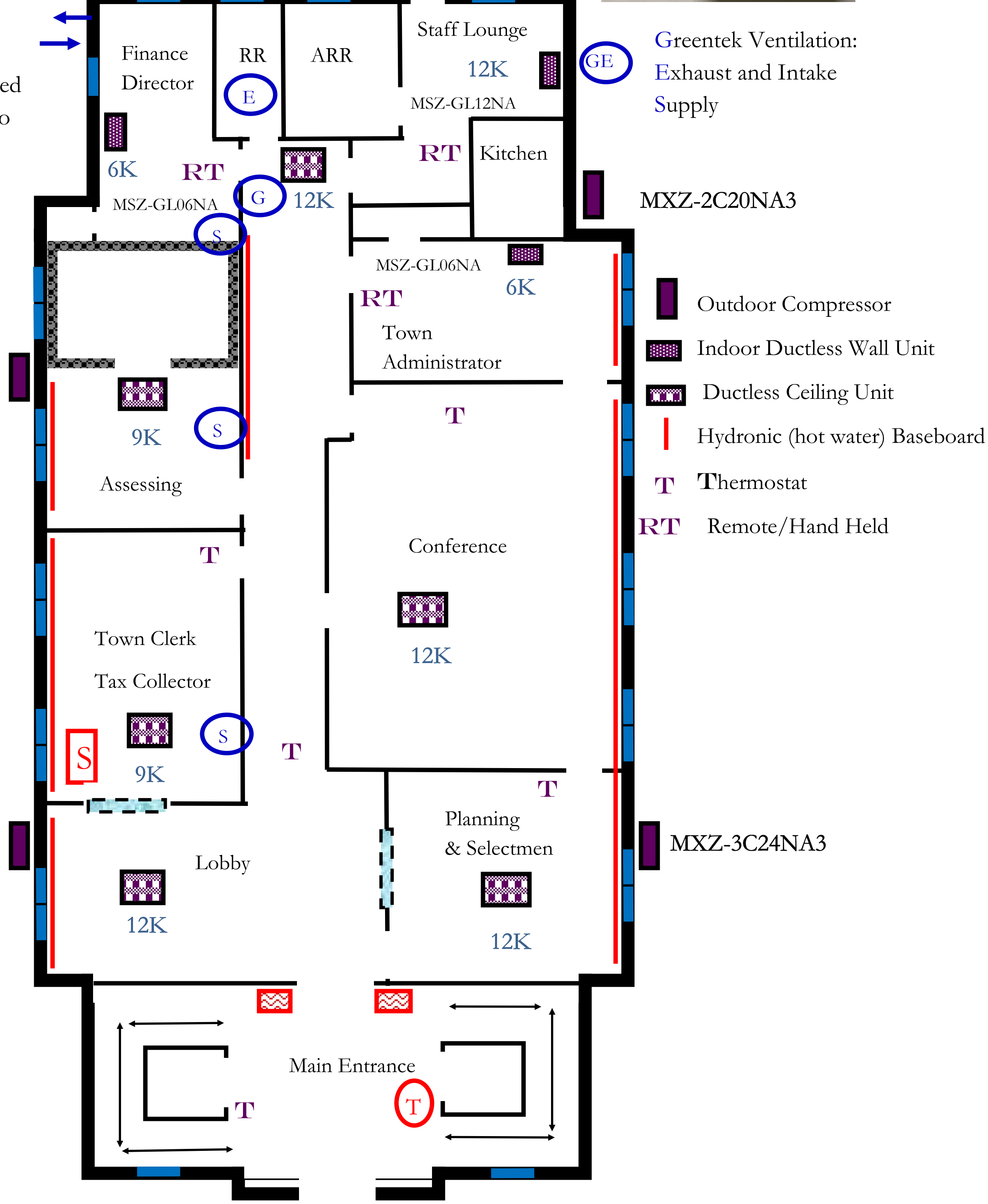
Lowering peak demand on the regional grid plays a critical part in reducing the need to build more generation plants. It may be impacted by a reduction in kWh consumption, but is mostly determined by time and the appliance used. Customers are allowed a peak use of 5.0KW each month before incurring charges.

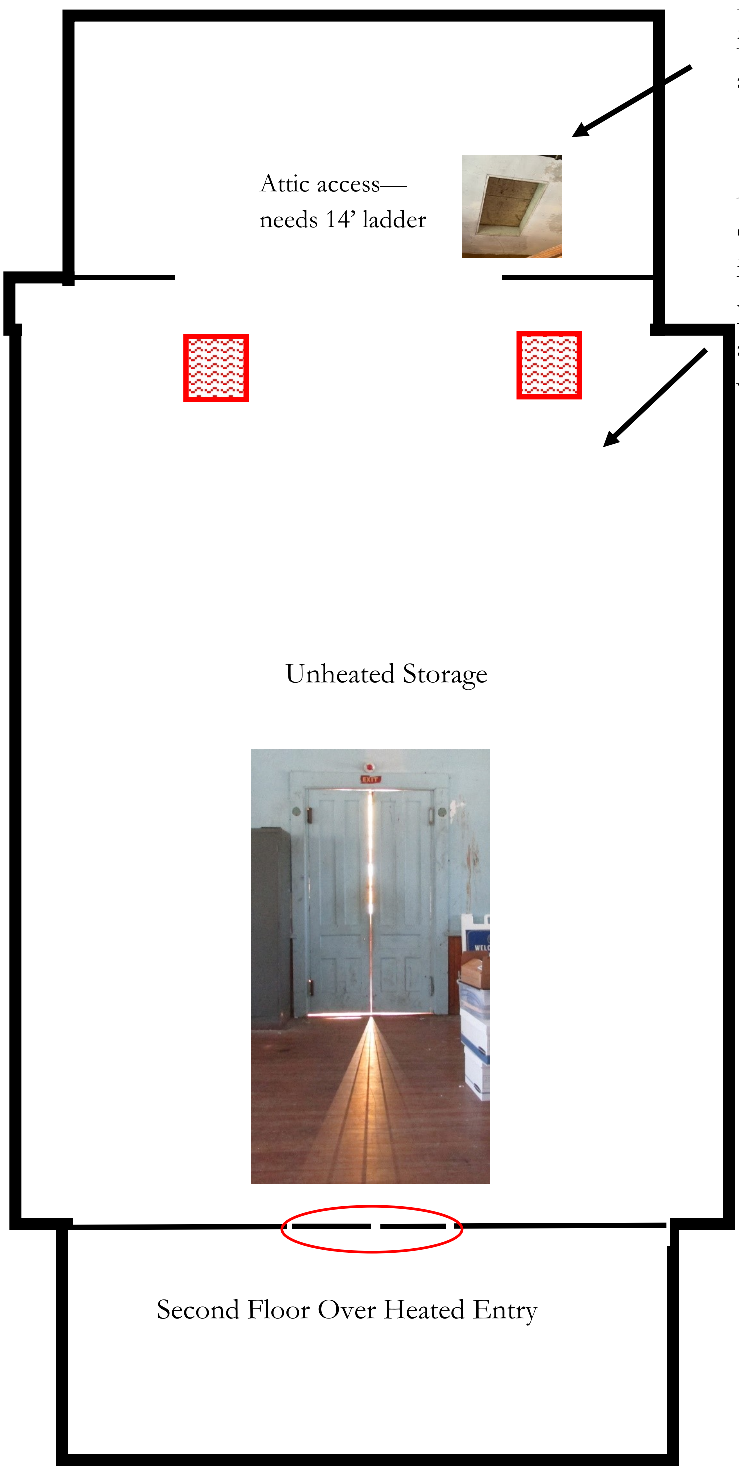


Floorplan Graphic

Hornet nest removed but all ducts need to be cleaned

Greentek Ventilation: Exhaust and Intake Supply





ESM 5: Blow cellulose into floor over lounge area

AND

Ask contractor to explore drilling holes into floor to dense pack walls from above as well as rest of floor, with fee proposal for

ESM 1:

Seal and insulate this double door. Adhere 2", min R10 rigid foam board to this side of the door in such a way that it can be removed without (much) damage and add thick weatherstripping. The result should be a tight and insulated but fully functional doorway.

Thermostat Set Backs

There is a bit of controversy around whether setting a thermostat to a lower temperature saves energy or not.
Two common myths:

1. "Thermostat setbacks during the winter won't save you money. Any energy you saved when the thermostat was turned down will be lost because of the amount of fuel the furnace needed to get you back to a comfortable level."

2. “Setting your thermostat back will save energy, but no more than four degrees.” (or 6 or some set number)

The reality is that lowering the indoor air temperature through thermostat setbacks for fuel burning equipment almost always saves heating energy because one of the factors of heat transfer is the temperature difference between inside and outside (aka delta T or ΔT): the lower the ΔT, the slower the rate of heat transfer, therefore heat loss is reduced. While its true that a furnace or boiler will run longer to bring the temperature back up to comfort levels, fossil fuel (and biomass) equipment operates more efficiently when it keeps running as opposed to turning on and off multiple times. For those two reasons, the energy saved from lower setbacks will *almost* always be more than the energy used to bring it back up to temperature. NOTE: This does NOT apply to variable speed heat pumps which operate most efficiently when left at one temperature.

But it is especially true for single stage oil fired equipment which is ‘oversized’. That is when its hourly BTU output capacity far exceeds the hourly heat loss. Ideally, peak capacity will equal peak heat lost—ie the BTU/hr heat loss during the coldest hour of the location’s winter, occurring 99% of the time on average. But non-modulating furnaces and boilers are frequently oversized—but as much as 50-150% . So when it comes on to satisfy the thermostat setting, it puts out a lot of heat, likely turns off fairly quickly, then on again minutes later. This on and off again is referred to as ‘short cycling’ and it results in low seasonal efficiency. (There are other maintenance reasons for short cycling, including a damaged flame sensor and dirty or misaligned air filters, so regular maintenance and inspections and can keep a furnace performing as efficiently as possible.)

But when a building is unoccupied overnight or for days at a time, keeping the thermostat set back means that the boiler will be off for many if not most of the winter hours, then run at its highest efficiency to recover.

All that said, there are other considerations with thermostat set backs, especially in a building with minimal insulation levels. As surfaces cool, there is a risk of condensation forming if surface temperatures drop below the dew point, though with low interior humidity, this should be a very low risk. The other common consideration is preventing the risk of freezing pipes on exterior walls, though again, this should not be an issue in the Community Center as long as the baseboard in the meeting room restroom is left on to 45 degrees.

There is likely an ‘optimal’ set back temperature for the propane and oil systems in these buildings. But it is unique to each building based on the thermal performance of the envelope and which will vary for each hour as the delta T varies. I’ve asked contractors who recommend specific set back temperatures, why they pick 4º or 6º or whatever and the response has usually been something on the order of “because its complicated and customers won’t understand. They just want simple instructions.”

The mission of S.E.E.D.S. is based on the principle that to transition to a low energy, carbon neutral economy, people, as consumers, deserve to at least be offered the opportunity to understand the complexities of physics as they relate to our energy usage. For more information, check out the links below.

https://cbe.berkeley.edu/research/setpoint-energy-savings-calculator/

https://www.energyvanguard.com/blog/if-you-think-thermostat-setbacks-don-t-save-energy-you-re-wrong/

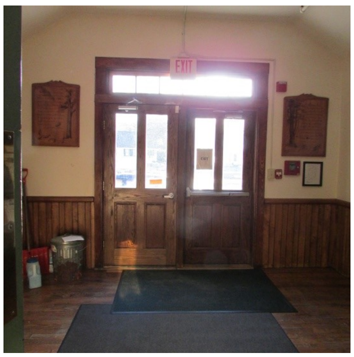
https://www.thisoldhouse.com/heating-cooling/21016013/how-thermostat-setbacks-save-money

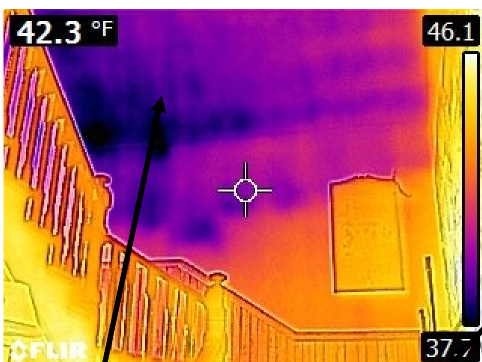
ESM: Main Entrance

Thermographic (aka Infra Red or IR) images depict differences in surface temperatures. Darker colors indicate cooler surfaces than brighter colors. Dark "blobs" or streaks can indicate cold air leaking into the building on a cold day, or washing through low density insulation such as fiberglass. Though in this case, the voids or uninsulated and narrow wall cavities reflect the highly conductive cold brick of the exterior walls.

Air leakage around the three exterior doors offer a cost effective opportunity to reduce air filtration though installing professional quality weather stripping.

ESM 2: Add weather-stripping around exterior doors

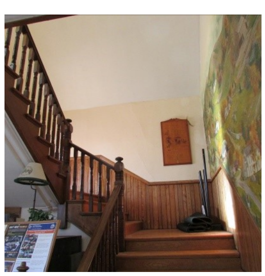


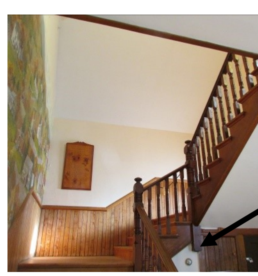


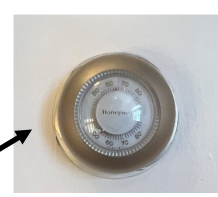
ESM 5: Blow in insulation above entrance ceiling (Access not known, possibly from ceiling hatch on northwest corner.

ESM 4: Blow in insulation into entrance's exterior wall cavities

Improving the thermal envelope* in the entrance and stairwell will save energy & dollars, but by reducing heat loss, it makes it possible to open doors to the office areas during the day and rely on heat pumps for heating.





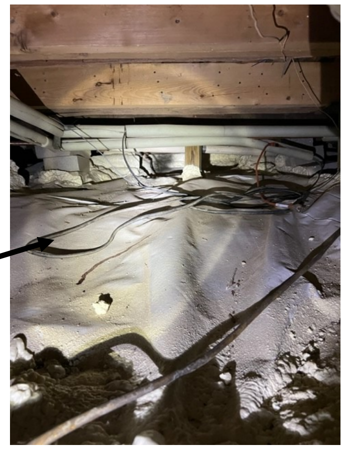


The thermostat is set to 64.

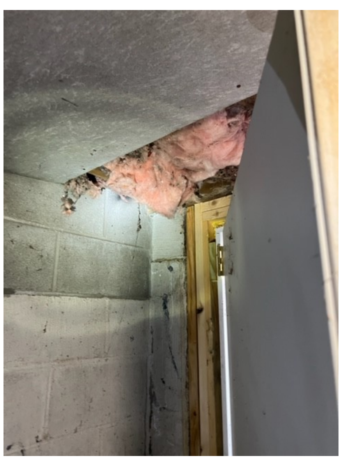
* ESM 1, 4, 2, and 5

ESM #6: Insulate the Remaining Foundation Walls

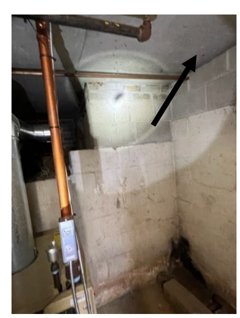
The small basement, where the boiler and hot water tank are located, has an opening to a crawl space which presumably extends under the rest of the building. It has had spray foam applied to the foundation and which also seals a vapor barrier membrane over the floor. All this would have been recommended had it not already been accomplished!



However, there have been issues with freezing pipes which is being addressed through 'expensive to run' electric resistance heat tapes. And the office and bathrooms over the basement have very cold floors. The fiberglass in the ceiling shows the effect of air filtration, which means its barely serving as any insulation at all. So the recommendation is continue insulating the foundation walls and add R12 Thermax board to the door and air seal.



It appears that a block wall has been added to the interior of the original granite and stone foundation, and a cementitious ceiling board added above the boiler to serve as a fire barrier. The exterior granite and sill may be able to be accessed—and foam sealed—but cutting into or removing the fire board and then replacing. If so, it is worth doing if mostly for the benefit of comfort to the finance office above. (Though it will also save energy)



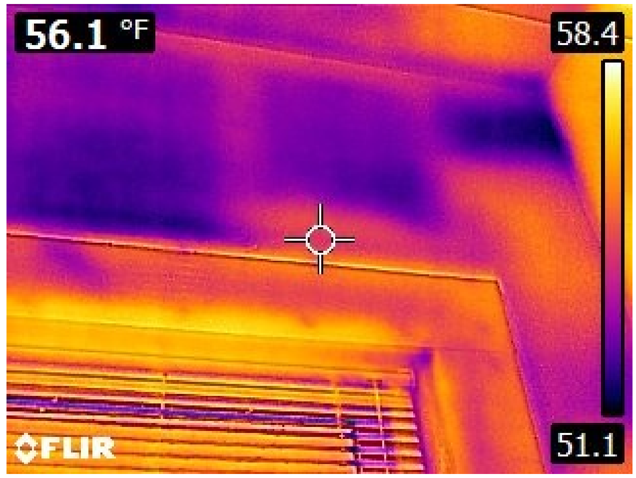
ESM #7 and #3

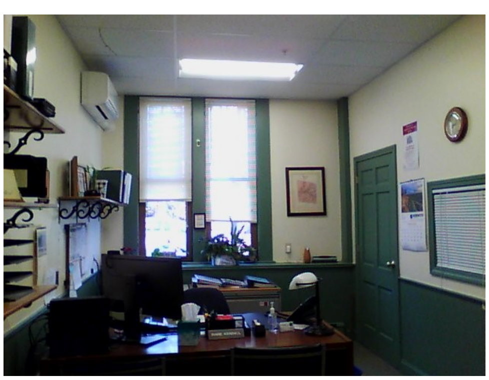
Wall cavities appear to have insulation material but it has settled in some cavities and appears 'performance-compromised' in others.

The objective of ESM 7 is to dense pack cellulose into each cavity—filling voids and compressing what already exists.

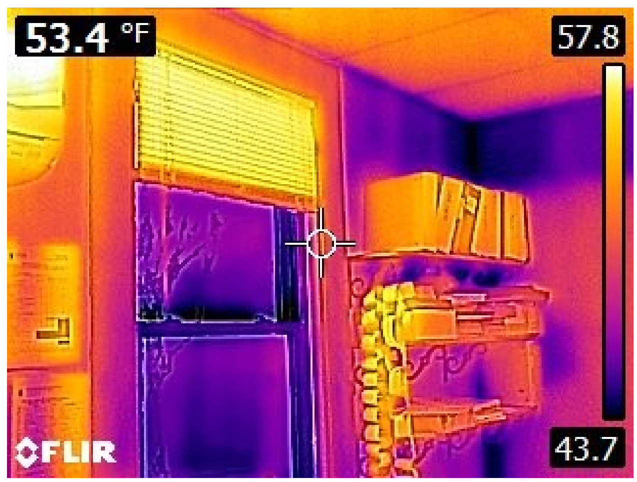
ESM #3 is intending to reduce drafts but also add "R-value" to the existing windows and frames by replacing the light filtering shades with insulated and tracked cellular shades.

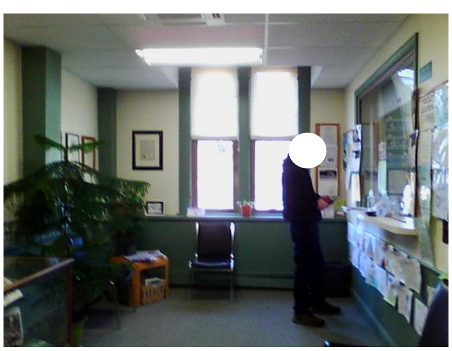
There are many different styles and colors to choose from and only some on tracks to reduce air leakage. The most important criteria is to select a shade with two layers of material creating a 'honeycomb' pocket of air.





ESM #7 and #3





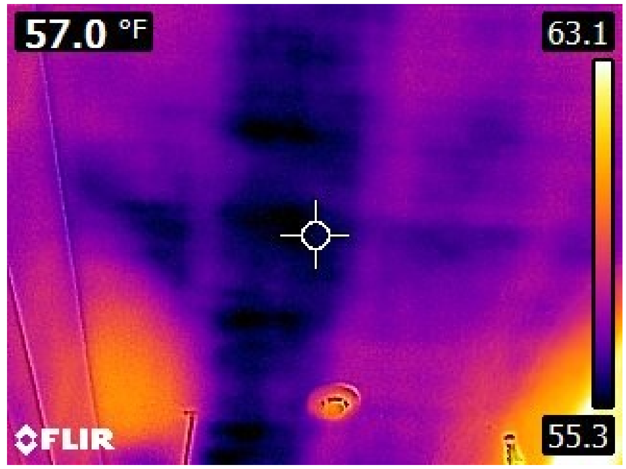
ESM #5

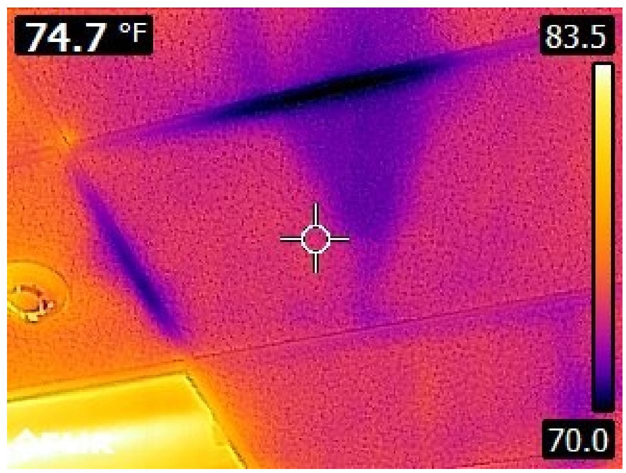
ESM #5 is intended to address the ceiling plane, where it also may provide access to top of walls.

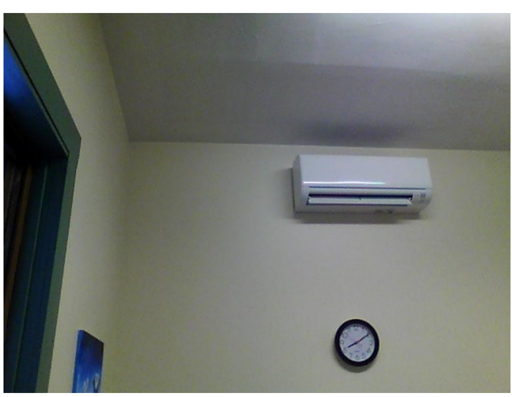
There are fiberglass batts above the suspending ceiling (where it exists) which does offer some level of thermal barrier.

But air can easily migrate through fiberglass and there also appears to be voids above the plaster ceiling of the lounge area.

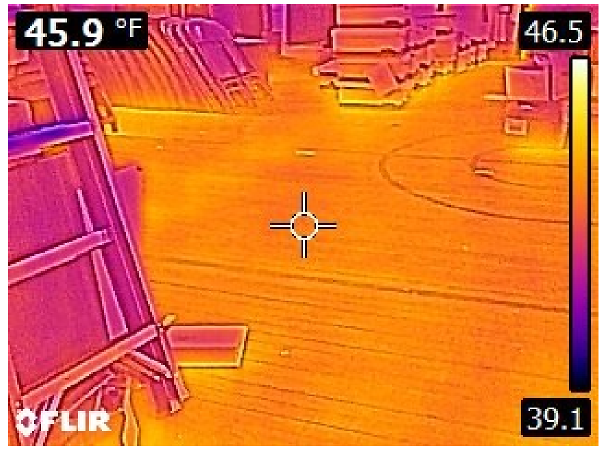
Ideally, the floor of the second floor would be dense packed with cellulose, but access and practicality of that measure needs to be explored by a contractor who would do the work.

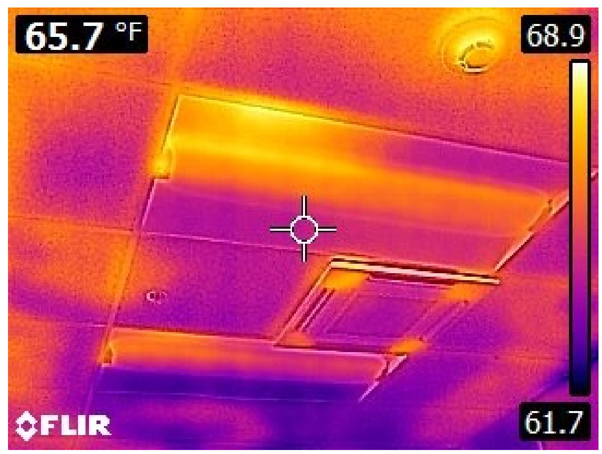




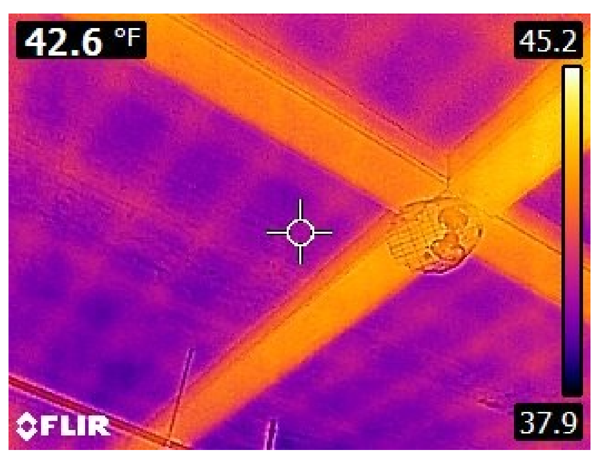


ESM #5

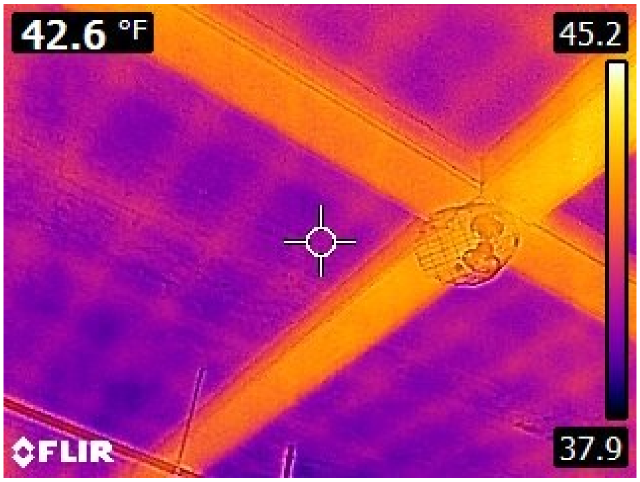


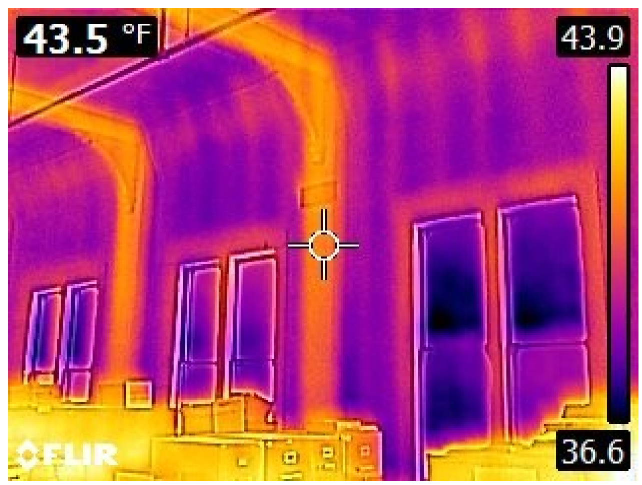


There does not appear to be insulation in the walls or above the ceiling of the second floor. As long is it remains un-heated, it is proposed to focus on improving the thermal barrier at the floor and stairwell wall boundary.



Unconditioned Second Floor Storage



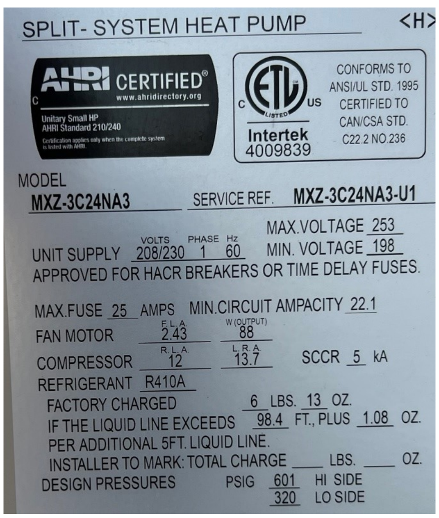


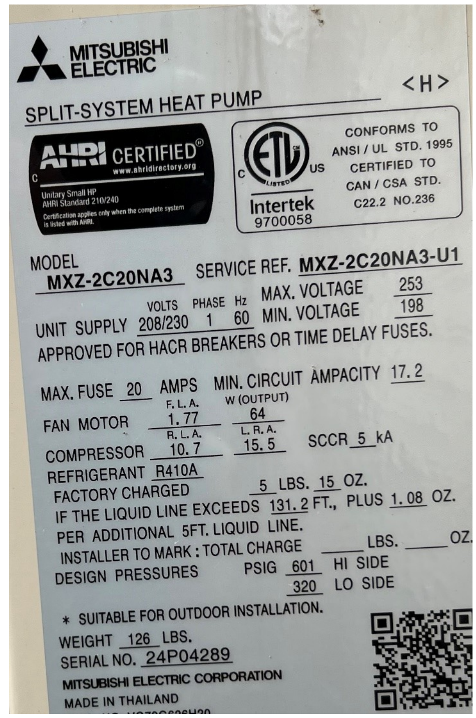
Heating and Cooling Equipment

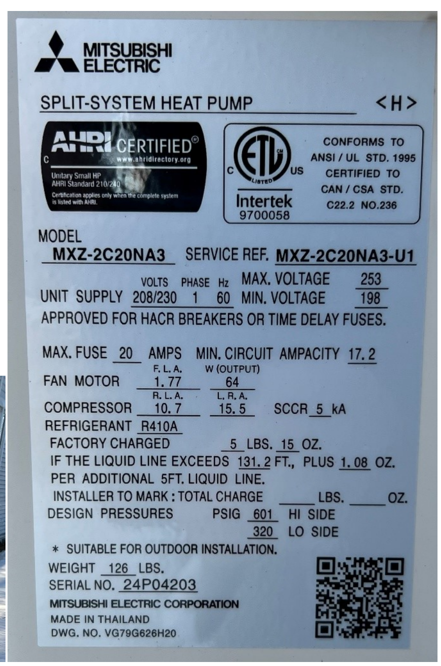
Weil-McLain
Model # WGO-5 or 5R
Output 152 or 128MBH

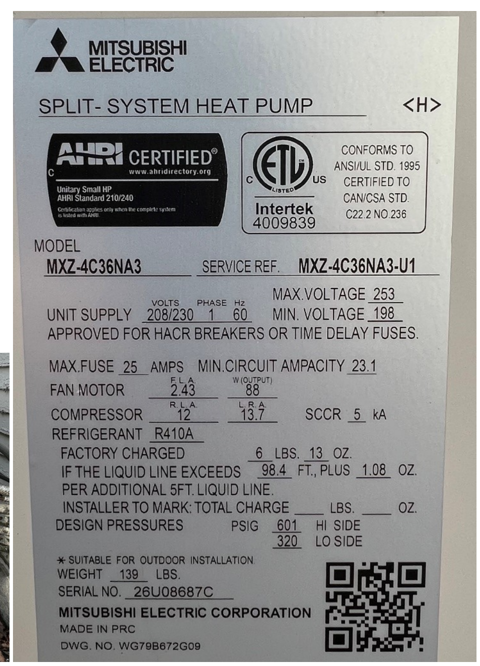
AFUE 85%

State Industries Elec
Water Heater
(2) 1650watt elements









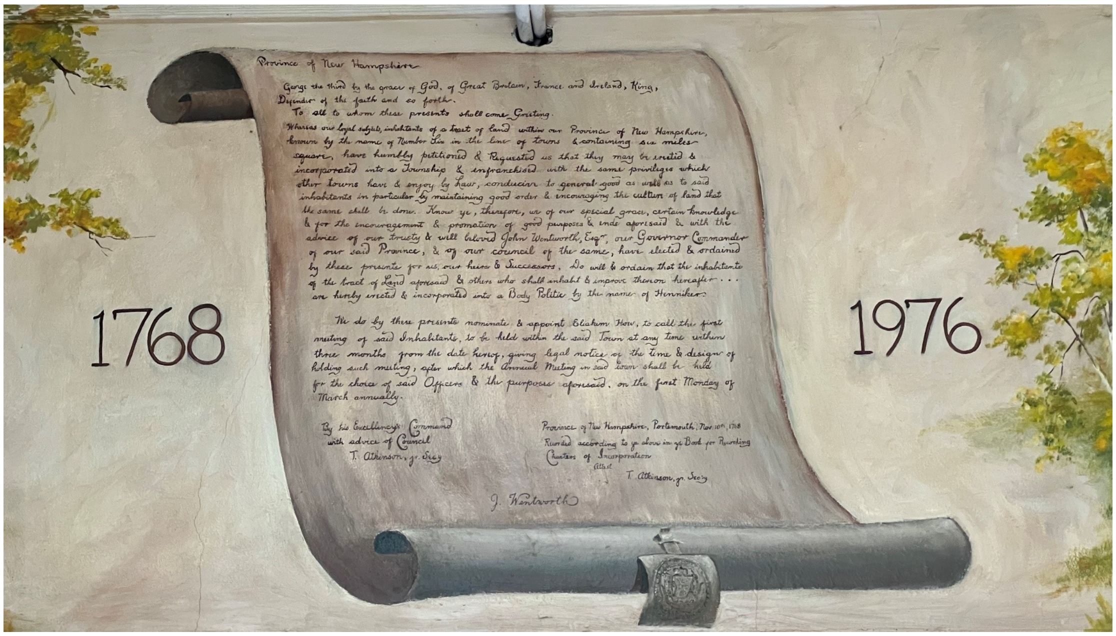
East Facing

North Facing

South Facing

West Facing

Just Because Its Such A Great Entrance



The Basics of Heat Transfer in a Building

Heat moves in three basic ways in a building: Conduction, convection, and radiation.

Heat **conducts** to coolth or cold in any direction and through physical contact of materials. Insulation can slow the rate of heat loss to the outside. The rate at which it moves is determined by the type and thickness of material and the temperature difference between inside and outside. Compare holding a ceramic mug of hot water vs a glass of hot water, vs a glass of cold water. The skin of your hand will be heated—or cooled—based on the conductivity of the mug, glass, and the temperature difference of the water and your hand.

In a building in our climate, heat moves, or 'is lost' to the outside as it moves from inside heated space to the colder outside through an assembly of materials. For the walls, the assembly may consist of plaster or sheet-rock, brick, or wood framing with insulation in cavities (or not), exterior board sheathing, wood clapboards, or perhaps a thin layer of insulation and vinyl siding. The rate of heat loss varies with the difference between the inside temperature and outside temperature. That is why setting the thermostat back to 55 degrees when the building is unoccupied saves energy; because the rate of heat loss is slowed.

Heat can also be transferred through air or water by **convection.** While heat moves to cold via conduction, warmer air rises because it is lighter, or less dense, than cooler air. This means that insulation can only work well if it doesn't allow air to pass through it. The other way to say it is: Insulation needs to be in contact with an air barrier on all sides to perform as expected. Weatherstripping around doors and windows, for example, can stop cold air infiltration which, when warmed, rises to the ceiling and exfiltrates through any cracks or gaps in the ceiling material.

Insulation is usually described by its R-value, or resistance to allow heat transfer. But R-value doesn't tell the whole story because it only refers to conductive heat loss and doesn't consider convection. Manufactures of insulation test their products in a laboratory by placing it, fully lofted, in a perfectly sealed box, and measure the rate that heat moves from one side to the other to determine what "R-Value" to stamp on the product to be sold. If its not installed in exactly the same way, that R-value has very little meaning.

The third way heat moves is by **radiation**. This happens through space and from a warmer source to cooler surface in visual contact. Think of feeling the warmth of the sun and the immediate difference when a cloud blocks it. The sun still warms the earth surfaces and surrounding air, but direct radiation can be blocked—or shaded. Same thing with a wood stove. A hot stove warms air, but its greatest impact is by radiation which is only felt when one is in visible contact. And the further away, the less heat is felt. Its often tempting to replace windows because we feel so cold when next to them! That's because our body heat radiates to the cold surface. Insulated shades or quilts stops that radiative loss (but also eliminates view and daylight). Interior glazing panels can make a big difference for single pane windows because the air space raises the surface temperature of the inside glass.

In reality, all three mechanisms happen at the same time, though one usually dominates the others in terms of how much heat is moved.

The role of heating equipment is to replace the heat that is lost through the envelope. This is described or measured as replacing BTU per hour (BTU/hr). If the heating system (electric baseboard, oil or propane furnace or boiler, etc…) creates or moves more heat (BTU) in an hour than in lost to the outside, the system is considered "over-sized" which can waste energy unnecessarily. On the other hand, if the system cannot generate or move enough heat to replace what is lost in any given hour, the system is "undersized" and will not be able to maintain warm enough inside temperatures for human comfort. So correct sizing is important!

Hopkinton Town Hall EXISTING HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Thursday, November 9, 2023

Rhvac is an ACCA approved Manual J, D and S computer program.
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	Hopkinton Town Hall EXISTING
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	1,789	CFM Per Square ft.:	0.638
Square ft. of Room Area:	2,802	Square ft. Per Ton:	722
Volume (ft³):	29,910		

Building Loads

Total Heating Required Including Ventilation Air:	92,438	Btuh	92.438	MBH
Total Sensible Gain:	38,872	Btuh	83	%
Total Latent Gain:	7,696	Btuh	17	%
Total Cooling Required Including Ventilation Air:	46,568	Btuh	3.88	Tons (Based On Sensible + Latent)

Notes

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All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Miscellaneous Report

System 1 Oil Boiler. ASHP Supplement Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	No		No	
Use Schedule:	No		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.592	AC/hr	0.592	AC/hr
	295	CFM	295	CFM
Infiltration Actual:	0.592	AC/hr	0.592	AC/hr
Above Grade Volume:	X 29,910	Cu.ft.	X 29,910	Cu.ft.
	17,700	Cu.ft./hr	17,700	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	295	CFM	295	CFM
Total Building Ventilation:	0	CFM	0	CFM

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.592 AC/hr (295 CFM)
Summer Infiltration Specified: 0.592 AC/hr (295 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	3.88	722	2,802	38,872	7,696	46,568	92,438	1,215	1,789	1,789	
System 1	3.88	722	2,802	38,872	7,696	46,568	92,438	1,215	1,789	1,789	0*
Zone 1			2,802	38,872	7,696	46,568	92,438	1,215	1,789	1,789	
1-Main Entrance			420	9,026	1,721	10,747	36,381	478	415	415	4--0*
2-Lobby			420	2,195	150	2,345	5,210	69	101	101	1--0*
3-Town Clerk.Tax Collector			294	3,856	625	4,481	6,043	79	177	177	2--0*
4-Assessing Office			252	2,425	393	2,818	4,817	63	112	112	2--0*
5-Finance			162	3,399	750	4,149	7,803	103	156	156	2--0*
6-Sm RR			40	1,127	43	1,170	1,499	20	52	52	1--0*
7-Lg RR			80	1,868	86	1,954	3,497	46	86	86	1--0*
8-Staff Lounge And Kitchen			192	4,419	738	5,157	10,247	135	203	203	2--0*
9-Town Administrator			162	1,749	329	2,078	3,338	44	81	81	1--0*
10-Meeting Room			540	6,479	2,289	8,768	9,150	120	298	298	3--0*
11-Planning & Selectmen			240	2,328	572	2,900	4,453	59	107	107	1--0*

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
1A-cm-o: Glazing-Single pane, operable window, clear, metal frame no break, U-value 1.27, SHGC 0.75	27.7	2,534	0	1,346	1,346
Replacement: Glazing-DP Pane with Low E, high SHGC, U-value 0.38, SHGC 0.49	326.2	8,920	0	8,290	8,290
Door: Door-Glass Entry Door, U-value 0.87	57.1	3,579	0	894	894
11D: Door-Wood - Solid Core, U-value 0.87	39.4	2,471	0	618	618
11L: Door-Metal - Paper Honeycomb Core, U-value 0.56	16.2	655	0	164	164
Historic Frame: Wall-Frame, Custom, Town Hall partially insulated frame walls, U-value 0.125	2089.8	18,809	0	2,454	2,454
12A-0bw: Wall-Frame, no insulation in stud cavity, no board insulation, brick finish, wood studs, U-value 0.353	200.6	5,097	0	665	665
Slopes.Poor: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Slopes Fiberglass, U-value 0.1	280	2,016	0	1,736	1,736
FG Batts-ml: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, FG batts over suspended ceiling, light metal, U-value 0.067	2110	10,178	0	5,938	5,938
voids-ml: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, minimal material over old plaster ceiling, light metal, U-value 0.2	272	3,917	0	2,285	2,285
19B-0sp: Floor-Over enclosed crawl space, R-4 insulation on exposed walls, sealed crawl space, passive, no floor insulation, carpet or hardwood, U-value 0.368	2328	5,461	0	910	910
Poor fg: Floor-Over enclosed crawl space, Custom, 19A fiberglass in poor condition, U-value 0.5	474	5,725	0	955	955
Subtotals for structure:		69,362	0	26,255	26,255
People:	20		4,000	4,600	8,600
Equipment:			0	1,250	1,250
Lighting:	545			1,858	1,858
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 295, Summer CFM: 295		23,076	3,696	3,846	7,542
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
AED Excursion:		0	0	1,062	1,062
Total Building Load Totals:		92,438	7,696	38,872	46,568

Check Figures

Total Building Supply CFM:	1,789	CFM Per Square ft.:	0.638
Square ft. of Room Area:	2,802	Square ft. Per Ton:	722
Volume (ft³):	29,910		

Building Loads

Total Heating Required Including Ventilation Air:	92,438	Btuh	92.438	MBH
Total Sensible Gain:	38,872	Btuh	83	%
Total Latent Gain:	7,696	Btuh	17	%
Total Cooling Required Including Ventilation Air:	46,568	Btuh	3.88	Tons (Based On Sensible + Latent)

Notes

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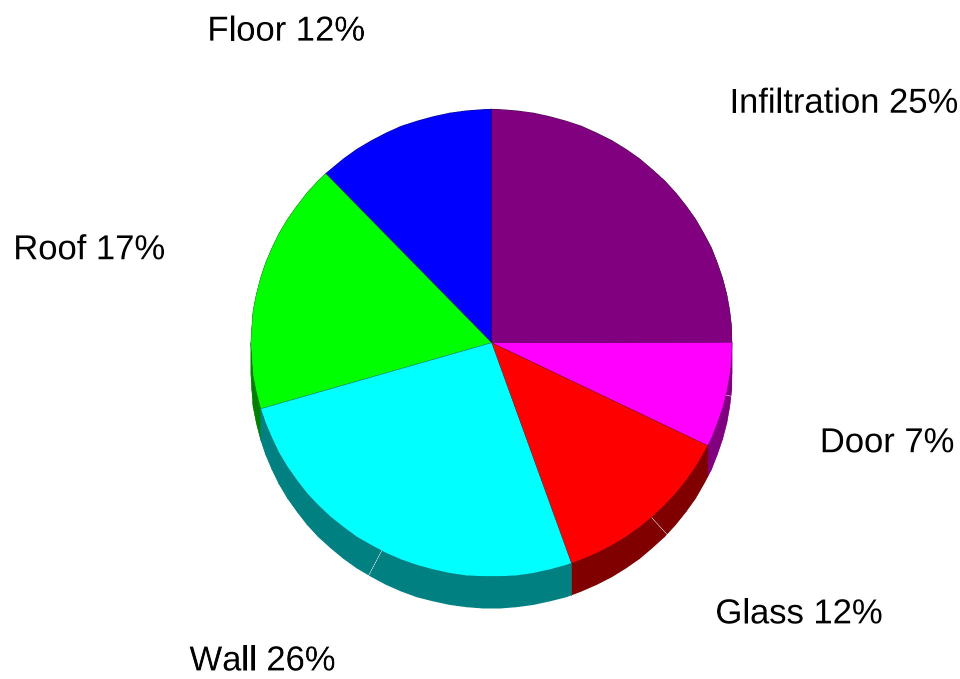
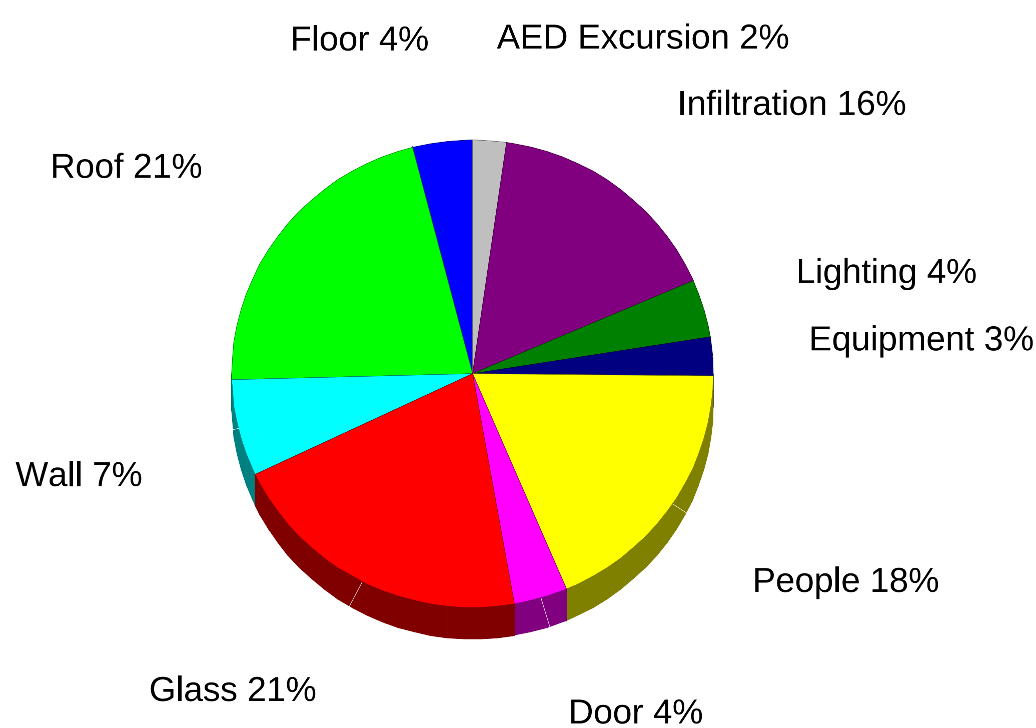
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Hopkinton Town Hall IMPROVED With DP Walls
HVAC Load Calculations

for

Town Of Henniker

Henniker NH 03242

RHVAC Residential HVAC Loads

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Thursday, November 9, 2023

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Project Report

General Project Information

Project Title:	Hopkinton Town Hall IMPROVED With DP Walls
Project Date:	Tuesday, October 17, 2023
Client Name:	Town Of Henniker
Client City:	Henniker NH 03242
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	[redacted]

Design Data

Reference City:		Concord AP, New Hampshire
Building Orientation:		Front door faces North
Daily Temperature Range:		High
Latitude:	43	Degrees
Elevation:	342	ft.
Altitude Factor:	0.988	

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	n/a	n/a	70	n/a
Summer:	87	70	43%	50%	75	19

Check Figures

Total Building Supply CFM:	1,507	CFM Per Square ft.:	0.538
Square ft. of Room Area:	2,802	Square ft. Per Ton:	873
Volume (ft³):	29,910		

Building Loads

Total Heating Required Including Ventilation Air:	60,063	Btuh	60.063	MBH
Total Sensible Gain:	32,756	Btuh	85	%
Total Latent Gain:	5,753	Btuh	15	%
Total Cooling Required Including Ventilation Air:	38,509	Btuh	3.21	Tons (Based On Sensible + Latent)

Notes

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Miscellaneous Report

System 1 Oil Boiler. ASHP Supplement Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-2	-2.6	80%	n/a	70	n/a
Summer:	87	70	43%	50%	75	18.65

Duct Sizing Inputs

	Main Trunk		Runouts	
Calculate:	No		No	
Use Schedule:	No		Yes	
Roughness Factor:	0.00300		0.01000	
Pressure Drop:	0.1000	in.wg./100 ft.	0.1000	in.wg./100 ft.
Minimum Velocity:	0	ft./min	0	ft./min
Maximum Velocity:	900	ft./min	750	ft./min
Minimum Height:	0	in.	0	in.
Maximum Height:	0	in.	0	in.

Outside Air Data

	Winter		Summer	
Infiltration Specified:	0.281	AC/hr	0.281	AC/hr
	140	CFM	140	CFM
Infiltration Actual:	0.281	AC/hr	0.281	AC/hr
Above Grade Volume:	X 29,910	Cu.ft.	X 29,910	Cu.ft.
	8,400	Cu.ft./hr	8,400	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	140	CFM	140	CFM
Total Building Ventilation:	0	CFM	0	CFM

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 13.04 = (1.10 X 0.988 X 12.00 Summer Temp. Difference)
Infiltration & Ventilation Latent Gain Multiplier: 12.52 = (0.68 X 0.988 X 18.65 Grains Difference)
Infiltration & Ventilation Sensible Loss Multiplier: 78.23 = (1.10 X 0.988 X 72.00 Winter Temp. Difference)
Winter Infiltration Specified: 0.281 AC/hr (140 CFM)
Summer Infiltration Specified: 0.281 AC/hr (140 CFM)

Load Preview Report

Scope	Net Ton	ft.² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	3.21	873	2,802	32,756	5,753	38,509	60,063	790	1,507	1,507	
System 1	3.21	873	2,802	32,756	5,753	38,509	60,063	790	1,507	1,507	0*
Zone 1			2,802	32,756	5,753	38,509	60,063	790	1,507	1,507	
1-Main Entrance			420	5,450	817	6,267	19,017	250	251	251	3--0*
2-Lobby			420	2,092	71	2,163	4,421	58	96	96	1--0*
3-Town Clerk.Tax Collector			294	3,709	507	4,216	4,964	65	171	171	2--0*
4-Assessing Office			252	2,292	292	2,584	3,832	50	105	105	1--0*
5-Finance			162	2,933	566	3,499	4,657	61	135	135	2--0*
6-Sm RR			40	1,045	20	1,065	985	13	48	48	1--0*
7-Lg RR			80	1,203	41	1,244	1,492	20	55	55	1--0*
8-Staff Lounge And Kitchen			192	3,863	560	4,423	6,603	87	178	178	2--0*
9-Town Administrator			162	1,664	261	1,925	2,708	36	77	77	1--0*
10-Meeting Room			540	6,294	2,137	8,431	7,798	103	290	290	3--0*
11-Planning & Selectmen			240	2,212	481	2,693	3,586	47	102	102	1--0*

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SP with Int: Glazing-Historic single pane with interior panels, U-value 0.38, SHGC 0.6	27.7	758	0	866	866
Replacement: Glazing-DP Pane with Low E, high SHGC, U-value 0.38, SHGC 0.49	326.2	8,920	0	8,290	8,290
Door: Door-Glass Entry Door, U-value 0.87	57.1	3,579	0	894	894
Wood with Foam: Door-Foam insert over double wood doors, U-value 0.09	39.4	256	0	64	64
11L: Door-Metal - Paper Honeycomb Core, U-value 0.56	16.2	655	0	164	164
DP cellulose 4": Wall-Frame, Custom, Dense Pack Cellulose, U-value 0.083	2089.8	12,488	0	1,995	1,995
12D-0bw: Wall-Frame, R-15 insulation in 2 x 4 stud cavity, no board insulation, brick finish, wood studs, U-value 0.071	200.6	1,025	0	57	57
12D-0bw: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), , Slopes Fiberglass, U-value 0.06	280	1,210	0	1,042	1,042
FG Batts-ml: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, FG batts over suspended ceiling, light metal, U-value 0.067	2110	10,178	0	5,938	5,938
Blow in Cellulose: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Blow in 10" Cellulose over questionable fiberglass batts, U-value 0.038	80	219	0	188	188
voids-ml: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, minimal material over old plaster ceiling, light metal, U-value 0.2	192	2,765	0	1,613	1,613
19B-0sp: Floor-Over enclosed crawl space, R-4 insulation on exposed walls, sealed crawl space, passive, no floor insulation, carpet or hardwood, U-value 0.368	2520	5,911	0	985	985
Thermax on Walls: Floor-Over enclosed crawl space, Custom, R12 Thermax on walls.SPF perimeter, U-value 0.083	282	1,149	0	191	191
Subtotals for structure:		49,113	0	22,287	22,287
People:	20		4,000	4,600	8,600
Equipment:			0	1,250	1,250
Lighting:	545			1,858	1,858
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 140, Summer CFM: 140		10,950	1,753	1,825	3,578
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
AED Excursion:		0	0	936	936
Total Building Load Totals:		60,063	5,753	32,756	38,509

Check Figures

Total Building Supply CFM:	1,507	CFM Per Square ft.:	0.538
Square ft. of Room Area:	2,802	Square ft. Per Ton:	873
Volume (ft³):	29,910		

Building Loads

Total Heating Required Including Ventilation Air:	60,063	Btuh	60.063	MBH
Total Sensible Gain:	32,756	Btuh	85	%
Total Latent Gain:	5,753	Btuh	15	%
Total Cooling Required Including Ventilation Air:	38,509	Btuh	3.21	Tons (Based On Sensible + Latent)

Notes

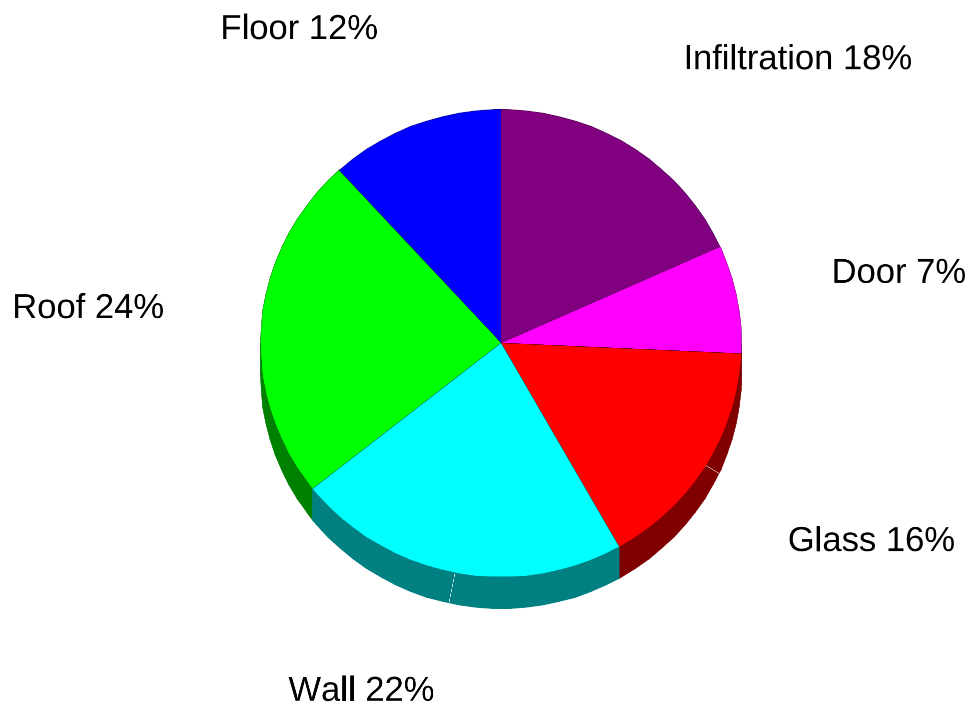
Rhvac is an ACCA approved Manual J, D and S computer program.

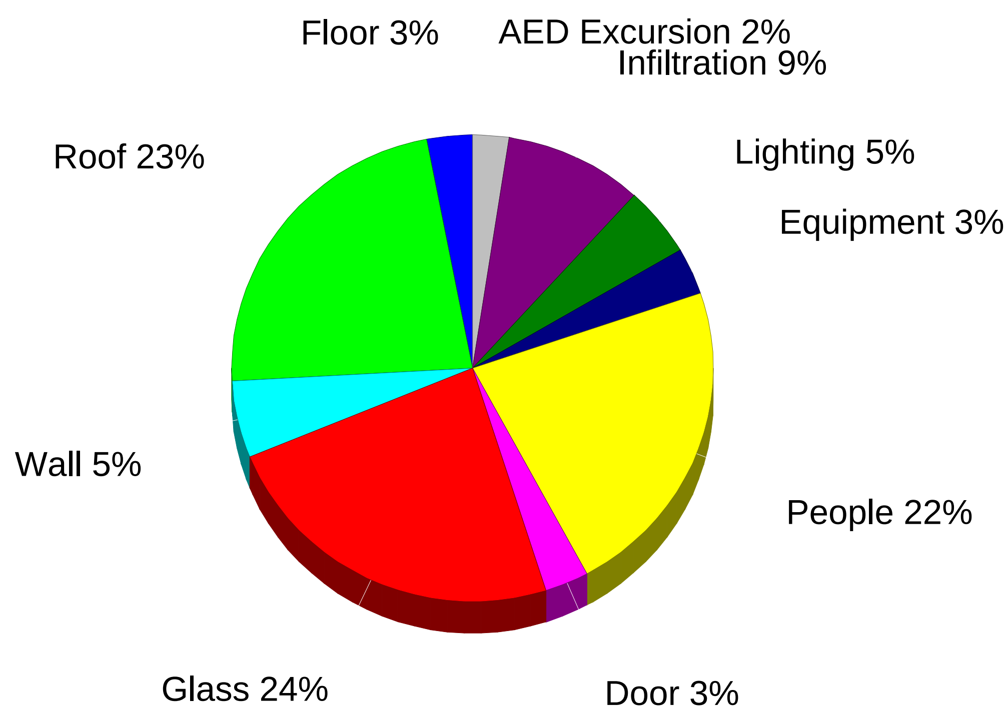
Total Building Summary Loads (cont'd)

Notes

Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Henniker Town Hall Oil as Primary Energy Cost Analysis

for

Town Of Henniker

Henniker NH 03242

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Wednesday, November 15, 2023

Project Information

Project Title:	Henniker Town Hall Oil as Primary	Company Name:	S.E.E.D.S.
Designed By:		Company Rep.:	Margaret Dillon
Project Date:	Thursday, November 2, 2023	Company Address:	
Project Comment:		Company City:	
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client Address:		Company Fax:	
Client City:	Henniker NH 03242	Company Comment:	
Client Phone:			
Client Fax:			
Client Comment:			

Cooling Equipment — System 1

Model Type: Standard Air Conditioner
Model Number:
Capacity: 60,000 Btuh
Efficiency: 10 SEER

Heating Equipment — System 1

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 154,000 Btuh
Efficiency: 85 AFUE

System Description: Existing Oil As Primary

Cooling Equipment — System 2

Model Type: Standard Air Conditioner
Model Number:
Capacity: 60,000 Btuh
Efficiency: 10 SEER

Heating Equipment — System 2

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 154,000 Btuh
Efficiency: 85 AFUE

System Description: Existing Oil As Primary

Cooling Equipment — System 3

Model Type: Standard Air Conditioner
Model Number:
Capacity: 60,000 Btuh
Efficiency: 10 SEER

Heating Equipment — System 3

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 154,000 Btuh
Efficiency: 85 AFUE

System Description: Existing Oil As Primary

Project Summary

General Project Information

Project Title:	Henniker Town Hall Oil as Primary	Company Name:	S.E.E.D.S.
Project Date:	Thursday, November 2, 2023	Company Rep:	Margaret Dillon
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client City:	Henniker NH 03242	Company E-Mail Address:	[redacted]

Design Data

Building Area:	2,802 sq.ft.	Cooling Load:	54,095 Btuh
People:	20	Heating Load:	95,428 Btuh
Occupancy:	8	Loads Adj. Factor:	0.71
		AC On Temp.:	75 °F
Actual City:	Concord AP, New Hampshire		
Weather Ref. City:	Concord, New Hampshire		
Summer Outdoor:	87 °F	Winter Outdoor:	-3 °F
Summer Indoor:	75 °F	Winter Indoor:	70 °F
Cooling Hours:	775	Degree Days:	7,471

Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
Existing Oil As Primary	1	$6,517	$434	$0	$6,951	$579
Existing Oil As Primary	1	$5,808	$434	$0	$6,243	$520
Existing Oil As Primary	1	$5,080	$434	$0	$5,515	$460

Monthly Costs - System 1 - Existing Oil As Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$1,059.05	100.0%	$1,059.05
February	$0.00	0.0%	$897.66	100.0%	$897.66
March	$0.00	0.0%	$835.12	100.0%	$835.12
April	$3.79	0.7%	$540.84	99.3%	$544.63
May	$40.31	11.0%	$325.49	89.0%	$365.80
June	$97.73	37.4%	$163.54	62.6%	$261.27
July	$142.42	62.6%	$85.20	37.4%	$227.62
August	$108.45	41.9%	$150.48	58.1%	$258.93
September	$35.47	11.1%	$283.63	88.9%	$319.10
October	$6.21	1.3%	$483.04	98.7%	$489.25
November	$0.00	0.0%	$679.19	100.0%	$679.19
December	$0.00	0.0%	$1,013.28	100.0%	$1,013.28
Total	$434.39	6.2%	$6,516.51	93.8%	$6,950.90

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,059.05	334.1
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$897.66	283.2
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$835.12	263.4
April	$3.79	29.2	$0.00	0.0	$0.00	0.0	$540.84	170.6
May	$40.31	310.1	$0.00	0.0	$0.00	0.0	$325.49	102.7
June	$97.73	751.8	$0.00	0.0	$0.00	0.0	$163.54	51.6
July	$142.42	1,095.5	$0.00	0.0	$0.00	0.0	$85.20	26.9
August	$108.45	834.2	$0.00	0.0	$0.00	0.0	$150.48	47.5
September	$35.47	272.9	$0.00	0.0	$0.00	0.0	$283.63	89.5
October	$6.21	47.8	$0.00	0.0	$0.00	0.0	$483.04	152.4
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$679.19	214.3
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,013.28	319.6
Total	$434.39	3,341.5	$0.00	0.0	$0.00	0.0	$6,516.51	2,055.7

Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	27,517,924 BTU
Total annual heating load energy:	268,461,408 BTU

Monthly Costs - System 2 - Existing Oil As Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$922.42	100.0%	$922.42
February	$0.00	0.0%	$784.23	100.0%	$784.23
March	$0.00	0.0%	$734.23	100.0%	$734.23
April	$3.79	0.8%	$487.88	99.2%	$491.68
May	$40.31	11.8%	$301.93	88.2%	$342.24
June	$97.73	38.6%	$155.62	61.4%	$253.35
July	$142.42	63.3%	$82.74	36.7%	$225.16
August	$108.45	43.0%	$143.70	57.0%	$252.15
September	$35.47	11.7%	$266.70	88.3%	$302.17
October	$6.21	1.4%	$440.63	98.6%	$446.84
November	$0.00	0.0%	$603.92	100.0%	$603.92
December	$0.00	0.0%	$884.33	100.0%	$884.33
Total	$434.39	7.0%	$5,808.31	93.0%	$6,242.71

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$0.00	0.0	$0.00	0.0	$0.00	0.0	$922.42	291.0
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$784.23	247.4
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$734.23	231.6
April	$3.79	29.2	$0.00	0.0	$0.00	0.0	$487.88	153.9
May	$40.31	310.1	$0.00	0.0	$0.00	0.0	$301.93	95.2
June	$97.73	751.8	$0.00	0.0	$0.00	0.0	$155.62	49.1
July	$142.42	1,095.5	$0.00	0.0	$0.00	0.0	$82.74	26.1
August	$108.45	834.2	$0.00	0.0	$0.00	0.0	$143.69	45.3
September	$35.47	272.9	$0.00	0.0	$0.00	0.0	$266.70	84.1
October	$6.21	47.8	$0.00	0.0	$0.00	0.0	$440.63	139.0
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$603.92	190.5
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$884.33	279.0
Total	$434.39	3,341.5	$0.00	0.0	$0.00	0.0	$5,808.31	1,832.3

Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	27,517,924 BTU
Total annual heating load energy:	209,530,864 BTU

Monthly Costs - System 3 - Existing Oil As Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$791.43	100.0%	$791.43
February	$0.00	0.0%	$674.71	100.0%	$674.71
March	$0.00	0.0%	$635.73	100.0%	$635.73
April	$3.79	0.9%	$431.29	99.1%	$435.08
May	$40.31	12.9%	$272.25	87.1%	$312.56
June	$97.73	40.6%	$142.71	59.4%	$240.44
July	$142.42	65.0%	$76.84	35.0%	$219.26
August	$108.45	45.1%	$132.05	54.9%	$240.50
September	$35.47	12.8%	$242.64	87.2%	$278.11
October	$6.21	1.6%	$392.55	98.4%	$398.76
November	$0.00	0.0%	$527.87	100.0%	$527.87
December	$0.00	0.0%	$760.13	100.0%	$760.13
Total	$434.39	7.9%	$5,080.19	92.1%	$5,514.58

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$0.00	0.0	$0.00	0.0	$0.00	0.0	$791.43	249.7
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$674.71	212.8
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$635.73	200.5
April	$3.79	29.2	$0.00	0.0	$0.00	0.0	$431.29	136.1
May	$40.31	310.1	$0.00	0.0	$0.00	0.0	$272.25	85.9
June	$97.73	751.8	$0.00	0.0	$0.00	0.0	$142.71	45.0
July	$142.42	1,095.5	$0.00	0.0	$0.00	0.0	$76.84	24.2
August	$108.45	834.2	$0.00	0.0	$0.00	0.0	$132.05	41.7
September	$35.47	272.9	$0.00	0.0	$0.00	0.0	$242.64	76.5
October	$6.21	47.8	$0.00	0.0	$0.00	0.0	$392.55	123.8
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$527.87	166.5
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$760.13	239.8
Total	$434.39	3,341.5	$0.00	0.0	$0.00	0.0	$5,080.19	1,602.6

Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	27,517,924 BTU
Total annual heating load energy:	178,036,576 BTU

Henniker Town Hall ASHP AS PRIMARY
Energy Cost Analysis

for

Town Of Henniker

Henniker NH 03242

Elite Software

Energy Audit

Residential and Light Commercial
Energy Analysis

Prepared By:

Margaret Dillon
S.E.E.D.S.

603-532-8979
Wednesday, November 15, 2023

Project Information

Project Title:	Henniker Town Hall ASHP AS PRIMARY	Company Name:	S.E.E.D.S.
Designed By:		Company Rep.:	Margaret Dillon
Project Date:	Thursday, November 2, 2023	Company Address:	
Project Comment:		Company City:	
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client Address:		Company Fax:	
Client City:	Henniker NH 03242	Company Comment:	
Client Phone:			
Client Fax:			
Client Comment:			

Cooling Equipment — System 1

Model Type: Air Source Heat Pump
Model Number:
Capacity: 60,000 Btuh
Efficiency: 18 SEER

Heating Equipment — System 1

Model Type: Air Source Heat Pump
Model Number:
Capacity: 98,400 Btuh
Efficiency: 11 HSPF

System Description: Existing ASHP Primary

Cooling Equipment — System 2

Model Type: Air Source Heat Pump
Model Number:
Capacity: 60,000 Btuh
Efficiency: 18 SEER

Heating Equipment — System 2

Model Type: Air Source Heat Pump
Model Number:
Capacity: 98,400 Btuh
Efficiency: 11 HSPF

System Description: ESM 1-6 ASHP Primary

Cooling Equipment — System 3

Model Type: Air Source Heat Pump
Model Number:
Capacity: 60,000 Btuh
Efficiency: 18 SEER

Heating Equipment — System 3

Model Type: Air Source Heat Pump
Model Number:
Capacity: 98,400 Btuh
Efficiency: 11 HSPF

System Description: ESM 1-7 ASHP Primary

Project Summary

General Project Information

Project Title:	Henniker Town Hall ASHP AS PRIMARY	Company Name:	S.E.E.D.S.
Project Date:	Thursday, November 2, 2023	Company Rep:	Margaret Dillon
Client Name:	Town Of Henniker	Company Phone:	603-532-8979
Client City:	Henniker NH 03242	Company E-Mail Address:	[redacted]

Design Data

Building Area:	2,802 sq.ft.	Cooling Load:	54,095 Btuh
People:	20	Heating Load:	95,428 Btuh
Occupancy:	8	Loads Adj. Factor:	0.98
		AC On Temp.:	75 °F
Actual City:	Concord AP, New Hampshire		
Weather Ref. City:	Concord, New Hampshire		
Summer Outdoor:	87 °F	Winter Outdoor:	-3 °F
Summer Indoor:	75 °F	Winter Indoor:	70 °F
Cooling Hours:	775	Degree Days:	7,471

Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
Existing ASHP Primary	1	$3,782	$186	$0	$3,968	$331
ESM 1-6 ASHP Primary	1	$2,874	$186	$0	$3,060	$255
ESM 1-7 ASHP Primary	1	$2,420	$186	$0	$2,606	$217

Monthly Costs - System 1 - Existing ASHP Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$782.10	100.0%	$782.10
February	$0.00	0.0%	$646.02	100.0%	$646.02
March	$0.00	0.0%	$475.20	100.0%	$475.20
April	$1.62	0.7%	$241.25	99.3%	$242.87
May	$17.26	12.2%	$124.41	87.8%	$141.67
June	$41.85	43.5%	$54.39	56.5%	$96.24
July	$60.99	70.7%	$25.27	29.3%	$86.26
August	$46.44	48.5%	$49.31	51.5%	$95.76
September	$15.19	13.0%	$101.83	87.0%	$117.02
October	$2.66	1.3%	$205.11	98.7%	$207.77
November	$0.00	0.0%	$341.25	100.0%	$341.25
December	$0.00	0.0%	$735.42	100.0%	$735.42
Total	$186.02	4.7%	$3,781.56	95.3%	$3,967.58

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$528.64	4,066.5	$0.00	0.0	$0.00	0.0	$253.46	80.0
February	$408.61	3,143.2	$0.00	0.0	$0.00	0.0	$237.41	74.9
March	$453.80	3,490.8	$0.00	0.0	$0.00	0.0	$21.40	6.8
April	$242.87	1,868.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$141.67	1,089.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$96.24	740.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$86.26	663.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$95.76	736.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$117.02	900.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$207.77	1,598.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$337.12	2,593.2	$0.00	0.0	$0.00	0.0	$4.13	1.3
December	$472.00	3,630.8	$0.00	0.0	$0.00	0.0	$263.42	83.1
Total	$3,187.77	24,521.3	$0.00	0.0	$0.00	0.0	$779.81	246.0

Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	25,757,124 BTU
Total annual heating load energy:	268,461,408 BTU

Monthly Costs - System 2 - ESM 1-6 ASHP Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$581.56	100.0%	$581.56
February	$0.00	0.0%	$487.83	100.0%	$487.83
March	$0.00	0.0%	$359.95	100.0%	$359.95
April	$1.62	0.9%	$188.29	99.1%	$189.92
May	$17.26	15.1%	$97.10	84.9%	$114.36
June	$41.85	49.6%	$42.45	50.4%	$84.30
July	$60.99	75.6%	$19.72	24.4%	$80.71
August	$46.44	54.7%	$38.49	45.3%	$84.93
September	$15.19	16.0%	$79.48	84.0%	$94.67
October	$2.66	1.6%	$160.08	98.4%	$162.75
November	$0.00	0.0%	$263.99	100.0%	$263.99
December	$0.00	0.0%	$555.26	100.0%	$555.26
Total	$186.02	6.1%	$2,874.20	93.9%	$3,060.23

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$444.80	3,421.5	$0.00	0.0	$0.00	0.0	$136.77	43.1
February	$337.23	2,594.0	$0.00	0.0	$0.00	0.0	$150.60	47.5
March	$359.68	2,766.7	$0.00	0.0	$0.00	0.0	$0.28	0.1
April	$189.92	1,460.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$114.36	879.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$84.30	648.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$80.71	620.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$84.93	653.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$94.67	728.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$162.75	1,251.9	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$263.99	2,030.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$388.79	2,990.7	$0.00	0.0	$0.00	0.0	$166.46	52.5
Total	$2,606.12	20,047.1	$0.00	0.0	$0.00	0.0	$454.11	143.3

Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	25,757,124 BTU
Total annual heating load energy:	209,530,864 BTU

Monthly Costs - System 3 - ESM 1-7 ASHP Primary

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$484.37	100.0%	$484.37
February	$0.00	0.0%	$408.46	100.0%	$408.46
March	$0.00	0.0%	$305.70	100.0%	$305.70
April	$1.62	1.0%	$159.99	99.0%	$161.62
May	$17.26	17.3%	$82.50	82.7%	$99.77
June	$41.85	53.7%	$36.07	46.3%	$77.92
July	$60.99	78.4%	$16.76	21.6%	$77.75
August	$46.44	58.7%	$32.70	41.3%	$79.15
September	$15.19	18.4%	$67.53	81.6%	$82.72
October	$2.66	1.9%	$136.02	98.1%	$138.68
November	$0.00	0.0%	$224.31	100.0%	$224.31
December	$0.00	0.0%	$465.62	100.0%	$465.62
Total	$186.02	7.1%	$2,420.04	92.9%	$2,606.07

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$384.08	2,954.4	$0.00	0.0	$0.00	0.0	$100.29	31.6
February	$290.33	2,233.3	$0.00	0.0	$0.00	0.0	$118.14	37.3
March	$305.70	2,351.6	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$161.62	1,243.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$99.77	767.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$77.92	599.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$77.75	598.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$79.15	608.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$82.72	636.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$138.68	1,066.8	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$224.31	1,725.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$334.24	2,571.0	$0.00	0.0	$0.00	0.0	$131.39	41.4
Total	$2,256.26	17,355.8	$0.00	0.0	$0.00	0.0	$349.81	110.3

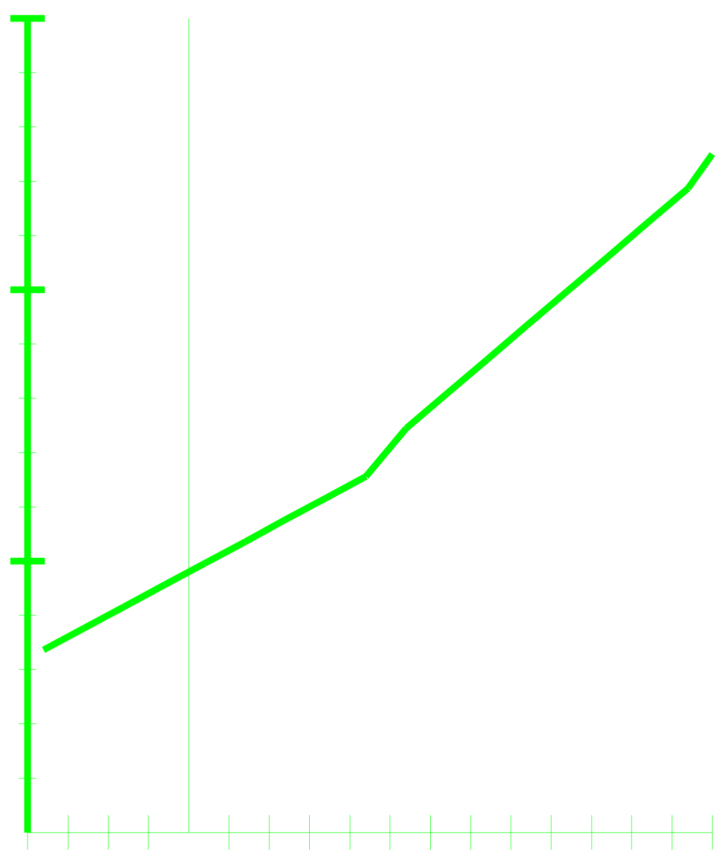
Average Electric Cost Per kWh:	$0.130/kWh
Average Fuel Oil Cost Per Gallon:	$3.170/Gallon
Total annual cooling load energy:	25,757,124 BTU
Total annual heating load energy:	178,036,576 BTU

Bin Analysis Report - System 1 - Existing ASHP Primary

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.98)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	109,179	106,996	0	0.000	106,996	0.00	2.88	2.88
-15 to -10	18	102,976	100,916	0	0.000	100,916	0.00	48.91	48.91
-10 to -5	19	96,772	94,837	0	0.000	94,837	0.00	48.52	48.52
-5 to 0	52	90,569	88,758	0	0.000	88,758	0.00	124.28	124.28
0 to 5	136	84,366	82,678	0	0.000	82,678	0.00	302.78	302.78
5 to 10	154	78,162	76,599	54,000	1.000	22,999	142.36	97.01	239.37
10 to 15	209	71,959	70,520	58,000	1.000	12,920	200.75	83.24	283.99
15 to 20	312	65,756	64,440	62,000	1.000	2,840	310.23	67.01	377.24
20 to 25	385	59,552	58,361	58,361	0.878	0	344.84	0.00	344.84
25 to 30	666	53,349	52,282	52,282	0.696	0	463.95	0.00	463.95
30 to 35	878	47,146	46,203	46,203	0.568	0	500.80	0.00	500.80
35 to 40	650	40,942	40,123	40,123	0.457	0	299.93	0.00	299.93
40 to 45	658	34,739	34,044	34,044	0.362	0	241.12	0.00	241.12
45 to 50	679	28,535	27,965	27,965	0.279	0	192.08	0.00	192.08
50 to 55	619	22,332	21,885	21,885	0.205	0	129.26	0.00	129.26
55 to 60	717	16,129	15,806	15,806	0.140	0	102.32	0.00	102.32
60 to 65	685	9,925	9,727	9,727	0.082	0	57.09	0.00	57.09
Totals:	6,838						$3,001.75	$779.81	$3,781.56

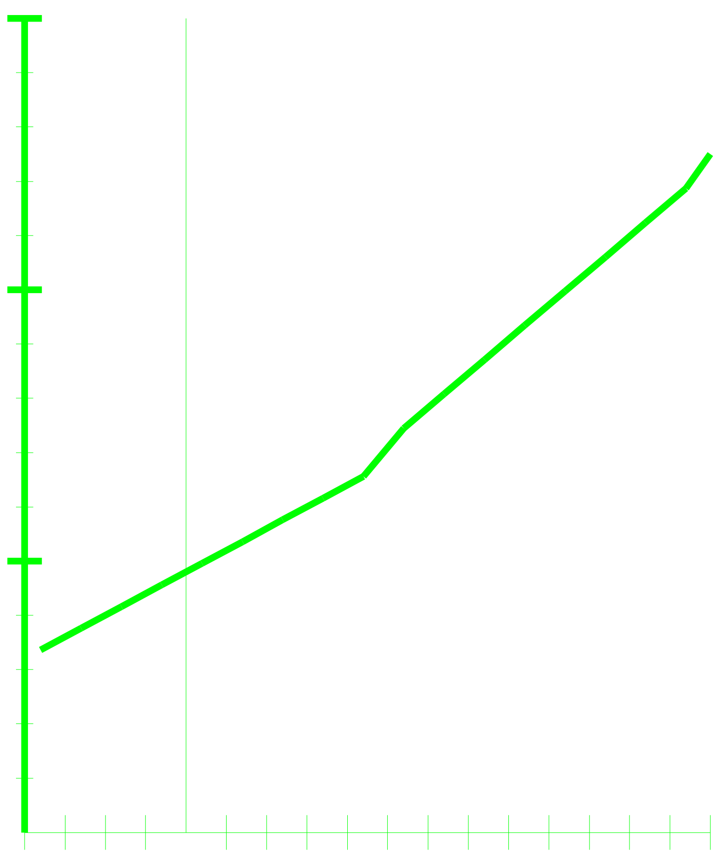
Bin Analysis Report - System 2 - ESM 1-6 ASHP Primary

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.98)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	85,213	83,509	0	0.000	83,509	0.00	2.25	2.25
-15 to -10	18	80,371	78,764	0	0.000	78,764	0.00	38.18	38.18
-10 to -5	19	75,530	74,019	0	0.000	74,019	0.00	37.87	37.87
-5 to 0	52	70,688	69,274	0	0.000	69,274	0.00	97.00	97.00
0 to 5	136	65,846	64,529	0	0.000	64,529	0.00	236.33	236.33
5 to 10	154	61,005	59,785	54,000	1.000	6,185	142.36	41.41	183.77
10 to 15	209	56,163	55,040	55,040	0.949	0	190.50	0.00	190.50
15 to 20	312	51,321	50,295	50,295	0.811	0	251.67	0.00	251.67
20 to 25	385	46,480	45,550	45,550	0.685	0	269.14	0.00	269.14
25 to 30	666	41,638	40,805	40,805	0.543	0	362.11	0.00	362.11
30 to 35	878	36,797	36,061	36,061	0.443	0	390.87	0.00	390.87
35 to 40	650	31,955	31,316	31,316	0.357	0	234.10	0.00	234.10
40 to 45	658	27,113	26,571	26,571	0.283	0	188.19	0.00	188.19
45 to 50	679	22,272	21,826	21,826	0.217	0	149.92	0.00	149.92
50 to 55	619	17,430	17,081	17,081	0.160	0	100.89	0.00	100.89
55 to 60	717	12,588	12,337	12,337	0.109	0	79.86	0.00	79.86
60 to 65	685	7,747	7,592	7,592	0.064	0	44.56	0.00	44.56
Totals:	6,838						$2,420.10	$454.11	$2,874.20



Bin Analysis Report - System 3 - ESM 1-7 ASHP Primary

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.98)	Heat Pump Output Btuh	H. Pump Run Time Fraction	Backup Output Btuh	H.Pump Heating Cost	Backup Heating Cost	Total Heating Cost
-20 to -15	1	72,405	70,957	0	0.000	70,957	0.00	1.91	1.91
-15 to -10	18	68,291	66,925	0	0.000	66,925	0.00	32.44	32.44
-10 to -5	19	64,177	62,893	0	0.000	62,893	0.00	32.18	32.18
-5 to 0	52	60,063	58,862	0	0.000	58,862	0.00	82.43	82.43
0 to 5	136	55,949	54,830	0	0.000	54,830	0.00	200.85	200.85
5 to 10	154	51,835	50,798	50,798	0.941	0	133.92	0.00	133.92
10 to 15	209	47,721	46,767	46,767	0.806	0	161.87	0.00	161.87
15 to 20	312	43,607	42,735	42,735	0.689	0	213.84	0.00	213.84
20 to 25	385	39,493	38,704	38,704	0.582	0	228.69	0.00	228.69
25 to 30	666	35,380	34,672	34,672	0.462	0	307.68	0.00	307.68
30 to 35	878	31,266	30,640	30,640	0.376	0	332.12	0.00	332.12
35 to 40	650	27,152	26,609	26,609	0.303	0	198.91	0.00	198.91
40 to 45	658	23,038	22,577	22,577	0.240	0	159.90	0.00	159.90
45 to 50	679	18,924	18,545	18,545	0.185	0	127.38	0.00	127.38
50 to 55	619	14,810	14,514	14,514	0.136	0	85.72	0.00	85.72
55 to 60	717	10,696	10,482	10,482	0.093	0	67.86	0.00	67.86
60 to 65	685	6,582	6,451	6,451	0.054	0	37.86	0.00	37.86
Totals:	6,838						$2,070.24	$349.81	$2,420.04



SPECIFICATIONS: MXZ-4C36NA3

Cooling[1] (Non-Ducted // Mix // Ducted)	Maximum Capacity	BTU/H	36,400 // 36,400 // 36,400
	Rated Capacity	BTU/H	35,400 // 34,900 // 34,400
	Minimum Capacity	BTU/H	11,700 // 11,500 // 11,300
	Maximum Power Input	W	3,960 // 3,960 // 3,960
	Rated Power Input	W	3,760 // 3,850 // 3,940
	Power Factor (208V, 230V)	%	99.0, 99.0 // 99.0, 99.0 // 99.0, 99.0
Heating at 47°F[2] (Non-Ducted // Mix // Ducted)	Maximum Capacity	BTU/H	43,000 // 43,000 // 43,000
	Rated Capacity	BTU/H	36,000 // 35,200 // 34,400
	Minimum Capacity	BTU/H	18,300 // 18,800 // 19,300
	Maximum Power Input	W	4,020 // 4,020 // 4,020
	Rated Power Input	W	3,020 // 3,060 // 3,100
	Power Factor (208V, 230V)	%	98.7, 98.7 // 98.8, 98.8 // 98.8, 98.8
Heating at 17°F[3] (Non-Ducted // Mix // Ducted)	Maximum Capacity	BTU/H	26,600 // 26,600 // 26,600
	Rated Capacity	BTU/H	22,400 // 22,400 // 22,400
	Maximum Power Input	W	3,440 // 3,490 // 3,540
	Rated Power Input	W	2,300 // 2,470 // 2,640
Heating at 5°F[4] (Non-Ducted // Mix // Ducted)	Maximum Capacity	BTU/H	24,000 // 24,000 // 24,000
	Maximum Power Input	W	3,320 // 3,280 // 3,240
Efficiency (Non-Ducted // Mix // Ducted)	SEER | SEER2		19.2 // 17.6 // 16.0 | 19.20 // 17.60 // 16.00
	EER[1] | EER2[1]		9.41 // 9.07 // 8.73 | 9.40 // 9.05 // 8.70
	HSPF (IV) | HSPF2 (IV)		11.0 // 10.4 // 9.8 | 9.8 // 9.65 // 9.5
	COP at 47°F[2]		3.5 // 3.37 // 3.25
	COP at 17°F at Maximum Capacity[3]		2.27 // 2.24 // 2.2
	COP at 5°F at Maximum Capacity[4]		2.12 // 2.14 // 2.17
	ENERGY STAR® Certified		No // No // No
Electrical	Electrical Power Requirements	Voltage, Phase, Frequency	208/230, 1, 60
	Guaranteed Voltage Range	V AC	187-253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208/230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Short-circuit Current Rating (SCCR)	kA	5
	Recommended Fuse/Breaker Size	A	25
	Recommended Wire Size	AWG	14
	Minimum Circuit Ampacity	A	23.1
	Maximum Overcurrent Protection	A	25
	Fan Motor Full Load Amperage	A	2.43
Outdoor unit	Airflow Rate (Cooling / Heating)	CFM	2,287 / 2,382
	Refrigerant Control		LEV
	Defrost Method		Reverse Cycle
	Heat Exchanger Type		Plate fin coil
	Sound Pressure Level, Cooling[1]	dB(A)	54
	Sound Pressure Level, Heating[2]	dB(A)	56
	Compressor Type		DC INVERTER-driven Twin Rotary
	Compressor Model		SNB220FQGMC
	Compressor Rated Load Amps	A	12
	Compressor Locked Rotor Amps	A	13.7
	Compressor Oil Type // Charge	oz.	FV50S // 23.7
	Base Pan Heater		Optional
	Unit Dimensions	W: In. [mm]	37-13/32 [950]
		D: In. [mm]	13 [330]
		H: In. [mm]	31-11/32 [796]
	Package Dimensions	W: In. [mm]	40-15/16 [1,040]
		D: In. [mm]	17-11/16 [450]
		H: In. [mm]	40-11/16 [1,033]
	Unit Weight	Lbs.[kg]	139 [63]
	Package Weight	Lbs.[kg]	159 [72]
Outdoor unit operating temperature range	Cooling Intake Air Temp (Maximum / Minimum[*A])	°FDB	115 / 14
	Cooling Thermal Lock-out / Re-start Temperatures	°FDB	10.4 / 14
	Heating Intake Air Temp (Maximum / Minimum)	°FWB	65 / 5
	Heating Thermal Lock-out / Re-start Temperatures	°FDB	1.4 / 5
Refrigerant	Charge	Lbs, oz	6.0, 13.0
	Chargeless Piping Length	Ft. [m]	98.0 [30.0]
	Additional Refrigerant Charge Per Additional Piping Length	oz./Ft. [g/m]	0.216 [20]

NOTES:

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
	[3]Heating at 17°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 17 DB, 15 WB
Conditions	[4]Heating at 5°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 5 DB, 4 WB

[*]Applications should be restricted to comfort cooling only; equipment cooling applications are not recommended for low ambient temperature conditions.
[*A] 5°F DB - 115°F DB when optional wind baffles are installed

For actual capacity performance based on indoor unit type and number of indoor units connected, please refer to MXZ Operational Performance.
Although the maximum connectable capacity is 130%, the outdoor unit cannot provide more than 100% of the rated capacity. Please utilize this over capacity capability for load shedding or applications where it is known that all connected units will NOT be operating at the same time.

SPECIFICATIONS: MXZ-4C36NA3

Indoor unit connection	Maximum Number of Connected IDU		4
	Minimum Number of Connected IDU		2
	Minimum connected capacity	BTU/H	12,000
	Maximum connected capacity	BTU/H	42,000
Piping	Liquid Pipe Size O.D. (Flared)	In.[mm]	A,B,C,D: 1/4 [A,B,C,D: 6.35]
	Gas Pipe Size O.D. (Flared)	In.[mm]	A: 1/2; B,C,D: 3/8 [A: 12.72; B,C,D: 9.52]
	Total Piping Length	Ft. [m]	230 [70]
	Maximum Height Difference, ODU above IDU	Ft. [m]	49 [15]
	Maximum Height Difference, ODU below IDU	Ft. [m]	49 [15]
	Farthest Piping Length from ODU to IDU	Ft. [m]	82 [25]
	Maximum Number of Bends for IDU		70

NOTES:

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
	[3]Heating at 17°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 17 DB, 15 WB
Conditions	[4]Heating at 5°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 5 DB, 4 WB

*Applications should be restricted to comfort cooling only; equipment cooling applications are not recommended for low ambient temperature conditions.
*^ 5°F DB - 115°F DB when optional wind baffles are installed

For actual capacity performance based on indoor unit type and number of indoor units connected, please refer to MXZ Operational Performance.
Although the maximum connectable capacity is 130%, the outdoor unit cannot provide more than 100% of the rated capacity. Please utilize this over capacity capability for load shedding or applications where it is known that all connected units will NOT be operating at the same time.

A.9.1 SPECIFICATIONS

A.9.1.1 Inverter Heat Pump

Item			Outdoor model	MXZ-2C20NA2-U1	
			Indoor type	Non-Duct (09+09)	Duct (09+12)
Capacity	Cooling	*1	Btu/h	18,000	20,000
	Heating 47	*1	Btu/h	22,000	22,000
	Heating 17	*2	Btu/h	1,2500	13,500
Power consumption	Cooling	*1	W	1,417	2,000
	Heating 47	*1	W	1,641	1,771
	Heating 17	*2	W	1,300	1,350
EER	Cooling			12.7	10.0
SEER	Cooling			20.0	16.0
HSPF IV(V)	Heating			10.0	9.3
COP	Heating			3.93	3.64
External finish				Munsell 3.0Y 7.8/1.1	
Power supply			V, phase, Hz	208/230, 1, 60	
Max. fuse size (time delay)			A	20	
Min. circuit ampacity			A	17.2	
Fan motor			F.L.A	1.77	
Compressor	Model			SNB140FQUH2T	
	Winding resistance (at 68 ºF)		Ω	U-V1.99 V-W 1.99 W-U 1.99	
			R.L.A	10.7	
			L.R.A	15.5	
Refrigerant control				LEV	
Sound level			dB(A)	50/54	
Defrost method				Reverse cycle	
Dimensions	W		in.	33-1/16	
	D		in.	13	
	H		in.	27-15/16	
Weight			lb.	126	
Remote controller				Wireless type	
Control voltage (by built-in transformer)				12 - 24 VDC	
Refrigerant piping				Not supplied (optional parts)	
Valve size	Liquid		in.	1/4	
	Gas		in.	3/8	
Connection method	Indoor			Flared	
	Outdoor			Flared	
Refrigerant charge (R410A)			lb.	5 lb. 15 oz.	
Refrigeration oil (Model)			fl oz. (L)	20.3 (0.6) (NEO22)	

NOTE: Test conditions are based on ARI 210/240.

Unit: °F

Mode	Test	Indoor air condition		Outdoor air condition	
		Dry bulb	Wet bulb	Dry bulb	Wet bulb
Cooling	*1: "A" Cooling steady state at rated compressor speed	80	67	95	(75)
	"B-2" Cooling steady state at rated compressor speed	80	67	82	(65)
	"B-1" Cooling steady state at minimum compressor speed	80	67	82	(65)
	Low ambient cooling steady state at minimum compressor speed	80	67	67	(53.5)
	Intermediate cooling steady state at intermediate compressor speed	80	67	87	(69)
Heating	*1: Standard rating-heating at rated compressor speed	70	60	47	43
	*2: Low temperature heating at maximum compressor speed	70	60	17	15
	Maximum temperature heating at minimum compressor speed	70	60	62	56.5
	High temperature heating at minimum compressor speed	70	60	47	43
	Frost accumulation at rated compressor speed	70	60	35	33
	Frost accumulation at intermediate compressor speed	70	60	35	33

Item			Outdoor model	MXZ-3C24NA2-U1	
			Indoor type	Non-Duct (06+09+09)	Duct (09+09+09)
Capacity	Cooling	*1	Btu/h	22,000	23,600
	Heating 47	*1	Btu/h	25,000	24,600
	Heating 17	*2	Btu/h	19,600	19,600
Power consumption	Cooling	*1	W	1,620	2,100
	Heating 47	*1	W	1,750	1,900
	Heating 17	*2	W	2,580	2,440
EER	Cooling			13.6	11.2
SEER	Cooling			20.0	16.0
HSPF IV(V)	Heating			9.8 (7.6)	9.2 (7.6)
COP	Heating			4.20	3.80
External finish				Munsell 3.0Y 7.8/1.1	
Power supply			V, phase, Hz	208/230, 1, 60	
Max. fuse size (time delay)			A	25	
Min. circuit ampacity			A	22.1	
Fan motor			F.L.A	2.43	
Compressor	Model			SNB220FQGMC	
	Winding resistance (at 68 ºF)		Ω	U-V 0.95 V-W 0.95 W-U 0.95	
			R.L.A	12	
			L.R.A	13.7	
Refrigerant control				LEV	
Sound level			dB(A)	51/55	
Defrost method				Reverse cycle	
Dimensions	W		in.	37-13/32	
	D		in.	13	
	H		in.	31-11/32	
Weight			lb.	137	
Remote controller				Wireless type	
Control voltage (by built-in transformer)				12-24 VDC	
Refrigerant piping				Not supplied (optional parts)	
Valve size	Liquid		in.	1/4	
	Gas		in.	A:1/2 B,C:3/8	
Connection method	Indoor			Flared	
	Outdoor			Flared	
Refrigerant charge (R410A)			lb.	6lb. 13oz.	
Refrigeration oil (Model)			fl oz. (L)	23.7 (0.7) (FV50S)	

NOTE: Test conditions are based on ARI 210/240.

Unit: °F

Mode	Test	Indoor air condition		Outdoor air condition	
		Dry bulb	Wet bulb	Dry bulb	Wet bulb
Cooling	*1: "A" Cooling steady state at rated compressor speed	80	67	95	(75)
	"B-2" Cooling steady state at rated compressor speed	80	67	82	(65)
	"B-1" Cooling steady state at minimum compressor speed	80	67	82	(65)
	Low ambient cooling steady state at minimum compressor speed	80	67	67	(53.5)
	Intermediate cooling steady state at intermediate compressor speed	80	67	87	(69)
Heating	*1: Standard rating-heating at rated compressor speed	70	60	47	43
	*2: Low temperature heating at maximum compressor speed	70	60	17	15
	Maximum temperature heating at minimum compressor speed	70	60	62	56.5
	High temperature heating at minimum compressor speed	70	60	47	43
	Frost accumulation at rated compressor speed	70	60	35	33
	Frost accumulation at intermediate compressor speed	70	60	35	33

Item		Outdoor model	MXZ-4C36NA2-U1	
		Indoor type	Non-Duct (09+09+09+09)	Duct (09+09+09+09)
Capacity	Cooling *1	Btu/h	35,400	34,400
	Heating 47 *1	Btu/h	36,000	34,400
	Heating 17 *2	Btu/h	26,600	26,600
Power consumption	Cooling *1	W	3,760	3,940
	Heating 47 *1	W	3,020	3,100
	Heating 17 *2	W	3,440	3,540
EER	Cooling		9.4	8.7
SEER	Cooling		19.2	16.0
HSPF IV(V)	Heating		11.0 (8.4)	9.8 (8.4)
COP	Heating		3.50	3.25
External finish			Munsell 3.0Y 7.8/1.1	
Power supply		V, phase, Hz	208/230, 1, 60	
Max. fuse size (time delay)		A	25	
Min. circuit ampacity		A	22.1	
Fan motor		F.L.A	2.43	
Compressor	Model		SNB220FQGMC	
	Winding resistance (at 68 ºF)	Ω	U-V 0.95 V-W 0.95 W-U 0.95	
		R.L.A	12	
		L.R.A	13.7	
Refrigerant control			LEV	
Sound level		dB(A)	54/56	
Defrost method			Reverse cycle	
Dimensions	W	in.	37-13/32	
	D	in.	13	
	H	in.	31-11/32	
Weight		lb.	139	
Remote controller			Wireless type	
Control voltage (by built-in transformer)			12-24 VDC	
Refrigerant piping			Not supplied (optional parts)	
Valve size	Liquid	in.	1/4	
	Gas	in.	A:1/2 B,C,D:3/8	
Connection method	Indoor		Flared	
	Outdoor		Flared	
Refrigerant charge (R410A)		lb.	6lb. 13oz.	
Refrigeration oil (Model)		fl oz. (L)	23.7 (0.7) (FV50S)	

NOTE: Test conditions are based on ARI 210/240.

Unit: °F

Mode	Test	Indoor air condition		Outdoor air condition	
		Dry bulb	Wet bulb	Dry bulb	Wet bulb
Cooling	*1: "A" Cooling steady state at rated compressor speed	80	67	95	(75)
	"B-2" Cooling steady state at rated compressor speed	80	67	82	(65)
	"B-1" Cooling steady state at minimum compressor speed	80	67	82	(65)
	Low ambient cooling steady state at minimum compressor speed	80	67	67	(53.5)
	Intermediate cooling steady state at intermediate compressor speed	80	67	87	(69)
Heating	*1: Standard rating-heating at rated compressor speed	70	60	47	43
	*2: Low temperature heating at maximum compressor speed	70	60	17	15
	Maximum temperature heating at minimum compressor speed	70	60	62	56.5
	High temperature heating at minimum compressor speed	70	60	47	43
	Frost accumulation at rated compressor speed	70	60	35	33
	Frost accumulation at intermediate compressor speed	70	60	35	33

MLZ-KP12NA2
12,000 BTU/H EZ FIT CEILING CASSETTE

MITSUBISHI ELECTRIC HEATING & AIR CONDITIONING

Job Name:
System Reference: Date:

GENERAL FEATURES

- Fits between 16” joists spacing
- Stylish, square design panel
- Built-in condensate lift mechanism (19.6”)
- Serviceable from the bottom (electrical and flare connections)
- Adjustable fan speeds and vane directions
- Washable antibacterial and deodorizing filter
- Multiple control options available:
  - Hand-held Remote Controller (provided with unit)
  - kumo cloud® smart device app for remote access
  - Third-party interface options
  - Wired or wireless controllers
- Pocket inside the access panel for kumo cloud® Wireless Interface

Specifications			System
Unit Type			MLZ-KP12NA2
Cooling Capacity[1, 3]		BTU/H	12,000
Heating Capacity[2, 3]		BTU/H	15,400
Electrical	Voltage, Phase, Frequency		208/230, 1, 60
	Guaranteed Voltage Range	V AC	187- 253V
	Voltage: Indoor - Outdoor, S1-S2	V AC	208/230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Short-circuit Current Rating [SCCR]	kA	5
Indoor Unit	MCA	A	1.0
	Fan Motor Full Load Amperage	A	0.68
	Airflow Rate at Cooling, Dry	CFM	212–272–297–332
	Airflow Rate at Cooling, Wet	CFM	180–219–252–282
	Airflow Rate at Heating, Dry	CFM	212–272–311–350
	Sound Pressure Level [Cooling]	dB[A]	27–32–36–40
	Sound Pressure Level [Heating]	dB[A]	26–32–36–40
	Drain Pipe Size	In. [mm]	1-1/4 [32]
	Condensate Lift Mechanism, Maximum Distance	In. [mm]	19-11/16 [500]
	Coating on Heat Exchanger		—
	External Finish Color		Munsell 4.0GY 9.1/0.2
	Unit Dimensions	W x D x H: In. [mm]	43-3/8 x 14-3/16 x 7-5/16 [1,102 x 360 x 185]
	Package Dimensions	W x D x H: In. [mm]	46-5/16 x 15-3/4 x 11-1/8 [1,177 x 400 x 284]
	Unit Weight	Lbs. [kg]	34 [15.5]
	Package Weight	Lbs. [kg]	41 [19.0]
Refrigerant	Type		R410A
Piping	Gas Pipe Size O.D. [Flared]	In.[mm]	3/8 [9.52]
	Liquid Pipe Size O.D. [Flared]	In.[mm]	1/4 [6.35]

NOTES:

Conditions			
	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB

[3]Capacity varies based on the number of indoor units operating and the model of the Multi-zone Outdoor Unit. For reference to connected capacity charts, please refer Multi-zone Outdoor Unit Operational Performance.:

SPECIFICATIONS: MSZ-GL06NA

Cooling Capacity[1, 3]		BTU/H	6,000
Heating Capacity[2, 3]		BTU/H	7,200
Electrical	Voltage, Phase, Frequency		208/230V, 1 phase, 60Hz
	Guaranteed Voltage Range	V AC	187 - 253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208 / 230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Short-circuit Current Rating (SCCR)		Wireless Type
MCA		A	1
Blower Motor Full Load Amperage		A	0.76
Blower Motor Output		W	30
Airflow Rate at Cooling, Dry		CFM	145-170-237-321-399
Airflow Rate at Cooling, Wet		CFM	109-134-201-286-364
Airflow Rate at Heating, Dry		CFM	145-170-237-321-406
Sound Pressure Level (Cooling)		dB(A)	19-22-30-37-43
Sound Pressure Level (Heating)		dB(A)	19-22-30-37-43
Drain Pipe Size		In. (mm)	5/8 (15.88)
Heat Exchanger Type			Plate fin coil
External Finish Color			Munsell 1.0Y 9.2/0.2
Unit Dimensions		W: In. (mm)	31-7/16 (798)
		D: In. (mm)	9-1/8 (232)
		H: In. (mm)	11-5/8 (295)
Package Dimensions		W: In. (mm)	33-1/2 (850)
		D: In. (mm)	12 (300)
		H: In. (mm)	14 (350)
Unit Weight		Lbs. (kg)	22 (10)
Package Weight		Lbs. (kg)	26 (11.5)
Refrigerant	Type		R410A
Piping	Gas Pipe Size O.D. (Flared)	In. (mm)	3/8 (9.52)
	Liquid Pipe Size O.D. (Flared)	In. (mm)	1/4 (6.35)

Notes:

Nominal Conditions	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
[3]Capacity varies based on the number of indoor units operating and the model of the Multi-zone Outdoor Unit. For reference to connected capacity charts, please refer Multi-zone Outdoor Unit Operational Performance.			

SPECIFICATIONS: MSZ-GL12NA

Cooling Capacity[1, 3]		BTU/H	12,000
Heating Capacity[2, 3]		BTU/H	14,400
Electrical	Voltage, Phase, Frequency		208/230V, 1 phase, 60Hz
	Guaranteed Voltage Range	V AC	187 - 253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208 / 230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Short-circuit Current Rating (SCCR)		5
MCA		A	1
Blower Motor Full Load Amperage		A	0.76
Blower Motor Output		W	30
Airflow Rate at Cooling, Dry		CFM	399-321-237-170-145
Airflow Rate at Cooling, Wet		CFM	364-286-201-134-109
Airflow Rate at Heating, Dry		CFM	406-321-237-170-145
Sound Pressure Level (Cooling)		dB(A)	45-37-30-22-19
Sound Pressure Level (Heating)		dB(A)	43-37-30-22-19
Drain Pipe Size		In. (mm)	5/8 (15.88)
Heat Exchanger Type			Plate fin coil
External Finish Color			Munsell 1.0Y 9.2/0.2
Unit Dimensions		W: In. (mm)	31-7/16 (798)
		D: In. (mm)	9-1/8 (232)
		H: In. (mm)	11-5/8 (295)
Package Dimensions		W: In. (mm)	33-1/2 (850)
		D: In. (mm)	12 (300)
		H: In. (mm)	14 (350)
Unit Weight		Lbs. (kg)	22 (10)
Package Weight		Lbs. (kg)	26 (11.5)
Refrigerant	Type		R410A
Piping	Gas Pipe Size O.D. (Flared)	In. (mm)	3/8 (9.52)
	Liquid Pipe Size O.D. (Flared)	In. (mm)	1/4 (6.35)

Notes:

Nominal Conditions	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
[3]Capacity varies based on the number of indoor units operating and the model of the Multi-zone Outdoor Unit. For reference to connected capacity charts, please refer Multi-zone Outdoor Unit Operational Performance.			

SLZ-KF12NA
12,000 BTU/H 2' X 2' 4-WAY CEILING CASSETTE

MITSUBISHI ELECTRIC
HEATING & AIR CONDITIONING

Job Name:

System Reference: Date:

GENERAL FEATURES

- Ceiling-recessed cassette (24"x24") ductless heat pump
- Install Konnect Series in a drywalled ceiling (with an access panel for servicing) or in a 2'x2' drop ceiling
- Wide airflow pattern for excellent air distribution
- Optional 3D i-see Sensor®
- Fresh air intake provided in the main body
- Built-in drain condensate lift mechanism (lifts to 33")
- Multiple control options available:
  - kumo cloud® smart device app for remote access
  - Third-party interface options
  - Wired or wireless controllers
- Long-life air filter included
- Individual vane control

Specifications			System
Unit Type			SLZ-KF12NA
Cooling Capacity[1, 3]		BTU/H	12,000
Heating Capacity[2, 3]		BTU/H	13,000
Electrical	Voltage, Phase, Frequency		208/230, 1, 60
	Guaranteed Voltage Range	V AC	187- 253V
	Voltage: Indoor - Outdoor, S1-S2	V AC	208/230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Short-circuit Current Rating [SCCR]	kA	5
Indoor Unit	MCA	A	0.3
	Fan Motor Full Load Amperage	A	0.24
	Airflow Rate at Cooling, Dry	CFM	230–265–335
	Airflow Rate at Cooling, Wet	CFM	207–252–302
	Airflow Rate at Heating, Dry	CFM	230–265–335
	Sound Pressure Level [Cooling]	dB[A]	25–30–34
	Sound Pressure Level [Heating]	dB[A]	25–30–34
	Drain Pipe Size	In. [mm]	1-1/4 [32]
	Condensate Lift Mechanism, Maximum Distance	In. [mm]	33 [850]
	Coating on Heat Exchanger		—
	External Finish Color		Munsell 1.0Y 9.2/0.0
	Unit Dimensions	W x D x H: In. [mm]	22-7/16 x 22-7/16 x 9-21/32 [570 x 570 x 245]
	Package Dimensions	W x D x H: In. [mm]	24-13/32 x 27-15/16 x 9-7/16 [620 x 710 x 240]
	Unit Weight	Lbs. [kg]	31 [13.9]
	Package Weight	Lbs. [kg]	37 [17]
Refrigerant	Type		R410A
Piping	Gas Pipe Size O.D. [Flared]	In.[mm]	3/8 [9.52]
	Liquid Pipe Size O.D. [Flared]	In.[mm]	1/4 [6.35]

NOTES:

Conditions	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB

[3]Capacity varies based on the number of indoor units operating and the model of the Multi-zone Outdoor Unit. For reference to connected capacity charts, please refer Multi-zone Outdoor Unit Operational Performance.

M-Series Efficiencies

Outdoor Unit Model	Indoor Unit Model	Configuration	Rated Capacity (Cooling)	Rated Capacity (Heating)	SEER	EER	HSPF	COP @ 47° F	COP @ 17° F
WALL-MOUNTED COOLING ONLY									
MUY-GL09NA-U1	MSY-GL09NA-U1	Mini-Splits	9,000	-	24.60	15.40	-	-	-
MUY-GL12NA-U1	MSY-GL12NA-U1	Mini-Splits	12,000	-	23.10	13.00	-	-	-
MUY-GL15NA-U1	MSY-GL15NA-U1	Mini-Splits	14,000	-	21.60	13.00	-	-	-
MUY-GL18NA-U1	MSY-GL18NA-U1	Mini-Splits	18,000	-	20.50	13.40	-	-	-
MUY-GL24NA-U1	MSY-GL24NA-U1	Mini-Splits	22,500	-	20.50	12.50	-	-	-
MUY-GE09NA	MSY-GE09NA-8	Mini-Splits	9,000	-	21.0	13.6	-	-	-
MUY-GE12NA	MSY-GE12NA-8	Mini-Splits	12,000	-	20.5	12.5	-	-	-
MUY-GE15NA-1	MSY-GE15NA-8	Mini-Splits	14,000	-	21.0	13.0	-	-	-
MUY-GE18NA-1	MSY-GE18NA-8	Mini-Splits	17,200	-	19.2	10.5	-	-	-
MUY-GE24NA	MSY-GE24NA	Mini-Splits	22,400	-	19.0	12.5	-	-	-
MUY-GE09NA2	MSY-GE09NA-9	Mini-Splits	9,000	-	23.2	13.6	-	-	-
MUY-GE12NA2	MSY-GE12NA-9	Mini-Splits	12,000	-	22.7	12.5	-	-	-
MUY-GE15NA2	MSY-GE15NA-9	Mini-Splits	14,000	-	21.6	13.0	-	-	-
MUY-D30NA	MSY-D30NA	Mini-Splits	30,600	-	16.0	9.1	-	-	-
MUY-D36NA	MSY-D36NA	Mini-Splits	34,600	-	15.1	8.2	-	-	-
WALL-MOUNTED HEAT PUMP									
MUZ-FE09NA	MSZ-FE09NA	Mini-Splits	9,000	10,900	15.5	26.0	10.0	4.50	3.02
MUZ-FE12NA1	MSZ-FE12NA	Mini-Splits	12,000	13,600	12.9	23.0	10.5	4.20	3.01
MUZ-FE18NA	MSZ-FE18NA	Mini-Splits	18,000	21,600	14.2	20.2	10.3	4.11	2.77
MUZ-FH06NA	MSZ-FH06NA	Mini-Splits	6,000	8,700	33.1	19.0	13.5	4.68	3.46
MUZ-FH09NA	MSZ-FH09NA	Mini-Splits	9,000	10,900	30.5	16.1	13.5	4.50	3.33
MUZ-FH09NA	MSZ-FH09NA-1	Mini-Splits	9,000	10,900	30.5	16.1	13.5	4.50	3.33
MUZ-FH12NA	MSZ-FH12NA	Mini-Splits	12,000	13,600	26.1	13.8	12.5	4.20	3.34
MUZ-FH12NA	MSZ-FH12NA-1	Mini-Splits	12,000	13,600	26.1	13.8	12.5	4.20	3.34
MUZ-FH15NA	MSZ-FH15NA	Mini-Splits	15,000	18,000	22.0	12.5	12.0	4.06	3.19
MUZ-FH18NA	MSZ-FH18NA	Mini-Splits	17,200	20,300	21.0	12.0	12.0	3.46	3.04
MUZ-FH18NA2	MSZ-FH18NA2	Mini-Splits	17,200	20,300	21.0	12.5	12.0	3.46	3.04
MSZ-GL09NA-U1	MUZ-GL09NA-U8	Mini-Splits	9,000	10,900	24.6	15.4	12.8	4.44	3.3
MUZ-GL12NA-U1	MSZ-GL12NA-U1	Mini-Splits	12,000	14,400	23.10	13.0	12.50	3.84	3.13
MUZ-GL15NA-U1	MSZ-GL15NA-U1	Mini-Splits	14,000	18,000	21.60	13.0	11.70	3.30	3.00
MUZ-GL18NA-U1	MSZ-GL18NA-U1	Mini-Splits	18,000	21,600	20.50	13.4	11.20	3.77	2.73
MUZ-GL24NA-U1	MSZ-GL24NA-U1	Mini-Splits	22,400	27,600	20.50	12.5	10.00	3.46	2.65
MUZ-GE09NA	MSZ-GE09NA-8	Mini-Splits	9,000	10,900	21.0	13.6	10.0	4.20	2.76
MUZ-GE12NA	MSZ-GE12NA-8	Mini-Splits	12,000	14,400	20.5	12.5	10.0	3.61	2.87
MUZ-GE15NA-1	MSZ-GE15NA-8	Mini-Splits	14,000	18,000	21.0	13.0	10.0	3.30	2.88
MUZ-GE18NA-1	MSZ-GE18NA-8	Mini-Splits	17,200	21,600	19.2	10.5	10.0	3.33	2.71
MUZ-GE24NA	MSZ-GE24NA	Mini-Splits	22,500	27,600	19.0	12.5	10.0	3.46	2.64
MUZ-GE09NA-2	MSZ-GE09NA-8	Mini-Splits	9,000	10,900	23.2	13.6	11.0	4.20	2.76
MUZ-GE12NA-2	MSZ-GE12NA-8	Mini-Splits	12,000	14,400	22.7	12.5	11.4	3.61	2.87
MUZ-GE15NA-2	MSZ-GE15NA-8	Mini-Splits	14,000	18,000	21.6	13.0	11.2	3.30	2.88
MUZ-HM09NA2***	MSZ-HM09NA***	Mini-Splits	9,000	10,900	18.00	12.0	8.50	3.55	2.80
MUZ-HM12NA2***	MSZ-HM12NA***	Mini-Splits	12,000	12,200	18.00	9.9	8.50	3.61	2.78
MUZ-HM15NA2***	MSZ-HM15NA***	Mini-Splits	14,000	18,000	18.00	12.0	8.50	3.30	2.55
MUZ-HM18NA2***	MSZ-HM18NA***	Mini-Splits	17,200	18,000	18.00	10.5	8.50	3.32	2.59
MUZ-HM24NA2***	MSZ-HM24NA***	Mini-Splits	22,400	26,000	18.00	8.6	8.50	3.05	2.36
MUZ-HE09NA	MSZ-HE09NA	Mini-Splits	9,000	10,900	18.0	12.0	8.5	3.55	2.76
MUZ-HE12NA	MSZ-HE12NA	Mini-Splits	12,000	12,200	18.0	9.9	8.5	3.61	2.87
MUZ-HE15NA	MSZ-HE15NA	Mini-Splits	14,000	18,000	18.0	12.0	8.5	3.30	2.81
MUZ-HE18NA	MSZ-HE18NA	Mini-Splits	17,200	18,000	18.0	10.5	8.5	3.32	2.71
MUZ-HE24NA	MSZ-HE24NA	Mini-Splits	22,500	26,600	18.0	8.6	8.5	3.45	2.64
MUZ-D30NA-1	MSZ-D30NA-8	Mini-Splits	30,600	32,600	14.5	8.0	8.2	2.84	2.33
MUZ-D36NA-1	MSZ-D36NA-8	Mini-Splits	33,200	35,200	14.5	7.6	8.2	2.69	2.23
FLOOR-MOUNTED HEAT PUMP									
MUFZ-KJ09NAHZ	MFZ-KJ09NA	Mini-Splits	9,000	11,000	28.20	15.80	13.00	4.30	2.71
MUFZ-KJ12NAHZ	MFZ-KJ12NA	Mini-Splits	12,000	13,000	25.50	13.60	12.00	4.20	2.77
MUFZ-KJ15NAHZ	MFZ-KJ15NA	Mini-Splits	15,000	18,000	21.80	13.50	11.60	3.70	2.71
MUFZ-KJ18NAHZ	MFZ-KJ18NA	Mini-Splits	17,000	21,000	21.00	12.60	11.30	3.50	2.62

SEZ HORIZONTAL-DUCTED HEAT PUMP SYSTEMS									
SUZ-KA09NA	SEZ-KD09NA4	Ducted	8,100	10,900	15.0	12.0	10.0	3.13	2.14
SUZ-KA12NA	SEZ-KD12NA4	Ducted	11,500	13,600	16.0	12.5	10.0	3.50	2.43
SUZ-KA15NA	SEZ-KD15NA4	Ducted	14,100	18,000	15.5	12.0	10.0	3.52	2.43
SUZ-KA18NA	SEZ-KD18NA4	Ducted	17,200	21,600	17.5	12.5	10.0	3.72	2.40
SLZ CEILING-RECESSED HEAT PUMP SYSTEMS									
SUZ-KA09NA	SLZ-KA09NA	Mini-Splits	8,400	10,900	15.0	12.0	9.6	3.44	2.46
SUZ-KA12NA	SLZ-KA12NA	Mini-Splits	11,100	13,600	15.4	12.0	9.6	3.38	2.62
SUZ-KA15NA	SLZ-KA15NA	Mini-Splits	15,000	18,000	16.0	10.2	9.6	2.70	2.38

AHRI CERTIFIED™ www.ahridirectory.org Unitary Small AC AHRI Standard 210/240 Certification applies only when the complete system is listed with AHRI.

AHRI CERTIFIED™ www.ahridirectory.org Unitary Small HP AHRI Standard 210/240 Certification applies only when the complete system is listed with AHRI.

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FORM# MXZ Multi-Zone Efficiencies - 201602Ver2

PUBLIC HEARING

TOWN OF HENNIKER, NEW HAMPSHIRE

PUBLIC HEARING

Place: Henniker Community Center 57 Main Street

Henniker, NH 03242

Tuesday, December 5, 2023

6:30 PM

Public Hearing

The Town of Henniker will hold a public hearing during the regularly scheduled Selectboard meeting on December 5, 2023, at 6:30pm at the Henniker Community Center, 57 Main Street under the provisions of RSA 31:95-b, II-IV to accept and appropriate unanticipated one-time State of New Hampshire HB 2 (SB 270) Highway Block Grant funding in the amount of $46,960.09 for immediate infrastructure improvements.

Diane Kendall

From: [redacted] on behalf of Katherine Heck
<[redacted]
Sent: Monday, November 6, 2023 3:35 PM
To: [redacted]
Subject: [NHGFOA] IMPORTANT State -Aid Update

IMPORTANT State Aid Update
HB 2 (SB 270)
Updated November 6, 2023

Certain provisions in Chapter 79 **(HB 2, Sections 520 and 521)** provides $20 million is one-time property tax relief through additional direct payments to cities and towns for immediate infrastructure improvements: an additional and $10 million in municipal highway block grants and $10 million for the repair and maintenance of municipally-owned bridges. This FAQ explains how this state aid will impact the local budget.

When can a municipality expect to receive these funds? The additional one-time lump-sum payment of highway block grant aid is expected to be disbursed by mid-November. The additional one-time lump-sum payment of bridge aid is expected to be disbursed in Late November – early December timeframe.

How can a municipality accept and expend these funds? The bill allows both categories of funds to be considered "unanticipated revenue." Therefore, a municipality may accept and expend the funds under the provisions of **RSA 31:95-b, II-IV**, whether or not a municipality has adopted that statute. For unanticipated money in the amount of $10,000 or more, RSA 31:95-b requires the governing body to hold a public hearing on the action to be taken, with notice of the time, place and subject of the hearing published at least seven days before the hearing is held. For unanticipated money less than $10,000, the governing body must post notice of the funds in the agenda and include notice in the minutes of the public meeting at which the money is discussed.

How much should my municipality expect to receive? The additional appropriations contained in **HB 2 (SB270)**, while less than the amount of **SB 401** from last session ($36 million), still represent a significant state investment in local infrastructure. Assuming all variables remain the same, your municipality would receive approximately 33 percent of the prior year's one-time funding for Class IV and V roads and 27 percent of the one-time bridge payment received last year.

What is the municipal distribution formula for roads and bridges? Every municipality with a municipally-owned bridge will receive a share of the $10 million allocated for the repair, maintenance, and construction in addition to any state or federal funds committed or available for bridge projects. No local match is required.

- ***Highway Block Grants.*** The $10 million allocated for roads will follow the Department of Transportation "Apportionment A" formula used when calculating the annual highway block grant each municipality receives. Therefore, funds will be distributed among the municipalities based on their population in proportion to the entire state's population and the other half is disbursed based on a municipality's Class IV and V road mileage in proportion to the total statewide Class IV and V mileage.

- ***Municipally-Owned Bridge Allocation.*** The appropriation for bridges will be based on a similar 50/50 formula, where $5 million will be distributed based on a municipality's deck area proportional to the total deck area for municipally-owned bridges, and $5 million will be distribution based on a municipality's total share of the state population.

- **What can this money be used for? HB 2** will provide funding with restricted uses, meaning that it may be used to supplement (not supplant) local budgets; The "supplement not supplant" provision requires that these funds must add to (supplement) and not replace (supplant) local budgeted funds when providing services that repair, maintain, and construct municipal bridges (bridge -aid); repair and maintain class IV and V roads or acquire the equipment necessary to maintain Class IV and V roads (additional highway block grant)including advancing sidewalk construction adjacent to a Class V Road.
    - RSA 32:7, IV, provides that money from a state grant for a specific purpose is non-lapsing;
    - The amount of additional grant will ***not*** be reported as "Highway Block Grant Revenue" on the municipalities 2023 MS-434 Report of Revised Estimated Revenue;
    - As dedicated state grant funds with a specific purpose outlined in the law, the additional funds will not become part of the unassigned fund balance;
    - Cities and towns are encouraged to inquire of their accountant or auditing firm to determine the appropriate fund where the money will be placed until obligated and expended: and,
    - It is not recommended these funds be placed in a Capital Reserve Fund. That action requires the vote of the legislative body, and the road and bridge funds are already restricted in their eligible use and may not be redesigned.

NHMA will continue to provide updated information and guidance on HB 2 as it becomes available to us.

Questions?

Please contact NHMA at 603.224.7447 or [redacted]

Respectfully,
Katherine

Katherine Heck
Government Finance Advisor
NH Municipal Association
25 Triangle Park Drive
Concord, NH 03301
Tel: (603) 224-7447
Email: [redacted]
Federal Funding and Resources

NHMA's 82nd Annual Conference and Exhibition

Zap the Gap: How to Make Peace and Work Effectively in a Multigenerational World
NHMA's 82nd Annual Conference and Exhibition
November 15 & 16, 2023
DoubleTree by Hilton Manchester Downtown Hotel, Manchester, NH

NEW BUSINESS

CONTINUED BUSINESS

PAST MEETING MINUTES

DRAFT

Disclaimer – The following are Draft Minutes, which could include errors and are subject to change upon approval of the Select Board.

Town of Henniker
Board of Selectmen Meeting
Tuesday November 21, 2023 6:15 PM
Henniker Community Center

Members Present:	Chairman Kris Blomback, Selectman Neal Martin, Selectman Jeff Morse, Selectman Scott Osgood
Member's Excused:	Vice-Chairman Bill Marko
Town Administrator:	Diane Kendall
Recording Secretary:	Hank Bernstein
Guests:	See attached Sign-In Sheet

CALL TO ORDER/PLEDGE OF ALLEGIANCE

Chairman Kris Blomback opened the meeting with recitation of the Pledge of Allegiance and called the meeting to order at 6:15pm.

ANNOUNCEMENTS

Item #1 - The Henniker Community Center has been listed in the New Hampshire State Register of Historic Places by the Division of Historical Resources, Department of Natural and Cultural Resources, on October 30, 2023.

The Board congratulated the Henniker Historical Society for acquiring this distinction.

CONSENT AGENDA

Item #2 - Chairman Blomback motioned to approve the Consent Agenda November 21, 2023, seconded by Selectman Martin. The motion passed, unanimously.

PUBLIC COMMENT #1

AJ Heinrich, of Snowshoe Rd, shared that the Perambulators will be putting their work on hold until the spring.

NEW BUSINESS

Item #3 - Fire Department EMPG Grant

TA Kendall gave background and introduced Joe Walsh. Mr. Walsh is the project leader on acquiring funding to replace the existing generator at the Emergency Operations Center. Henniker's EOC is the Fire/Rescue Department. Mr. Walsh is interested in applying for an Emergency Management Performance Grant that has a $50,000 in kind match. To meet this match Mr. Walsh suggests replacing the bay doors and keypad locks. Discussion ensued. **Selectman Martin moved to authorize the Town apply for EMPG funding and approve the Town Administrator as the authorized representative; Selectman Morse seconded. Motion carried unanimously.**

Item #4 - Request to close Transfer Station at noon on Christmas eve

Christmas Eve falls on a Sunday and is not listed as a Holiday. The Transfer Station employees requested to close early that day. Discussion ensued. Selectman Martin suggested closing at 1 PM and making it a half day.

TA Kendall believes they will be responsive to that. **Selectman Martin moved to close the Transfer Station at 1 PM on December 24th, 2023; Selectman Morse seconded. Motion carried unanimously.**

CONTINUED BUSINESS:

Item #5 - Fund Balance Policy – 3rd Reading

TA Kendall gave background. This is the third reading of the recommended policy for fund balance use and stabilization. At the last meeting the Board changed the retention range to between six and ten percent. That change has been made. **Chairman Blomback moved to approve Policy III. 13 Financial Fund Balance Policy, seconded by Selectman Osgood. Motion carried unanimously.**

Item #6 - Wastewater Warrant Article

The Town applied for funding for the Wastewater upgrades at the 2022 Town Meeting. Due to the lapse in time and reprioritization the town is seeking supplemental funding. The NH Clean Water State Revolving Fund is offering a bond of $1,500,000 with $425,000 principal forgiveness. Discussion ensued. **Chairman Blomback moved to support the 2024 special warrant article for the issuance of $1,500,000 in bonds for the purpose of supplemental upgrades to the wastewater treatment facility with the understanding that $425,000 will be in principal forgiveness from the state revolving fund loan and further authorize the TA to find out the details and have wording vetted by town council and authorize the TA to sign on behalf of the board; Selectman Martin seconded. Motion carried unanimously.**

Item #7 - 2024 Budget

Chairman Blomback noted that this item will be on the agenda going forward until budgets are finalized.

a) Request by CASA of New Hampshire to appropriate $500 to Henniker's vulnerable children.

Court Appointed Special Advocates sent a letter requesting a $500 contribution. Discussion ensued. Selectman Martin requested information on the number of Henniker children this funding will support. No action taken at this time.

PAST MEETING MINUTES

Item #8 - Acceptance of Board of Selectmen public meeting minutes November 7, 2023, 5:45 PM

Selectman Osgood moved to approve these minutes, seconded by Selectman Morse. Motion carried unanimously.

Item #9 - Acceptance of Board of Selectmen non-public meeting minutes November 7, 2023, 5:45 PM

Chairman Blomback moved to approve these minutes, seconded by Selectman Osgood. Motion carried unanimously.

COMMUNICATIONS

Item #10 - Town Administrator Reprot

TA Kendall reported on:

- Budgets
- Highway Block Grant
- Transfer Station Thanksgiving Closure
- The Communication Tower
- Fire Pond
- Solar Project

Item #11 - Correspondence

No remarks from the Board

Item #12 - Department Reports

No remarks from the board

Item #13 - Selectmen Reports

Chairman Blomback reported on the Police Facility Assessment Committee.
Selectman Martin reported on the joint meeting with the Budget Advisory Committee.
Selectman Morse reported on the Road Management Committee.
Selectman Osgood had nothing to report.

PUBLIC COMMENT #2:

AJ Heinrich, of Snowshoe Rd, asked if the bond for Wastewater upgrades has funds designated for staffing. Mr. Heinrich expressed concern that without sufficient staffing in that department the equipment will not be properly cared for, and the current staff is already overworked.

ADJOURMENT

Chairman Blomback moved to adjourn at 7:05 PM, seconded by Selectman Martin. Motion carried unanimously.

Respectfully submitted,

Hank Bernstein
Minute Taker

Minutes Approved:

Meeting: BOARD OF SELECTMEN

Date: November 21, 2023

PLEASE PRINT

Name	Address
AJ HEINRICH	133 Snowshoe Rd
Joe Walsh	179 Washington Heights Rd.

DRAFT

Disclaimer – The following are Draft Minutes, which could include errors and are subject to change upon approval of the Select Board.

Town of Henniker
Board of Selectmen Joint Meeting with Budget Advisory Committee
Saturday, November 18th 2023, 8:30 AM
Henniker Community Center

Members Present: *Board of Selectmen:* Chairman Kris Blomback, Vice-Chairman Bill Marko, Selectman Neal Martin, Selectman Jeff Morse, Selectman Scott Osgood
Budget Advisory Committee: Chairwoman Lori Marko, Vice-Chairwoman Heidi Aucoin, Jarrod Gleason, Luke Reynard

Member's Excused:
Town Administrator: Diane Kendall
Finance Director: Sherry Bradstreet
Recording Secretary: Hank Bernstein
Guests: See attached Sign-In Sheet

CALL TO ORDER/PLEDGE OF ALLEGIANCE

Chairman Kris Blomback opened the meeting with recitation of the Pledge of Allegiance and called the meeting to order at 8:30am.

FIRE/RESCUE/EMERGENCY MANAGEMENT

Rescue Chief Greg Aucoin presented the Fire, Rescue, and Emergency Management Budgets. He discussed the importance of supporting the employees and noted that was the most crucial part of the budget.

WASTEWATER

Wastewater Superintendent Rich Slager presented the Wastewater Budget. He discussed the ongoing equipment repairs needed at the plant. The Board asked Supt. Slager to follow up with the water supply issues and investigate sludge disposal.

TUCKER FREE LIBRARY

Fran Tain and Lynn Piotrowicz presented the Tucker Free Library Budget. Discussion ensued. The Board requested an in-depth breakdown of the budget, showing more detail on revenues, wages, and trust funds. The Board also requested information on the trusts showing how the Town can and cannot expend them.

COMMUNITY CONCERTS

Concert Committee Chairwoman Ruth Zax presented the Community Concert Budget. She shared that the committee would like to add another concert the week of Labor Day. Discussion ensued.

TOWN CLERK/ELECTIONS/TAX COLLECTOR

Town Clerk / Tax Collector Debbie Aucoin presented the budgets for Town Clerk, Elections, and Tax Collector. She noted an increase in wages in anticipation of the four elections scheduled for 2024. TC/TX Aucoin also shared that the ballot machine will need to be replaced in 2024 and the potential for the ability pay tax bills online in 2024.

POLICE DEPARTMENT/ANIMAL CONTROL

Police Chief Matt French presented the Police Department Budget. He shared that they still short a full time employee but are hopeful to find another candidate.

WELFARE

Welfare Director Carol Conforti-Adams presented the Welfare Budget. She noted rent has increased but wages have not, creating more instances of people requesting rent assistance. Ms. Conforti-Adams shared that she focuses on case work and providing resources for those in need.

HIGHWAY/STREETS/LIGHTS

Highway Superintendent Leo Aucoin presented the budgets for Highway, Streets, and Lights. He noted that repairs are very expensive. Supt. Aucoin shared that he is interested in painting lines on the main roads in Town.

TRANSFER STATION/GOVERNMENT BUILDING/PARKS AND PROPERTY

Transfer Station Manager Marc Boisvert and Transfer Station Assistant Manager Matt Bumford presented the budgets for Transfer Station, Government Buildings, and Parks and Property. Previously these budgets were all combined under the Transfer Station but have been separated for the sake of transparency.

ATHLETICS

Chris Woodbury of the Athletics Budget. They kept the budget flat to last year's budget.

CEMETERY

Tim McComish, of the Cemetery Trustees, presented the Cemetery Budget. His biggest concern was three trees in the Plummer Cemetery and the extensive work it will take to remove them. Discussion ensued.

CONSERVATION

Mark Mitch, Cochair of the Conservation Commission presented the Conservation Budget. He also informed the Board of ongoing projects of the Conservation Commission.

EXECUTIVE

TA Kendall presented the Executive Budget. She discussed Cost of Living Adjustments and possible changes to the health insurance plan.

FINANCE

TA Kendall presented the Finance Budget. She explained the computer licensing and maintenance that was split out into other budgets.

TAX MAPS AND ASSESSING

TA Kendall presented the Tax Maps and Assessing Budgets. She discussed the contract with Avitar Associates and the letter they sent out about their cyclical data verification.

LEGAL

TA Kendall presented the Legal Budget. She shared that this portion is difficult to budget for, especially with ongoing litigation with Eversource.

CYBER SECRUITY

TA Kendall presented the Cyber Security Budget. She spoke highly of the service provided by Mirador IT, Henniker's contracted IT support company.

BUILDING INSPECTOR/CODE ENFORCEMENT

TA Kendall presented the Building Inspector/ Code Enforcement Budget. She shared that revenue received from permits exceeded the cost of this budget in 2023.

HEALTH OFFICER

TA Kendall presented the Health Officer Budget. Chief Aucoin fills this role in addition to his other duties.

INSURANCE

TA Kendall presented the Insurance Budget. This covers items like Workers' Comp, General Liability, and Unemployment Insurance.

ANIMAL CONTROL

TA Kendall shared that there is currently nobody in the role of Animal Control.

PATRIOTIC PURPOSES

Fire Chief Jim Morse presented this budget at the Board of Selectman meeting of November 3.

CAP PROGRAM

TA Kendall presented the Cap Program Budget.

WHITE BIRCH

White Birch Executive Director Marc McMurphy presented this budget at the Board of Selectman meeting of November 3.

MUNICIPAL DUES

TA Kendall presented the Municipal Dues Budget.

DEBT SERVICE

FD Bradstreet presented the Debt Service Budget.

PLANNING AND ZONING

TA Kendall presented the Planning and Zoning Budget. This budget is dependent on applications.

COMMUNITY ORGANIZATIONS

TA Kendall presented the Community Organizations Budget.

TA Kendall noted that the Budget Hearing will take place on February 6th, and that budgets should be finalized on January 30th.

ADJOURNMENT

Selectman Marko moved to adjourn at 3:08 PM, seconded by Selectman Martin. Motion carried unanimously.

Respectfully submitted,

Hank Bernstein
Minute Taker

Minutes Approved:

Meeting: **BOARD OF SELECTMEN & BUDGET ADVISORY COMMITTEE JOINT MEETING**

Date: **November 18, 2023**

PLEASE PRINT

Name	Address
Sherry Bradstreet	Finance Dept
Chaz Freeman	Wastewater
Rich Slager	Wastewater
Lynn Piotrowicz	Tucker Free
Joe Petrick	↓
Fran Tain	↓
Anne Crotti	↓
Deb Kreutzer	↓
Ruth Zax	247 Hall Ave
Lt. Michelle Dandeneau +ofc. Frankie Ramsdell	Henniker Police
Chief Matthew Freese	HPD
Chris Woodbury	Athletics
Tim McComish	Cem.

TOWN ADMINISTRATOR REPORT

CORRESPONDENCE

COUNTY OF MERRIMACK

333 DANIEL WEBSTER HIGHWAY, SUITE 2
BOSCAWEN, NEW HAMPSHIRE 03303-2415
(603) 796-6800 FAX: (603) 796-6840
www.merrimackcounty.net

COMMISSIONERS

TARA REARDON, Chair, Concord
STUART D. TRACHY, Vice Chair, Franklin
DAVID M. LOVLIEN JR., Clerk, Pembroke

COUNTY ADMINISTRATOR
ROSS L. CUNNINGHAM

November 27th, 2023

TO: Members of the Merrimack County Delegation
Chair, Merrimack County Select Boards
Honorable James Bouley, Mayor City of Concord
Honorable David M. Scanlan, Secretary of State
Honorable Jo Brown, Mayor City of Franklin

Dear Ladies and Gentlemen,

In compliance with NH RSA 24:21-a, we are providing you with a copy of the proposed Merrimack County budget for calendar year 2024.

The proposed $102,592,397 budget includes a 9.0% increase in tax revenue, a $4,254,825 increase. Our average increase from 2020 to the 2023 budget was only 0.67%.The 2024 budget reflects an overall increase of general fund expenses of 8.75%, or $8,220,612, above the 2023 budget. The 2024 budget utilizes $4,226,285 of fund balance to balance.

Nursing Home revenue is projected to increase by $4,788,085 and our alternative care reimbursement and the Department of Corrections revenues are decreasing by $942,000 in aggregate. Health insurance rates have increased by roughly 7.72% for a $539,959 increase. Combined Alternative Care and Nursing Home Care costs are expected to increase by $367,787, 2.32%. Overall, personnel costs are set to increase by 3.97% or $1,513,022 & attributable benefits by 2.61% or $466,604.

The 2024 budget does not include any reimbursed portions of grant funding, a change from prior years. We are still spending down our American Rescue Plan Act (ARPA) monies. The largest projects in process are updates and repairs to our Waste Water Treatment Plant as well as an investment into a solar array.

We look forward to working with you at upcoming budget subcommittee meetings and throughout the new fiscal year to pass a responsible budget to meet the needs of Merrimack County.

Respectfully submitted,

Tara Reardon, Chair

Stuart D. Trachy, Vice Chair

David M. Lovlien Jr., Clerk

New Hampshire
Department of
Revenue Administration

2024
MS-46

Proposed Budget and Estimate of Revenue
Merrimack County

For the period beginning January 1, 2024 and ending December 31, 2024

Form Due Date: **September 1**

County commissioners should use this form to prepare the county budget for delivery to each member of the county convention who will be in office on the date of the appropriation vote and to the chairman of the board of selectmen or the mayor for each city/town within the county, and to the Secretary of State as required by RSA 24:21-a. The completed form must be submitted to the Department of Revenue Administration by September 1 per RSA 21-J:34.

GOVERNING BODY CERTIFICATION

Under penalties of perjury, I declare that I have examined the information contained in this form and to the best of my belief it is true, correct and complete.

Name	Position	Signature
Tara Reardon	Commissioner	
Stuart D. Trachy	Commissioner	
David M. Lovlien	Commissioner	

This form must be signed, scanned, and uploaded to the Municipal Tax Rate Setting Portal:
https://www.proptax.org/

For assistance please contact:
NH DRA Municipal and Property Division
(603) 230-5090
http://www.revenue.nh.gov/mun-prop/

New Hampshire
Department of
Revenue Administration

2024
MS-46

Appropriations

Account	Purpose	Article	Actual Expenditures for period ending 12/31/2023	Appropriations Approved by DRA for period ending 12/31/2023	Proposed Budget for period ending 12/31/2024
General Government					
4110	County Convention Costs	2024 Budget	$5,355	$9,800	$9,800
4120	Judicial		$0	$0	$0
4122	Jury Costs		$0	$0	$0
4123	County Attorney's Office	2024 Budget	$3,086,764	$4,094,608	$4,512,619
4124	Victim Witness Advocacy Program		$98,044	$120,244	$0
4130	Executive	2024 Budget	$1,025,848	$1,327,311	$1,510,101
4150	Financial Administration	2024 Budget	$1,565,814	$2,033,101	$2,258,396
4151	Treasurer		$0	$0	$0
4153	Other Legal Costs		$0	$0	$0
4155	Personnel Administration	2024 Budget	$434,248	$787,022	$581,494
4191	Planning and Zoning (Unincorp. Places)		$0	$0	$0
4192	Medical Examiner	2024 Budget	$43,748	$50,000	$50,000
4193	Register of Deeds	2024 Budget	$551,910	$722,841	$758,617
4194	Maintenance of Government Buildings	2024 Budget	$2,889,291	$4,023,670	$3,954,765
4196	Insurance Not Otherwise Allocated	2024 Budget	$193,590	$193,590	$210,118
4198	Contingency	2024 Budget	$0	$50,000	$50,000
4199	Other General Government	2024 Budget	$6,520,637	$7,494,763	$25,000
	General Government Subtotal		**$16,415,249**	**$20,906,950**	**$13,920,910**
Public Safety & Corrections					
4211	Sheriff's Department	2024 Budget	$2,017,631	$2,639,343	$2,745,692
4212	Custody of Prisoners	2024 Budget	$743,517	$986,867	$1,181,483
4214	Sheriff's Support Services	2024 Budget	$799,237	$1,034,648	$1,256,764
4219	Other Public Safety		$58,273	$117,361	$0
4230	Corrections	2024 Budget	$11,521,531	$15,707,096	$15,878,108
4235	Adult Probation and Parole	2024 Budget	$853,628	$1,201,308	$1,217,447
	Public Safety & Corrections Subtotal		**$15,993,817**	**$21,686,623**	**$22,279,494**

Appropriations

Account	Purpose	Article	Actual Expenditures for period ending 12/31/2023	Appropriations Approved by DRA for period ending 12/31/2023	Proposed Budget for period ending 12/31/2024
County Farm					
4301	Administration		$0	$0	$0
4302	Operating Expenditures		$0	$0	$0
4309	Other County Farm		$0	$0	$0
	County Farm Subtotal		**$0**	**$0**	**$0**
County Nursing Home					
4411	Administration	2024 Budget	$4,521,814	$5,728,533	$5,929,042
4412	Operating Expense	2024 Budget	$26,080,589	$29,230,098	$35,136,173
4439	Other Health	2024 Budget	$14,255,432	$17,250,311	$17,781,043
	County Nursing Home Subtotal		**$44,857,835**	**$52,208,942**	**$58,846,258**
Human Services					
4441	Administration	2024 Budget	$746,881	$1,205,170	$1,255,698
4442	Direct Assistance		$0	$0	$0
4443	Board and Care of Children		$0	$0	$0
4447	Special Outside Services	2024 Budget	$177,581	$398,166	$248,000
4449	Other Human Services		$544,194	$705,807	$0
	Human Services Subtotal		**$1,468,656**	**$2,309,143**	**$1,503,698**
Cooperative Extension Services					
4611	Administration	2024 Budget	$373,705	$448,070	$459,271
4619	Other Conservation	2024 Budget	$54,710	$54,710	$59,700
	Cooperative Extension Services Subtotal		**$428,415**	**$502,780**	**$518,971**
Economic Development					
4651	Administration		$0	$0	$0
4652	Economic Development		$0	$0	$0
4659	Other Economic Development		$0	$0	$0
	Economic Development Subtotal		**$0**	**$0**	**$0**

Appropriations

Account	Purpose	Article	Actual Expenditures for period ending 12/31/2023	Appropriations Approved by DRA for period ending 12/31/2023	Proposed Budget for period ending 12/31/2024
Debt Service					
4711	Principal - Long Term Bonds, Notes, and Other Debt	2024 Budget	$1,880,000	$3,630,000	$3,325,000
4721	Interest - Long Term Bonds, Notes, and Other Debt	2024 Budget	$999,698	$1,087,448	$936,348
4723	Interest on Tax and Revenue Anticipation Notes	2024 Budget	$237,813	$250,000	$675,000
4750	Fiscal Agents' Fees		$0	$0	$0
4760	Bond Issuance Costs		$0	$0	$0
4790	Other Debt Service Charges		$0	$0	$0
	Debt Service Subtotal		**$3,117,511**	**$4,967,448**	**$4,936,348**
Intergovernmental Transfers					
4800	Intergovernmental Transfers		$552,443	$1	$0
	Intergovernmental Transfers Subtotal		**$552,443**	**$1**	**$0**
Capital Outlay					
4901	Land and Improvements		$0	$0	$0
4902	Machinery, Vehicles, and Equipment	2024 Budget	$238,319	$179,083	$86,718
4903	Buildings		$37,659	$0	$0
4904	Improvements other than Buildings		$0	$0	$0
	Capital Outlay Subtotal		**$275,978**	**$179,083**	**$86,718**
Depreciation Expense					
4905	Depreciation		$0	$0	$0
4906	Amortization		$0	$0	$0
	Depreciation Expense Subtotal		**$0**	**$0**	**$0**
Interfund Operating Transfers					
4911	Transfers to General Fund		$0	$0	$0
4912	Transfers to Special Revenue Fund		$0	$0	$0
4913	Transfers to Capital Projects Fund		$0	$0	$0
4914	Transfers to Proprietary Fund		$0	$0	$0
4915	Transfers to Capital Reserve Fund	2024 Budget	$0	$300,993	$500,000
4916	Transfers to Trust and Fiduciary Funds		$0	$0	$0
	Interfund Operating Transfers Subtotal		**$0**	**$300,993**	**$500,000**
	Total Appropriations		**$83,109,904**	**$103,061,963**	**$102,592,397**

Revenues

Account	Source	Article	Actual Revenues for period ending 12/31/2023	Estimated Revenues for period ending 12/31/2023	Estimated Revenues for period ending 12/31/2024
Assessments/Taxes					
3110	Property Taxes (Unincorp. Places)		$47,275,835	$0	$0
3111	Municipal Assessment		$0	$0	$0
3120	Land Use Change Taxes (Unincorp. Places)		$0	$0	$0
3180	Resident Taxes (Unincorp. Places)		$0	$0	$0
3185	Yield Taxes (Unincorp. Places)		$0	$0	$0
3186	Payment in Lieu of Taxes (Unincorp. Places)		$0	$0	$0
3187	Payment in Lieu of Taxes		$0	$0	$0
3189	Other Taxes		$0	$0	$0
3190	Interest and Penalties on Delinquent Taxes (Uninco		$0	$0	$0
3191	Penalties on Delinquent Municipal Assessments		$0	$0	$0
3200	Licenses, Permits, and Fees		$0	$0	$0
	Assessments/Taxes Subtotal		**$47,275,835**	**$0**	**$0**
Licenses, Permits, and Fees					
3220	Motor Vehicle Fees (Unincorp. Places)		$0	$0	$0
3230	Building Permits (Unincorp. Places)		$0	$0	$0
3290	Other Licenses, Permits, and Fees		$0	$0	$0
	Licenses, Permits, and Fees Subtotal		**$0**	**$0**	**$0**
From the Federal Government					
3319	Federal Grants and Reimbursements		$5,794,221	$8,156,469	$0
	From the Federal Government Subtotal		**$5,794,221**	**$8,156,469**	**$0**
From the State of New Hampshire					
3351	Shared Revenue - Block Grant (Unincorp. Places)		$0	$0	$0
3352	Incentive Funds		$0	$0	$0
3354	Water Pollution Grants	2024 Budget	$0	$7,830	$7,491
3355	Housing and Community Development		$550,544	$1	$0
3356	State/Federal Forest Land Reimbursements (Unincorp		$0	$0	$0
3359	Other State Grants and Reimbursements	2024 Budget	$1,870,959	$904,000	$200,000
	From the State of New Hampshire Subtotal		**$2,421,503**	**$911,831**	**$207,491**
Revenue from Other Governments					
3379	Intergovernmental Revenues - Other		$0	$0	$0
	Revenue from Other Governments Subtotal		**$0**	**$0**	**$0**

Revenues

Account	Source	Article	Actual Revenues for period ending 12/31/2023	Estimated Revenues for period ending 12/31/2023	Estimated Revenues for period ending 12/31/2024
Charges for Services					
3401	Sheriff's Department	2024 Budget	$1,287,981	$1,289,437	$1,578,348
3402	Register of Deeds	2024 Budget	$1,048,220	$1,545,500	$1,545,500
3403	County Corrections	2024 Budget	$931,939	$1,800,000	$1,483,000
3404	County Nursing Homes	2024 Budget	$26,674,438	$34,103,031	$38,891,116
3405	County Farm		$0	$0	$0
3406	Cooperative Extension Service	2024 Budget	$33,456	$44,608	$45,724
3407	Maintenance Department	2024 Budget	$70,649	$111,097	$99,923
3409	Other Charges	2024 Budget	$1,066,815	$1,267,495	$1,605,069
	Charges for Services Subtotal		**$31,113,498**	**$40,161,168**	**$45,248,680**
Miscellaneous Sources					
3501	Sale of County Property		$0	$0	$0
3502	Interest on Investments	2024 Budget	$660,598	$250,000	$628,563
3503	Rents of Property		$0	$0	$0
3504	Fines and Forfeits		$0	$0	$0
3505	Escheats	2024 Budget	$44,228	$250,000	$45,000
3506	Insurance Dividends and Reimbursements		$0	$0	$0
3508	Contributions and Donations	2024 Budget	$13,040	$14,000	$14,000
3509	Other Miscellaneous Sources	2024 Budget	$475,974	$30,000	$380,000
	Miscellaneous Sources Subtotal		**$1,193,840**	**$544,000**	**$1,067,563**
Other Financial Sources					
3911	Transfers from General Fund		$0	$0	$0
3912	Transfers from Special Revenue Fund		$0	$0	$0
3913	Transfers from Capital Projects Fund		$0	$0	$0
3915	Transfers from Capital Reserve Fund	2024 Budget	$0	$514,083	$311,718
3916	Transfers from Trust and Fiduciary Funds		$0	$0	$0
3934	Proceeds from Long-Term Bonds/Notes		$0	$0	$0
9999	Fund Balance to Reduce Taxes	2024 Budget	$0	$0	$4,226,285
	Other Financial Sources Subtotal		**$0**	**$514,083**	**$4,538,003**
	Total Estimated Revenues and Credits		**$87,798,897**	**$50,287,551**	**$51,061,737**

Budget Summary

Item	Period ending 12/31/2024

Revenues

Total Proposed Appropriations	$102,592,397
(Less) Total Estimated Revenues & Credits	$51,061,737
Estimated Amount of Taxes to be Raised	**$51,530,660**

COUNTY OF MERRIMACK

333 DANIEL WEBSTER HIGHWAY, SUITE 2
BOSCAWEN, NEW HAMPSHIRE 03303-2415
(603) 796-6800 FAX: (603) 796-6840
www.merrimackcounty.net

COMMISSIONERS

TARA REARDON, Chair, Concord
STUART D. TRACHY, Vice Chair, Franklin
DAVID M. LOVLIEN JR., Clerk, Pembroke

COUNTY ADMINISTRATOR
ROSS L. CUNNINGHAM

November 16, 2023

PUBLIC NOTICE

MERRIMACK COUNTY DELEGATION

Pursuant to RSA 24:23, there will be a Public Hearing for Merrimack County before the County Delegation at 10:00 a.m. on **Friday, December 8, 2023** at the Old Courthouse, 2nd floor conference room, 163 North Main Street, Concord, New Hampshire.

The purpose of the meeting is as follows:

1. Presentation of the Commissioners Proposed 2024 Budget.

2. To consider any other business that may appropriately come before them.

At this time, any member of the public may present oral or written testimony regarding the 2024 budget estimates as proposed by the Merrimack County Board of Commissioners.

Pursuant to RSA 24:9-a, there will be a meeting for Merrimack County before the County Delegation immediately following the public hearing at 10:00 a.m. on **Friday, December 8, 2023** at the Old Courthouse, 2nd floor conference room, 163 North Main Street, Concord, New Hampshire

The purpose of the meeting is as follows:

1. Presentation of the Commissioners proposed 2024 budget.

2. Resolution to authorize continuation of county expenditures.

3. To consider any other business that may appropriately come before them.

Rep. Dianne Schuett, Chair
Merrimack County Delegation

Please be advised that these meetings are recorded for documentation purposes.

Special accomodations for individuals with a disability are available upon request (Americans with Disabilities Act of 1990).

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COUNTY ADMINISTRATOR
ROSS L. CUNNINGHAM

November 16, 2023

PUBLIC NOTICE

MERRIMACK COUNTY DELEGATION

EXECUTIVE COMMITTEE

There will be a meeting of the Merrimack County Executive Committee immediately following the 10:00 a.m. Public Hearing and Merrimack County Delegation meetings on Friday, December 8, 2023 at the Old Courthouse, 2nd floor conference room, 163 North Main Street, Concord, New Hampshire.

The purpose of the meeting is as follows:

1. Authorize tax anticipation borrowing for 2024.

2. Any other Business.

Rep. James MacKay, Chairman
Rep. Michael Moffett, Clerk
Merrimack County Executive Committee

Please be advised that these meetings are recorded for documentation purposes.

Special accommodations for individuals with a disability are available upon request (Americans with Disabilities Act of 1990).

NONPUBLIC #2