Energy Audit

Funded by

December 7, 2021

Newport Town Offices
15 Sunapee Street
Newport, NH

Audit Prepared by

BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE
S.E.E.D.S.
SUSTAINABLE ENERGY EDUCATION DEMONSTRATION SERVICES
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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, lighting and equipment upgrades.

The purpose of an energy audit is to identify ESM in a building. Computer simulated and other energy models were developed for this project using multiple strategies and software. The models estimate predicted future 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. The cost of those measures can then be analyzed in terms of predicted energy saved. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures. In many cases, as in this one, improving the thermal envelope is expected to yield 'non energy saving' benefits, such as improving occupant comfort, building durability, and reducing the size of any future HVAC equipment.

This audit has been prepared with the best of intentions to assist the Town of Newport make informed decisions regarding energy improvements while also helping Eversource determine if the ESM warrant financial incentives. 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 building known as the Newport Town Offices is a three story brick building built in 1903. It was constructed as a School and the ten current offices are largely located in former classrooms. A back entrance enters the full basement which has a repair shop, a staff break room, three file storage rooms and all mechanical services.

This report has explored several envelope improvement opportunities to reduce heating energy usage. These are summarized on the next page and explored further on pages 12-16.

The original single pane windows rattle in the wind and are a source of heat loss and discomfort as well as some pose a safety risk. The Town is in the process of selecting window replacement proposals. Replacing windows is typically excluded from 'cost effective' energy upgrades due to the high installation cost for relatively minor energy savings. Since the Town is planning to replace the windows, this study includes estimated energy savings as well as recommendations for their installation.

An alternative, more cost effective option, is to install air tight, interior glazing panels. Several companies make these interior panels as repairing historic windows has been becoming a popular option. The cost to buy the 86 window units is estimated to be $28,604. They can be installed 'in house' and are removable. If properly air sealed, the energy savings could be similar, though the labor involved in installation and removal would likely be considerable. Operability of the original windows would remain an issue. Under normal times, Eversource might have been able offer incentives for this more cost effective ESM. However, as incentives may not be available in 2022 and the Town has already decided to replace the windows with new units, this Study has focused the analysis on that approach.

ESM #1 involves weatherstripping all exterior doors, sealing around window AC units (or removing them if converting to ASHP), air sealing the 3rd floor ceiling plane and adding R50 insulation in and above the attic floor.

ESM #2 refers to installing new windows as proposed. Pages13 and 14 show why additional steps to assure optimal energy savings—and avoid disappointment with the considerable investment.

ESM #3 studied insulating the walls on the interior with a vapor open R10 insulation and new finished surface. Although the measure would dramatically reduce energy use and heating & cooling loads, the dollar cost cannot be justified at this time to be included in the recommendations.

Energy Savings Analysis

The chart below summarizes four ESM in terms of estimated installed costs and predicted energy savings in kWh and MMBTU, as well as the annual reduction of CO2 emissions from completing those measures. The lower chart summarizes the savings in terms of dollars for supply and delivery, based on the current averaged price of $.22 per kWh which includes KW demand charges, though the latter is hard to predict.

Once the windows are replaced, as already planned by the Town, the walls become even more glaringly thermally deficient, so insulating them on the interior was analyzed for energy savings.

#	ESM	Cost of Measure	Site Energy Saved MMBTU	Source Energy Saved MMBTU	Reduced CO2 Emissions	Electric kWh Saved	Oil Gallons Saved	Life of Measure
1	Air Sealing & Ceiling	$15,638	81.1	95.1	7.0	765	567	25
2	New Windows	$135,000	227.0	243.4	20.1	6164	1487	25
	ESM 1&2	**$150,638**	**308.1**	**338.5**	**27.1**	**6929**	**2054**	**25**
3	Insulate Walls	$194,920	147.3	229.8	12.5	503	1053	25
	ESM 1-3	$345,558	455.7	504.7	39.6	7432	3107	25

As discussed elsewhere, installing new windows is rarely considered a cost effective measure. Not because they don't save energy and improve comfort, but because of the high installation costs. The cost below is estimated only, based on the materials only proposal of $64,581 from Mathew Brother's. Though an unimpressive return on investment, there are other reasons to replace old windows, including operability and lead removal. In this case, new windows will also have a marked impact on reducing heating and cooling loads, thereby reducing the cost to install air source heat pumps. By converting to heat pumps for summer cooling, the air leaky (and potentially dangerous) window units can be removed in favor of considerably more efficient heat pumps technology.

Insulating the brick walls will also save energy and improve comfort dramatically. Again, costs are estimated but probably on the low side. Even so, at today's energy prices, the ESM cannot be recommended at this time.

Following the two ESM, installing ductless multi split heat pumps, with indoor units serving each department, the conversion could be expected to save on the order of $10,388 a year. Savings will depend on the efficiency and capacity of the units selected. Costs are not known. Relying on the boiler for only approximately 150 hours of the coldest winter temps, converting to heat pumps will reduce source energy 115 MMBTU/ year, 48 tons of CO2 emissions, and provide the opportunity for clean, renewable energy.

Converting the oil boiler to a pellet fired boiler for future back up is recommended.

#	ESM	Cost of Measure	Annual Savings	Simple Payback Years	Life of Measure	Investment Gain	ROI	Annual ROI
1	Air Sealing & Ceiling	$15,638	$1,869	8.4	25	$19,787	126.5%	3.3%
2	New Windows	$135,000	$5,817	23.2	25	$11,750	8.7%	0.3%
	ESM 1&2	**$150,638**	**$7,686**	**19.6**	**25**	**$31,537**	**20.9%**	**0.8%**
3	Insulate Walls	$194,920	$3,270	59.6	25	-$113.70	-58.1%	-3.4%
	ESM 1-3	$345,558	$10,956	31.5	25	-$71,658	-20.7%	-0.9%

Heading & Cooling Load Reductions

ESM which improve the envelope reduce energy use and annual energy costs, but also reduce the peak heating and cooling loads or demands on the building. The lower the peak loads (at the near coldest outdoor winter temperature and hottest summer days) the lower the capacity of heating and cooling equipment. Heat pump capacity is sized by a cooling ton, or 12,000 Btu/Hr.

The Town Offices are heating load dominant now, and will be after improvements have been made. That means it takes more energy to heat in the winter than cool in the summer.

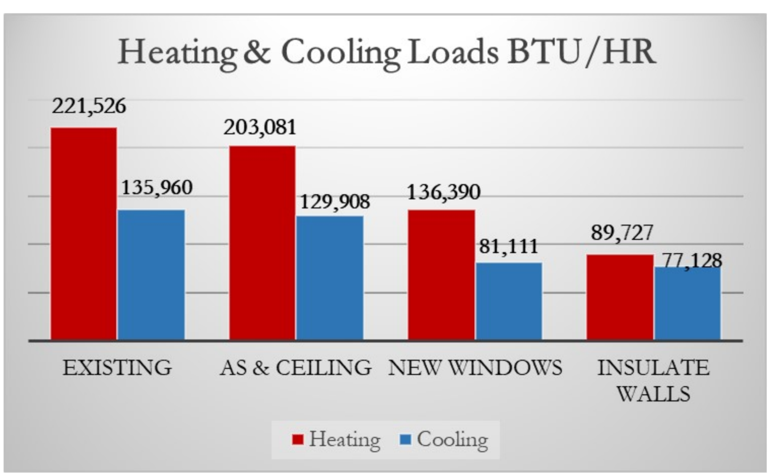
Heat pumps can be 'sized' to handle heating loads down to 30 degrees outside air temperature (OAT) or lower—even down to –15 degrees with today's technology without relying as much on a back up source of heat. There is typically a 'sweet spot' based on installed costs and the back up source. Further engineering design services are recommended to select appropriate equipment, but the loads below can serve as a guide.

Summary reports for the heating and cooling load calculations are included at the end of this report. Loads have been calculated for department areas for optimal temperature control and efficiency.

Also included is an Energy Analysis Summary report. The last page of that report includes a temperature bin analysis based on 30 year average outdoor air temperatures for Concord, NH. This is especially useful for sizing heat pump capacities because—depending on the equipment selected—the capacity and efficiency is reduced at lower outdoor air temperatures.

In the example used for this analysis, 10 tons of heat pump (120,000 Btu), after ESM 1 and ESM 2 have been implemented, would be expected to satisfy heating down to 5 degrees without back up. That would leave about 226 hours in the winter with OAT below 5 degrees where back up heating would be necessary.

The existing boiler could serve those hours, or to supplement as necessary. Baseboard heating does help warm the uninsulated brick walls, where as relying on heat pumps to deliver warm air may create a comfort issue—not from the windows as much as from body heat radiating to cold wall surfaces. That is one reason to consider the suggestion of converting to a properly sized, and more efficient, pellet boiler or even district heating plant to serve all three buildings.



A Case for District Pellet Heating Plant

The annual fuel oil consumed by the Town Offices could not be compared to actual consumption because three buildings share fuel tanks. The fuel purchased for 2020/2021 to heat The Offices. Fire Station, and the Opera House, was 22,336 gallons. Apparently, the two other buildings heat via steam. By estimating floor areas, building types, and the efficiency of steam heat, the model's predicted Office usage of 5569 gallons appears reasonable assuming that the Fire Station could need 6,000 gallons and the Opera House 10,000 gallons.

Each building deserves its own analysis, but considering the shift away from burning fossil fuels, it might be worth exploring converting to a biomass (pellets) district heating (or back up) plant biomass with existing distribution systems. Heat pumps have their advantages, but cold climate heating

Energy Source	Total Fuel Purchased	Equivalent MMBTU	Current Price per Unit	Fuel price per MMBTU	Fuel Cost per MMBTU	Annual Heating Cost
Oil Gallons	22336	3094	$3.00	$27.04	$83,649	$67,008
Pellet Tons	187.5	3094	$255	$19.81	$61,287	$47,809

Heating Energy Costs

The chart below shows the cost of heating per million Btu (MMBTU) based on Btu content of a unit of the variety of energy sources and the efficiency of the delivery system. At current price of $3.00/gallon, the cost of #2 heating oil in the existing boiler is $29.29 per MMBTU. At $255 per ton of pellets, in a modern pellet boiler, the cost per delivered MMBTU is $19.81. Pellets are somewhat tied to the cost of petroleum but have remained relatively stable over the years and at an estimated 75% reduction of greenhouse gas emissions, converting to pellets may be worth considering. (Some argue burning biomass is carbon neutral, but it depends on if trees are replanted and even then, there's at least 15-20 year gap before sequestration happens—decades we don't have).

The cost of delivered heating energy of various electric heating systems, for both space heating and domestic hot water is most relevant for this study. The calculations are based on kWh and heat content of each kWh. Electric costs would be higher for customers who pay for KW Demand.

Note that heating with electric resistance baseboards is the most expensive way to heat a building, but heating with ground source heat pumps (GSHP aka geothermal) is the most efficient and the least expensive. However, GSHP costs more to install be far. Air source heat pumps (ASHP) has a lower cost per million BTU than any of the fossil fuels and is considerably less expensive to install than GSHP.

Considering the cooling loads for the Offices and the air leakage around the window mounted units, converting to ductless multi split ASHP makes sense. It also offers the opportunity to offset energy usage through solar PV generation.

That said, replacing the oil boiler with a smaller, properly sized pellet boiler in the future as back up, using the existing baseboard, is also a reasonable strategy.

Fuel Type	Fuel Unit	Fuel Price Per Unit (dollars)	Fuel Heat Content Per Unit (Btu)	Fuel Price Per Million Btu (dollars)	Heating Appliance Type	Type of Efficiency Rating	Approx. Efficiency (%)	Fuel Cost Per Million Btu (dollars)
Propane	gallons	$3.00	91,333	$27.37	HE Condensing Boiler	AFUE	93%	$35.32
Oil	gallon	$3.00	138,690	$19.83	boiler	AFUE	80%	$29.29
Pellets	Ton	$255	16,500,000	$15.45	Space Heater	EPA	78%	$19.81
Electricity	kWh	0.170	3,412	$49.82	Electric Resistance	COP 1	99.9%	$52.81
				domestic Hot water	Electric Resistance Water Heater	Energy Factor (EF)	.90	$57.34
				domestic Hot water	Hot Water Heat Pump - in unconditioned space	EF (varies)	2.30	$22.94
				domestic Hot water	Hot Water Heat Pump - in conditioned space	EF (up to)	3.70	$14.26
				Space heating	VRF ASHP (average)	COP 2.3	230%	$22.94
				Space heating	GSHP (aka geothermal)	COP 3.8	400%	$13.19

Historic Energy Usage

The energy analysis below is based on the data provided from November 2020 through October 2021 for electric and the results of the energy model for heating oil. Oil is delivered to tanks which serve three buildings, so there is no historic record of actual heating oil consumed at the Town Offices.

Energy	Units	Site Energy BTU	Source Energy BTU	Cost	CO2 Tons
Electric kWh	46480	158,589,760	528,059,280	$13,016	20.7
Oil Gallons	4998	692,223,000	761,445,300	$14,994	58.4
Totals		850,812,760	1,289,504,580	$28,010	79.0
EUI KBtu/Ft2	9443	90.1	136.6	$2.97	

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 total raw energy the building requires .

Based on the information provided, the building's EUI is 90.1 KBtu/ft2; Source Energy EUI is 136.6 KBtu/FT2 with energy costs at $2.97per sq ft in 2021 energy rates.

Month	KW Demand	kWh Consumed	Delivery $	Supply $	Monthly Total
November	18.4	3400	$427.94	$266.90	$694.84
December	18.6	3160	$429.31	$248.06	$677.37
January	9.9	2200	$241.22	$172.70	$413.92
February	5.2	2280	$160.39	$178.98	$339.37
March	18.3	2440	$434.42	$191.54	$625.96
April	19.4	3280	$492.51	$257.48	$749.99
May	23.7	4120	$615.87	$659.20	$1,275.07
June	24.1	5680	$690.22	$1,079.20	$1,769.42
July	26.5	5680	$735.78	$1,079.20	$1,814.98
August	26.2	6280	$731.59	$1,193.20	$1,924.79
September	26	4760	$669.38	$904.40	$1,573.78
October	23	3200	$548.63	$608.00	$1,156.63
Totals	n/a	**46480**	**$6,177.26**	**$6,838.86**	**$13,016.12**

Electric usage is highest in the summer months, most likely due to summer cooling. Based on a monthly base load of 2200 kWh and the results of the energy model, an estimated 17,600 kWh are consumed for cooling, at an estimated cost of $3,778.

As a non-residential customer, the offices are is also charged for KW demand, which also varies each month.

Summer Cooling	kWh
April	1,080
May	1,920
June	3,480
July	3,480
August	4,080
September	2,560
October	1,000
	17,600

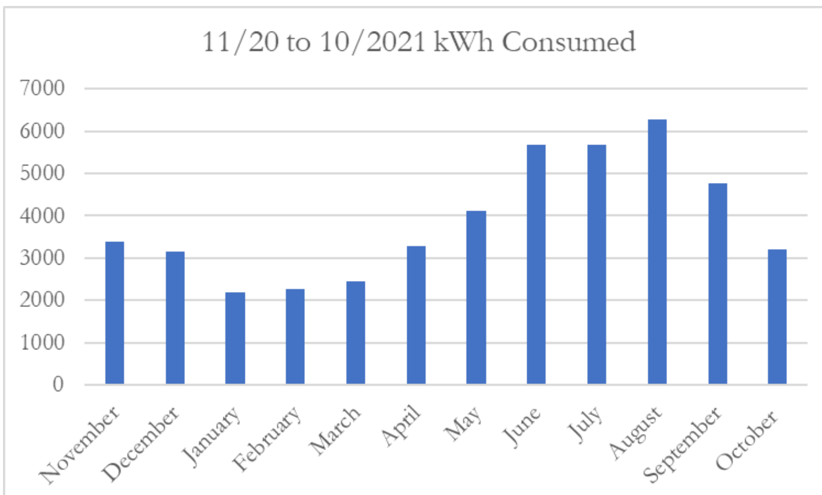
Monthly kWh Pattern and KW Demand

The KW Demand is determined each month by the peak call for power during any 30 minute window within a billing cycle. Demand Charges accounted for an estimated 16% of the annual cost for electricity. This is based on $11.69 per KW over the first 5.0KW each month. The charge is based on another customer as the Town's charge is not available.

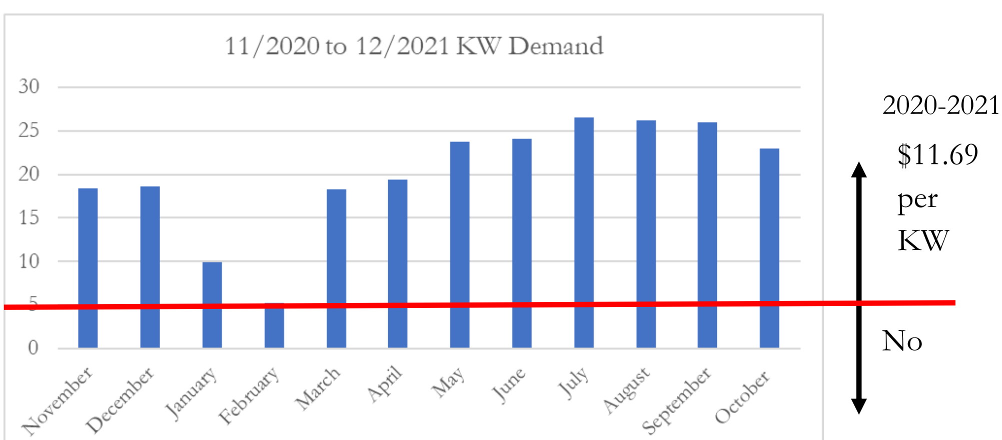
Reducing electric usage saves energy and monthly costs in both the supply side (actual electricity used) and the delivery side (the very real transmission costs of delivering kWh to the meter, maintaining lines, etc).

Lowering that 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]

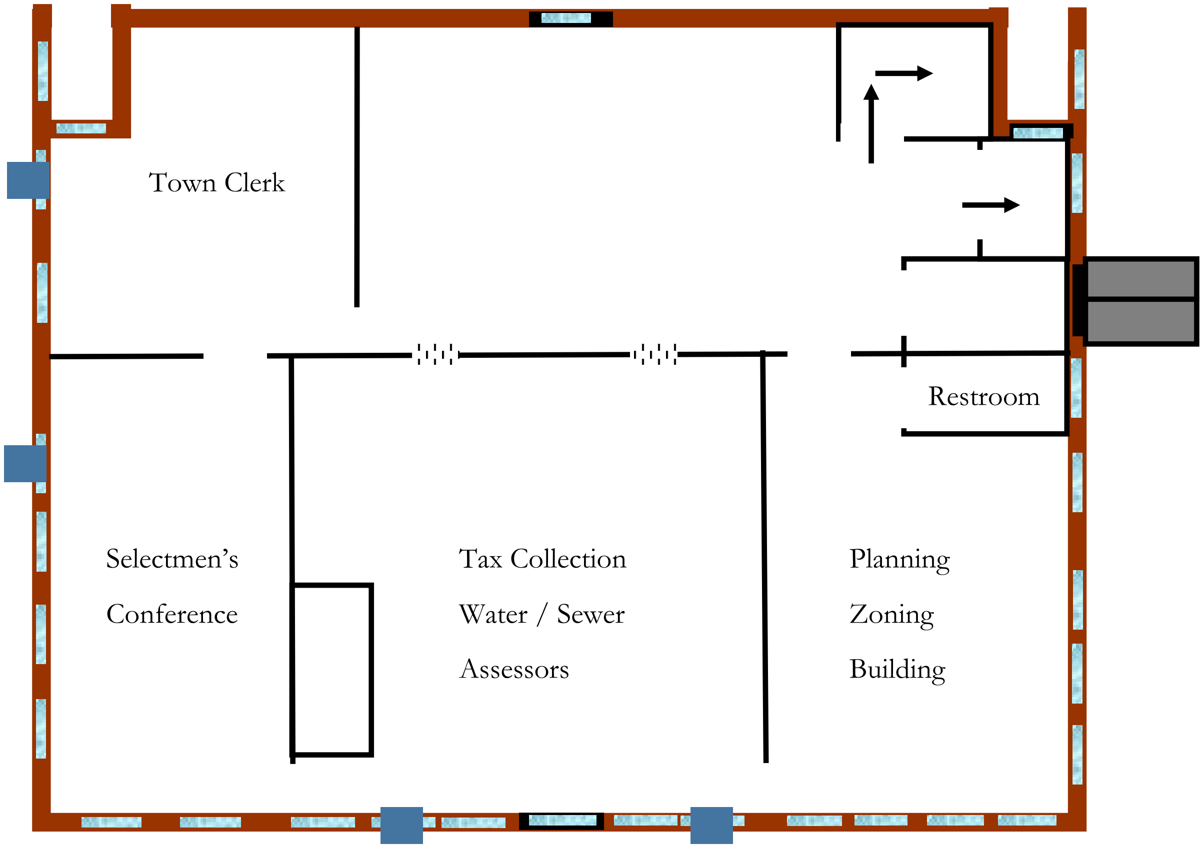


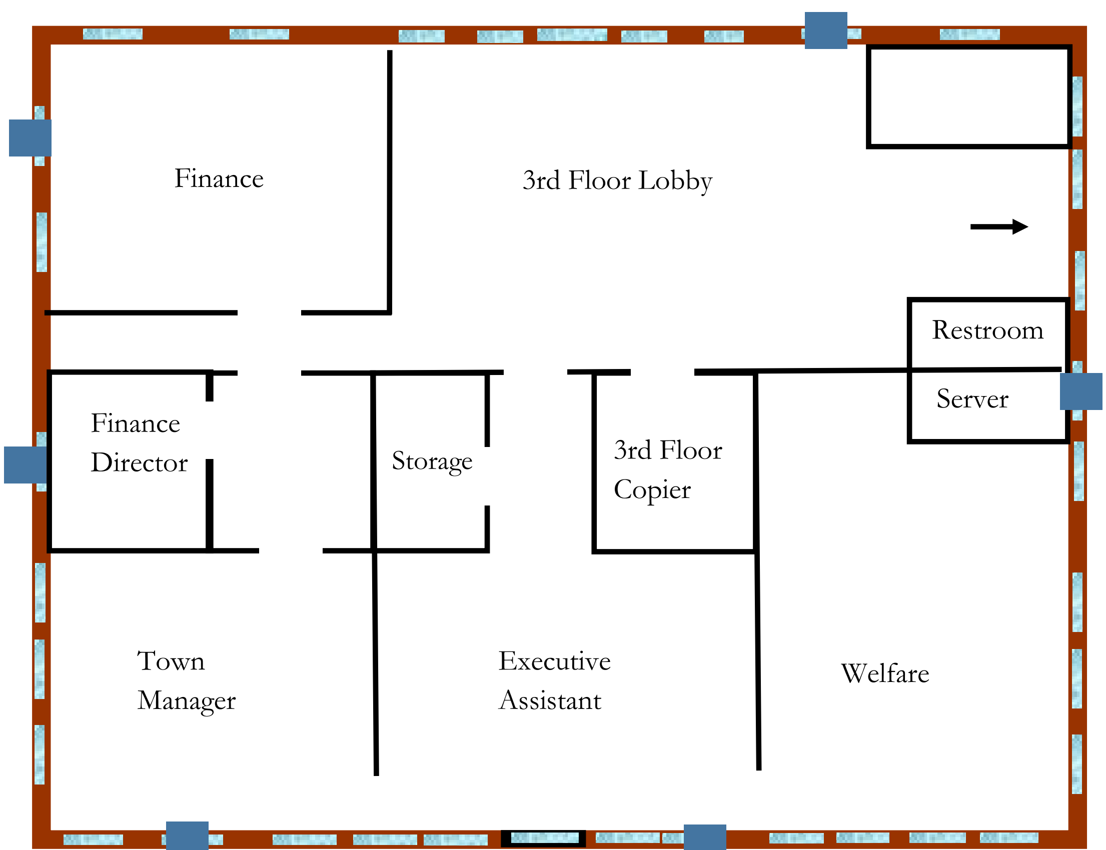
Since cooling appears to be a significant load for both kWh consumption and KW demand, converting to heat pumps for both greater efficiency in heating and cooling, should also lower the demand in the summer, while increasing demand in the winter. Dollar savings for changes in KW demand have not been included in this analysis. Installing a timer on the hot water heater to heat only at nighttime may have an impact on KW demand.



	KW Demand >5.0	Cost @ $11.69
November	13.4	$156.65
December	13.6	$158.98
January	4.9	$57.28
February	0.2	$2.34
March	13.3	$155.48
April	14.4	$168.34
May	18.7	$218.60
June	19.1	$223.28
July	21.5	$251.34
August	21.2	$247.83
September	21	$245.49
October	18	$210.42

Conceptual Floorplans for identifying room names and general locations






NEWPORT


FIRE ESCAPE

Air Sealing and Re-Insulating the Attic Floor

The goal of this measure is to establish an air barrier at the original plane of the ceiling (above the suspended tiles) and to upgrade insulation levels to an minimum effective R50. Ideally, this would involve removing (with a vacuum) all existing material below the floor decking, dense packing cellulose below the boards, then blowing in enough on top for a level 18 inches across the entire floor. Use mineral wool batts and fire stop caulk around the chimney per code.

After vacuuming, inspect wiring and other conditions and make any necessary repairs as once the attic floor is effectively insulated, it would be best not to ever have to walk through it.

The weight and pulley at the hatch is an excellent opening strategy, but replace the fiberglass with at least six inches of rich foam board and installing a gasket seal around the edges.

Windows

Thermographic (aka infra red or IR) images depict differences in surface temperatures. Darker colors indicate cooler surfaces. Dark streaking or "blobs" often indicate cold air infiltration, when its colder outside than inside, and is referred to as 'wind washing.' I agree that the window openings do leak a lot of air and that they must rattle at times.

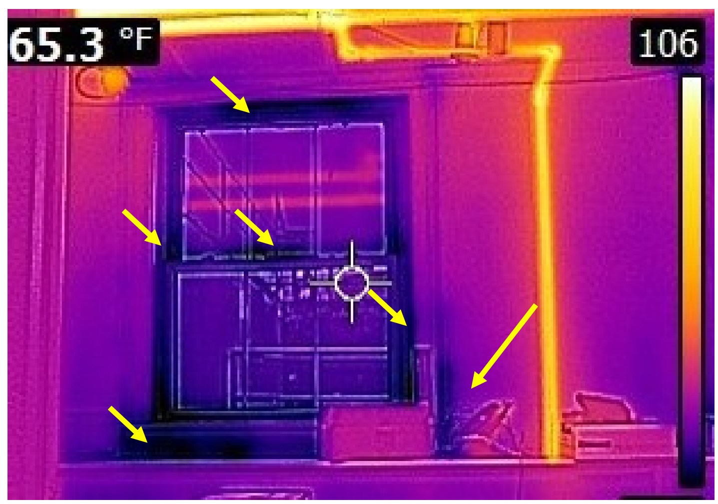
But its also true that due to the high cost of installing new or replacement units, the "simple payback" can be a very long time. And even after replacement, windows typically are still the weakest part of the thermal envelope! Also, old wooden windows can be repaired as necessary and can literally last centuries, whereas replacement windows may last decades without the ability to adjust or repair them as needed.

It doesn't mean its not a good idea—as there can be other reasons to replace old windows: hard to open, lead paint, even the risk of glass panes falling out.

In terms of reducing heat loss, it is usually the case that air sealing the openings is far more important than replacing the glass or sashes with better performing units. As you receive proposals to install the windows on order, the recommendation is to carefully consider the scope and quality of installation.

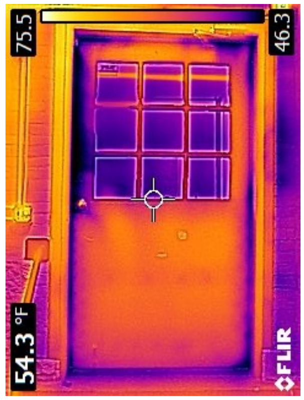
The IR images below show air leakage at the edges of the sashes, but also note the air leakage from the rough opening in the brick which can be equally or more 'leaky' than the window unit itself. Unless there is a dedicated and conscious effort to air seal the entire rough opening—including removing rope and pulley chases and filling them with cellulose or foam—you may still end up with air leaky windows.

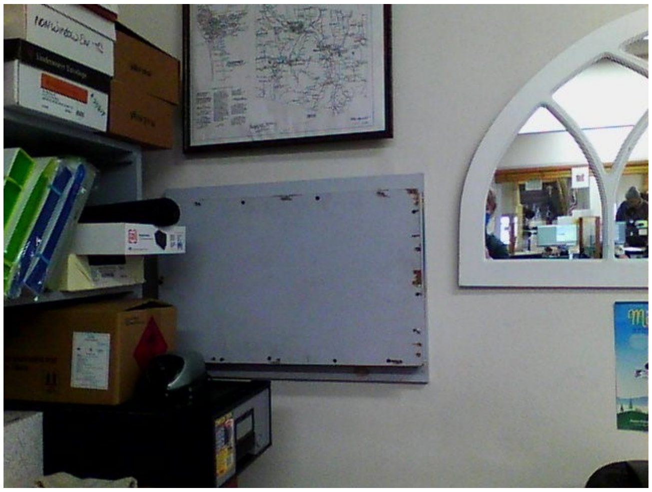
The window below shows air leakage around the sashes, but also from behind the trim—in equal or even greater amounts.

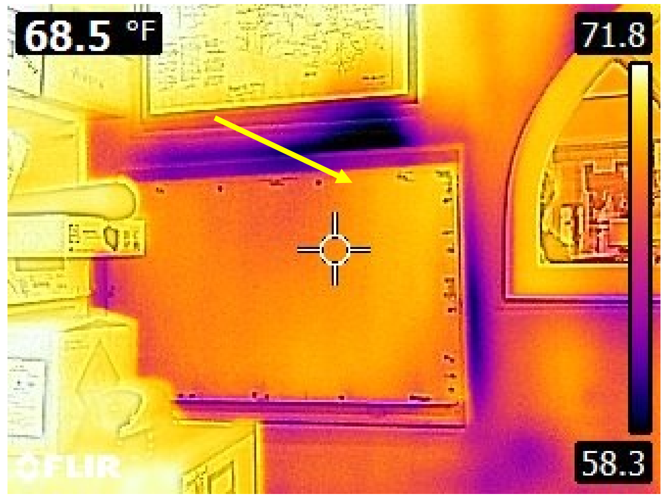


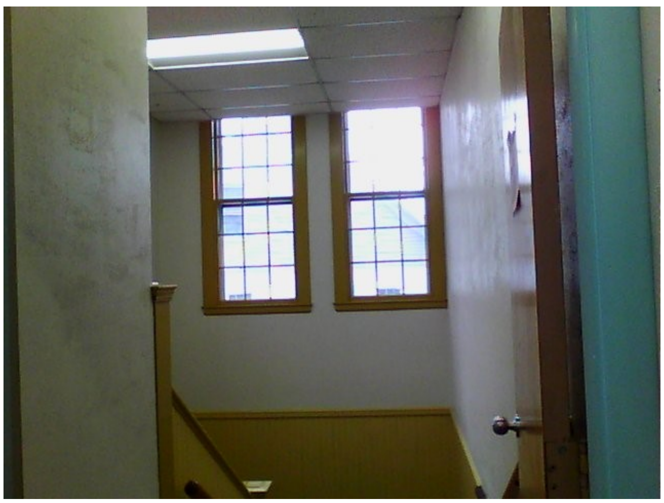
In many cases, there is more air leakage from the rough opening than through the window unit itself.

And in terms of volume of air, doors and all the A/C window boxes each leak more than any one of the windows units. This is why professional weatherstripping all exterior doors is included in ESM 1.









Lastly, there is the issue of the conductivity of the brick. Below are images of you and an employee, literally radiating your body heat to the glass and to the brick also highly conductive, uninsulated brick walls.

There is no question that new windows will save energy, but installation will matter a great deal. And, typically, the recommendation is almost always: first air seal and improve insulation at the ceiling plane; air seal the largest holes throughout the building (doors and AC boxes—or remove the latter) then the more cost effective 'repair sashes and air seal' windows and consider various treatments. In this case, installing new windows has already been approved and will have multiple benefits. But as circumstances permit, consider adding at least R10 to the interior walls from rigid mineral wool comfort batts or an three inches open cell closed cell foam behind offset framing.

Bin Analysis and Comparing Existing Historic Windows with Proposed New Windows

A complicating factor in predicting energy savings from new, more efficient, windows is the fact that single pane windows allow for more solar gains in the winter as well as the overheating gains in the summer. While the existing windows lose more than twice the amount of heat through conduction through glass and air leakage, they can also introduce as much as three times more heating in the winter!

The chart below is called a temperature bin analysis. Outdoor temperatures are grouped in a 5 degree range and the number of hours, over a 30 year average, that a location is that temperature range. The data below is for Concord NH. For example, over the past 30 years, Concord has seen outdoor temperatures between 0 and 5 degrees for 136 hours—most of them at night. In that range, the existing windows are predicted to lose almost 10million BTU an hour through conductive losses. The proposed replacements will lose just 4.6 million BTU during the same hour. Total annual losses are presented below. Total potential gains are presented to offset losses with a net BTU impact of window glazing for existing and new windows.

This is all theoretical, since colder temperatures tend to happen at night when there are no solar gains. The point is that new windows offer lower solar gains—a good thing in summer, not as much of a good thing in winter. Their ability to conserve heat—ie reducing losses—makes up for lower gains, and this calculation confirms it's a worthy trade off.

Gains have been calculated from solar isolation values from PV Watts and glazing areas as shown on the next page.

Avg Temp	Bin Temp Ranges Degree F	Hours Per Bin	Avg ΔT°F Indoor 70	Exist Heating Load Btuh	New Window Loads	Bin % of total winter load	% in Temp Ranges
-17	-20 to -15	1	87	95,259	44,071	0.04%	3.2%
-12	-15 to -10	18	82	1,616,116	747,687	0.70%	
-7	-10 to -5	19	77	1,601,882	741,102	0.69%	
-3	-5 to 0	52	73	4,156,352	1,922,914	1.79%	
3	0 to 5	136	67	9,976,996	4,615,804	4.29%	30.9%
7	5 to 10	154	63	10,623,004	4,914,676	4.57%	
12	10 to 15	209	58	13,272,733	6,140,559	5.71%	
17	15 to 20	312	53	18,105,751	8,376,529	7.79%	
23	20 to 25	385	47	19,812,746	9,166,261	8.52%	
28	25 to 30	666	42	30,627,363	14,169,586	13.17%	65.9%
33	30 to 35	878	37	35,569,873	16,456,212	15.30%	
37	35 to 40	650	33	23,486,234	10,865,781	10.10%	
43	40 to 45	658	27	19,452,514	8,999,602	8.37%	
47	45 to 50	679	23	17,099,511	7,910,998	7.36%	
53	50 to 55	619	17	11,521,941	5,330,565	4.96%	
57	55 to 60	717	13	10,205,836	4,721,676	4.39%	
63	60 to 65	685	7	5,250,186	2,428,971	2.26%	
	Total Glazing	6838		232,474,295	107,552,993	100%	100%
	Total Glazing Heat Gains			(92,971,103)	(29,053,469)		
	Total Glazing		BTU	139,503,192	78,499,524		

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Estimated Conductive Losses and Solar Gains

	South 538 Ft2	West 330 FT2	East 306 FT2	Existing Windows Winter Loss BTU/Month	Existing Windows Summer Gains BTU/Month	New Windows Winter Gains BTUH	New Windows Summer Gains BTU/Month
Jan	3.89	1.50	1.51	15,214,584		4,754,558	
Feb	4.55	2.10	2.11	17,195,797		5,373,687	
Mar	3.89	2.50	2.44	18,690,227		5,840,696	
Apr	3.22	3.00	3.17	17,982,024		5,619,382	
May	2.75	3.22	3.37				
Jun	2.50	3.35	3.15		12,905,576		4,120,261
Jul	2.83	3.81	3.58		15,026,463		4,516,014
Aug	3.23	3.25	3.32		14,318,711		4,303,974
Sep	3.73	2.97	2.64		7,682,558		4,022,948
Oct	3.20	1.75	1.92				
Nov	3.21	1.33	1.26	12,082,918		3,775,912	
Dec	3.07	1.07	1.34	11,805,552		3,689,235	
				92,971,102	54,282,231	29,053,470	16,963,197

Solar insolation values for Newport, NH as reported from PVWatts.gov

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

The Basics of Heat Transfer in a Building

Its helpful to understand the basics of heat transfer in order to understand how to heat a building efficiently. A three page primer on heat transfer in a building has been included at the end of this report for anyone who is interested. It was written as part of a grant program for homeowners in Keene several years ago and inserted here as a reference.

For a shorter version: 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 consists of plaster or sheetrock, wood framing, insulation in cavities, exterior board sheathing, wood clapboards, and—in this case- aa 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.

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!

Newport Town Offices EXISTING HVAC Load Calculations

for

Town Of Newport
15 Sunapee
Newport, NH

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

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

603-532-8979
Tuesday, December 7, 2021

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:	Newport Town Offices EXISTING
Project Date:	Thursday, December 2, 2021
Client Name:	Town Of Newport
Client Address:	15 Sunapee
Client City:	Newport, NH
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	mdillon@myfairpoint.net

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:	5,944	CFM Per Square ft.:	0.872	*
Square ft. of Room Area:	9,443	Square ft. Per Ton:	569	**
Volume (ft^3):	90,737			

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	246,828	Btuh	246.828	MBH
Total Sensible Gain:	129,165	Btuh	90	%
Total Latent Gain:	14,567	Btuh	10	%
Total Cooling Required Including Ventilation Air:	143,732	Btuh	11.98	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 Oil Fired Boiler 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:	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:	0.463	AC/hr	0.463	AC/hr
	700	CFM	700	CFM
Infiltration Actual:	0.463	AC/hr	0.463	AC/hr
Above Grade Volume:	X 90,737	Cu.ft.	X 90,737	Cu.ft.
	42,000	Cu.ft./hr	42,000	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	700	CFM	700	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: 0.463 AC/hr (700 CFM)
Summer Infiltration Specified: 0.463 AC/hr (700 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	11.98	569	9,443	129,165	14,567	143,732	246,828	3,245	5,944	5,944	
System 1	11.98	569	9,443	129,165	14,567	143,732	246,828	3,245	5,944	5,944	0*
HW Piping							19,404				
Zone 1			9,443	129,165	14,567	143,732	227,424	3,245	5,944	5,944	
1-Lobby			684	5,862	1,111	6,973	19,584	279	270	270	3--0*
2-Town Clerk			364	5,461	1,057	6,518	9,871	141	251	251	3--0*
3-Selectmen's / Conference			672	17,348	3,850	21,198	15,672	224	798	798	8--0*
4-Tax/Water/Assessors			672	6,588	992	7,580	8,197	117	303	303	3--0*
5-Planning.Zoning.Building			720	12,209	1,368	13,577	15,097	215	562	562	6--0*
6-Restroom			84	660	114	774	2,127	30	30	30	1--0*
7-3rd Floor Lobby			684	9,256	799	10,055	18,004	257	426	426	4--0*
8-Finance			468	9,437	919	10,356	14,603	208	434	434	4--0*
9-Finance Director			384	7,306	879	8,185	9,423	134	336	336	4--0*
10-Town Manager			384	9,192	971	10,163	16,297	233	423	423	4--0*
11-Executive Assistant			525	9,281	480	9,761	10,558	151	427	427	4--0*
12-Welfare Office			450	14,057	1,039	15,096	18,364	262	647	647	6--0*
13-Server			192	8,780	559	9,339	9,638	138	404	404	4--0*
14-3rd Floor Restroom			28	5,251	80	5,331	1,902	27	242	242	3--0*
15-3rd Floor Copier			216	3,546	0	3,546	1,400	20	163	163	2--0*
16-3rd Storage			144	804	0	804	933	13	37	37	1--0*
17-Break Room			144	4,128	349	4,477	5,347	76	190	190	2--0*
18-Basement Halls & Elec			460	0	0	0	13,014	186	0	0	0--0
19-Basement East Storage			180	0	0	0	4,409	63	0	0	0--0
20-Basement South Storage			500	0	0	0	10,216	146	0	0	0--0
21-Basement West Stoage			288	0	0	0	2,812	40	0	0	0--0
22-Repair Shops			1,200	0	0	0	19,956	285	0	0	0--0

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SPwithStorm: Glazing-Wood frame with single pane and alumin storm, U-value 0.61, SHGC 0.64	1636	71,848	0	59,900	59,900
double pane: Glazing-wood thermal pane window 90s, U-value 0.47, SHGC 0.56	65.7	2,223	0	2,230	2,230
11D: Door-Wood - Solid Core, U-value 0.39	96.3	2,705	0	678	678
11D: Door-Wood - Solid Core, U-value 0.59	41.5	1,763	0	441	441
11D: Door-Wood - Solid Core, U-value 0.69	38.9	1,930	0	0	0
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.2	4873	70,171	0	5,992	5,992
Newport TO: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Suspended ceiling with 3.5" and some in attic above, U-value 0.08	684	3,940	0	3,393	3,393
Newport TO: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Suspended ceiling with 3.5" and some in attic above, U-value 0.09	2791	18,085	0	15,574	15,574
Subtotals for structure:		172,665	0	88,208	88,208
People:	29		5,800	6,670	12,470
Equipment:			0	21,204	21,204
Lighting:	1160			3,956	3,956
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 700, Summer CFM: 700		54,759	8,767	9,127	17,894
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 600 ft. Total:		19,404	0	0	0
Total Building Load Totals:		246,828	14,567	129,165	143,732

Check Figures

Total Building Supply CFM:	5,944	CFM Per Square ft.:	0.872 *
Square ft. of Room Area:	9,443	Square ft. Per Ton:	569 **
Volume (ft³):	90,737		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	246,828	Btuh	246.828	MBH
Total Sensible Gain:	129,165	Btuh	90	%
Total Latent Gain:	14,567	Btuh	10	%
Total Cooling Required Including Ventilation Air:	143,732	Btuh	11.98	Tons (Based On Sensible + Latent)

Notes

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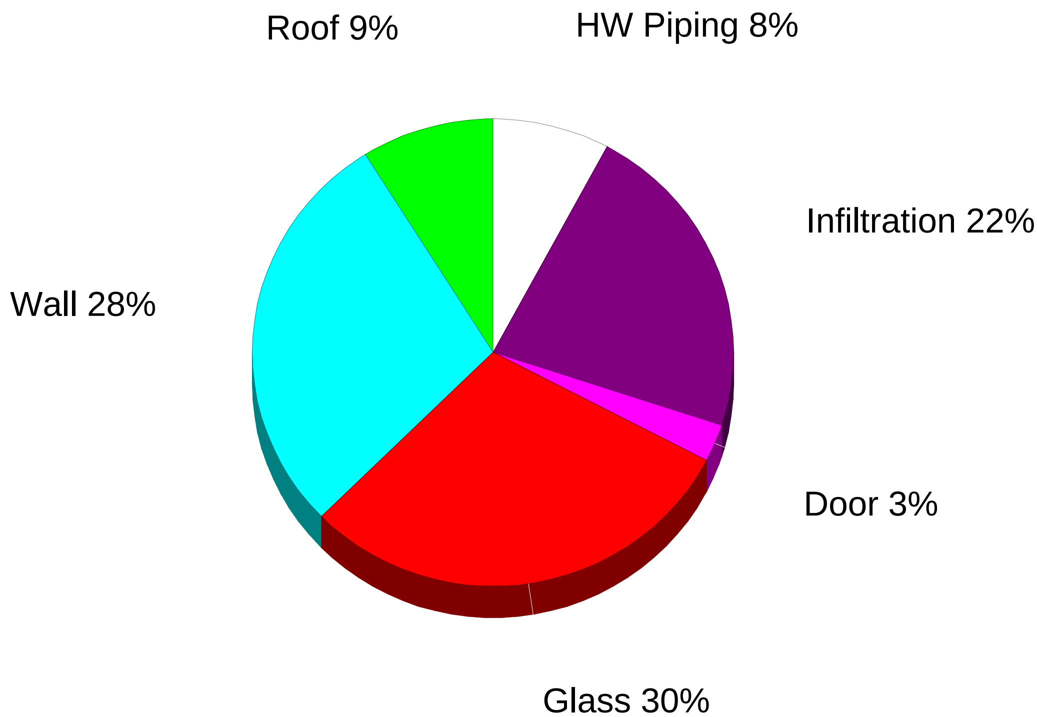
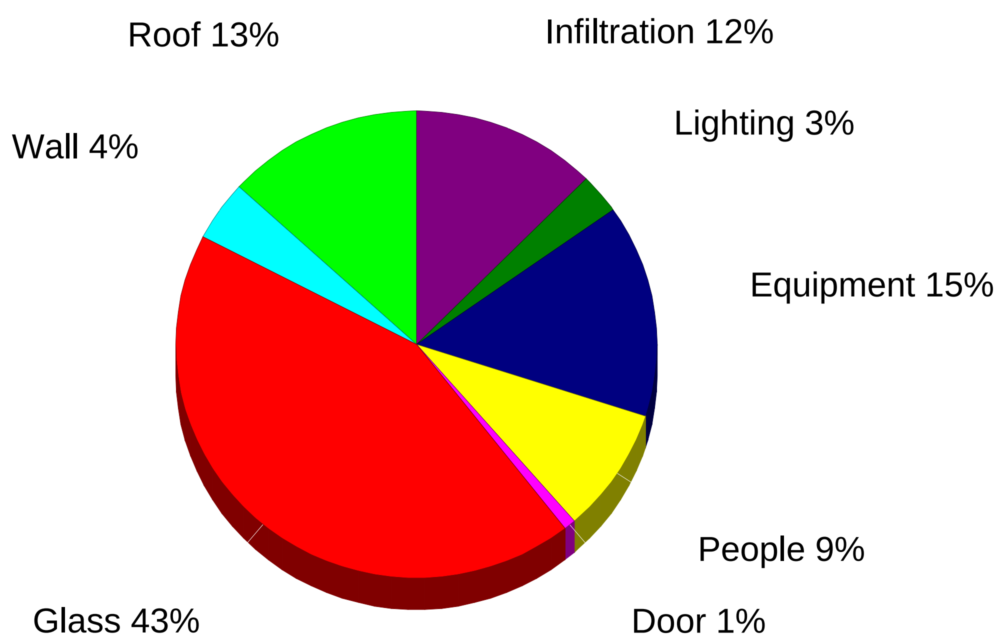
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





System 1 Oil Fired Boiler Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SPwithStorm: Glazing-Wood frame with single pane and alumin storm, U-value 0.61, SHGC 0.64	1636	71,848	0	59,900	59,900
double pane: Glazing-wood thermal pane window 90s, U-value 0.47, SHGC 0.56	65.7	2,223	0	2,230	2,230
11D: Door-Wood - Solid Core, U-value 0.39	96.3	2,705	0	678	678
11D: Door-Wood - Solid Core, U-value 0.59	41.5	1,763	0	441	441
11D: Door-Wood - Solid Core, U-value 0.69	38.9	1,930	0	0	0
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.2	4873	70,171	0	5,992	5,992
Newport TO: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Suspended ceiling with 3.5" and some in attic above, U-value 0.08	684	3,940	0	3,393	3,393
Newport TO: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Suspended ceiling with 3.5" and some in attic above, U-value 0.09	2791	18,085	0	15,574	15,574
Subtotals for structure:		172,665	0	88,208	88,208
People:	29		5,800	6,670	12,470
Equipment:			0	21,204	21,204
Lighting:	1160			3,956	3,956
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 700, Summer CFM: 700		54,759	8,767	9,127	17,894
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 600 ft. Total:		19,404	0	0	0
System 1 Oil Fired Boiler Load Totals:		246,828	14,567	129,165	143,732

Check Figures

Supply CFM:	5,944	CFM Per Square ft.:	0.872	*
Square ft. of Room Area:	9,443	Square ft. Per Ton:	569	**
Volume (ft³):	90,737			

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

System Loads

Total Heating Required Including Ventilation Air:	246,828	Btuh	246.828	MBH
Total Sensible Gain:	129,165	Btuh	90	%
Total Latent Gain:	14,567	Btuh	10	%
Total Cooling Required Including Ventilation Air:	143,732	Btuh	11.98	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.

System 1 Room Load Summary

No	Room Name	Area SF	Htg Sens Btuh	Htg Rad Len	Run Duct Size	Run Duct Vel	Clg Sens Btuh	Clg Lat Btuh	Clg Nom CFM	Air Sys CFM
---Zone 1---										
1	Lobby	684	19,584	27.3	3-0	0	5,862	1,111	270	270
2	Town Clerk	364	9,871	13.8	3-0	0	5,461	1,057	251	251
3	Selectmen's / Conference	672	15,672	21.9	8-0	0	17,348	3,850	798	798
4	Tax/Water/Assessors	672	8,197	11.4	3-0	0	6,588	992	303	303
5	Planning.Zoning.Building	720	15,097	21.1	6-0	0	12,209	1,368	562	562
6	Restroom	84	2,127	3.0	1-0	0	660	114	30	30
7	3rd Floor Lobby	684	18,004	25.1	4-0	0	9,256	799	426	426
8	Finance	468	14,603	20.4	4-0	0	9,437	919	434	434
9	Finance Director	384	9,423	13.1	4-0	0	7,306	879	336	336
10	Town Manager	384	16,297	22.7	4-0	0	9,192	971	423	423
11	Executive Assistant	525	10,558	14.7	4-0	0	9,281	480	427	427
12	Welfare Office	450	18,364	25.6	6-0	0	14,057	1,039	647	647
13	Server	192	9,638	13.4	4-0	0	8,780	559	404	404
14	3rd Floor Restroom	28	1,902	2.7	3-0	0	5,251	80	242	242
15	3rd Floor Copier	216	1,400	2.0	2-0	0	3,546	0	163	163
16	3rd Storage	144	933	1.3	1-0	0	804	0	37	37
17	Break Room	144	5,347	7.5	2-0	0	4,128	349	190	190
18	Basement Halls & Elec	460	13,014	18.2	0-0	0	0	0	0	0
19	Basement East Storage	180	4,409	6.1	0-0	0	0	0	0	0
20	Basement South Storage	500	10,216	14.2	0-0	0	0	0	0	0
21	Basement West Stoage	288	2,812	3.9	0-0	0	0	0	0	0
22	Repair Shops	1,200	19,956	27.8	0-0	0	0	0	0	0
	HW Piping		19,404							
	System 1 total	9,443	246,828	344.3			129,165	14,567	5,944	5,944

Cooling System Summary

	Cooling Tons	Sensible/Latent Split	Sensible Btuh	Latent Btuh	Total Btuh
Net Required:	11.98	90% / 10%	129,165	14,567	143,732

Equipment Data

	Heating System	Cooling System
Type:	Fuel Oil Boiler	Standard Air Conditioner
Model:		
Indoor Model:		
Brand:		
Description:	8L-584WP	
Efficiency:	80 AFUE	0 SEER
Sound:	0	0
Capacity:	633 Btuh	0 Btuh
Sensible Capacity:	n/a	0 Btuh
Latent Capacity:	n/a	0 Btuh

Newport Town Offices AIR SEAL & CEILING
HVAC Load Calculations

for

Town Of Newport
15 Sunapee
Newport, NH

Prepared By:

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

603-532-8979
Tuesday, December 7, 2021

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Project Report

General Project Information

Project Title:	Newport Town Offices AIR SEAL & CEILING
Project Date:	Thursday, December 2, 2021
Client Name:	Town Of Newport
Client Address:	15 Sunapee
Client City:	Newport, NH
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	mdillon@myfairpoint.net

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:	5,360	CFM Per Square ft.:	0.786 *
Square ft. of Room Area:	9,443	Square ft. Per Ton:	631 **
Volume (ft³):	90,737		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	221,702	Btuh	221.702	MBH
Total Sensible Gain:	116,465	Btuh	90	%
Total Latent Gain:	13,189	Btuh	10	%
Total Cooling Required Including Ventilation Air:	129,654	Btuh	10.80	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.

Miscellaneous Report

System 1 Oil Fired Boiler 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:	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:	0.390	AC/hr	0.390	AC/hr
	590	CFM	590	CFM
Infiltration Actual:	0.390	AC/hr	0.390	AC/hr
Above Grade Volume:	X 90,737	Cu.ft.	X 90,737	Cu.ft.
	35,400	Cu.ft./hr	35,400	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	590	CFM	590	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: 0.390 AC/hr (590 CFM)
Summer Infiltration Specified: 0.390 AC/hr (590 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	10.80	631	9,443	116,465	13,189	129,654	221,702	2,915	5,360	5,360	
System 1	10.80	631	9,443	116,465	13,189	129,654	221,702	2,915	5,360	5,360	0*
HW Piping							19,404				
Zone 1			9,443	116,465	13,189	129,654	202,298	2,915	5,360	5,360	
1-Lobby			684	5,680	937	6,617	18,804	271	261	261	3--0*
2-Town Clerk			364	5,353	954	6,307	9,410	136	246	246	3--0*
3-Selectmen's / Conference			672	17,209	3,716	20,925	15,075	217	792	792	8--0*
4-Tax/Water/Assessors			672	6,524	931	7,455	7,922	114	300	300	3--0*
5-Planning.Zoning.Building			720	12,083	1,247	13,330	14,558	210	556	556	6--0*
6-Restroom			84	641	96	737	2,047	29	29	29	1--0*
7-3rd Floor Lobby			684	6,665	673	7,338	14,586	210	307	307	3--0*
8-Finance			468	7,347	806	8,153	11,806	170	338	338	4--0*
9-Finance Director			384	5,609	804	6,413	7,207	104	258	258	3--0*
10-Town Manager			384	7,446	850	8,296	13,876	200	343	343	4--0*
11-Executive Assistant			525	7,021	436	7,457	7,792	112	323	323	3--0*
12-Welfare Office			450	12,023	907	12,930	15,572	224	553	553	6--0*
13-Server			192	10,842	471	11,313	8,306	120	499	499	5--0*
14-3rd Floor Restroom			28	5,120	67	5,187	1,709	25	236	236	3--0*
15-3rd Floor Copier			216	2,636	0	2,636	342	5	121	121	2--0*
16-3rd Storage			144	196	0	196	228	3	9	9	1--0*
17-Break Room			144	4,071	294	4,365	5,103	74	187	187	2--0*
18-Basement Halls & Elec			460	0	0	0	12,291	177	0	0	0--0
19-Basement East Storage			180	0	0	0	4,202	61	0	0	0--0
20-Basement South Storage			500	0	0	0	9,681	140	0	0	0--0
21-Basement West Stoage			288	0	0	0	2,674	39	0	0	0--0
22-Repair Shops			1,200	0	0	0	19,107	275	0	0	0--0

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SPwithStorm: Glazing-Wood frame with single pane and alumin storm, U-value 0.61, SHGC 0.64	1636	71,848	0	59,900	59,900
double pane: Glazing-wood thermal pane window 90s, U-value 0.47, SHGC 0.56	65.7	2,223	0	2,230	2,230
11D: Door-Wood - Solid Core, U-value 0.39	96.3	2,705	0	678	678
11D: Door-Wood - Solid Core, U-value 0.59	41.5	1,763	0	441	441
11D: Door-Wood - Solid Core, U-value 0.69	38.9	1,930	0	0	0
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.2	4873	70,171	0	5,992	5,992
R50 Blown: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Air Sealed with R50 Cellulose or Rockwool, U-value 0.022	3475	5,503	0	4,740	4,740
Subtotals for structure:		156,143	0	73,981	73,981
People:	29		5,800	6,670	12,470
Equipment:			0	24,166	24,166
Lighting:	1160			3,956	3,956
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 590, Summer CFM: 590		46,155	7,389	7,692	15,081
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 600 ft. Total:		19,404	0	0	0
Total Building Load Totals:		221,702	13,189	116,465	129,654

Check Figures

Total Building Supply CFM:	5,360	CFM Per Square ft.:	0.786	*
Square ft. of Room Area:	9,443	Square ft. Per Ton:	631	**
Volume (ft³):	90,737			

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	221,702	Btuh	221.702	MBH
Total Sensible Gain:	116,465	Btuh	90	%
Total Latent Gain:	13,189	Btuh	10	%
Total Cooling Required Including Ventilation Air:	129,654	Btuh	10.80	Tons (Based On Sensible + Latent)

Notes

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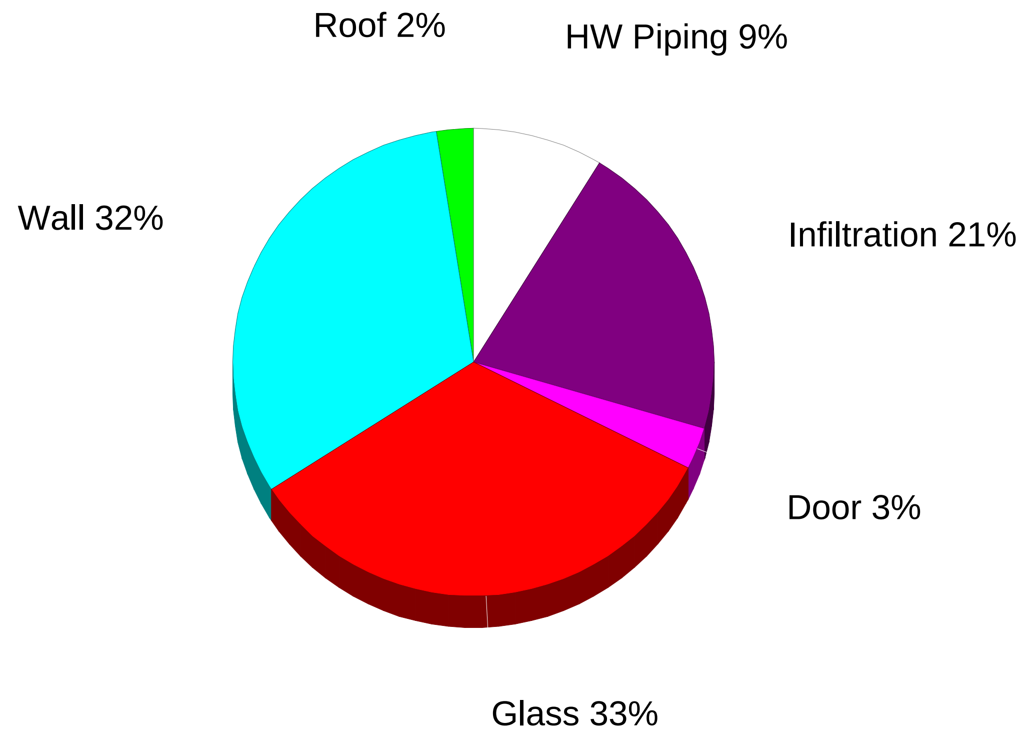
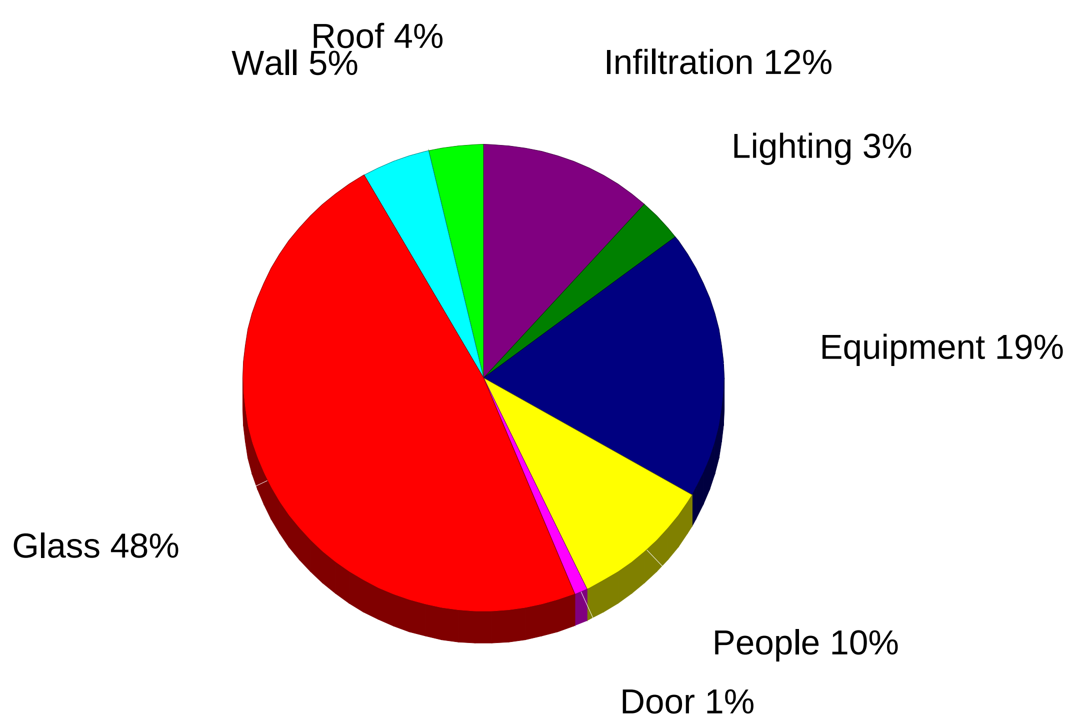
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





Newport Town Offices NEW WINDOWS
HVAC Load Calculations

for

Town Of Newport
15 Sunapee
Newport, NH

Elite Software

RHVAC RESIDENTIAL HVAC LOADS

Prepared By:

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

603-532-8979
Sunday, December 5, 2021

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:	Newport Town Offices NEW WINDOWS
Project Date:	Thursday, December 2, 2021
Client Name:	Town Of Newport
Client Address:	15 Sunapee
Client City:	Newport, NH
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	mdillon@myfairpoint.net

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:	3,379	CFM Per Square ft.:	0.496 *
Square ft. of Room Area:	9,443	Square ft. Per Ton:	1,008 **
Volume (ft³):	90,737		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	136,390	Btuh	136.390	MBH
Total Sensible Gain:	73,416	Btuh	91	%
Total Latent Gain:	7,695	Btuh	9	%
Total Cooling Required Including Ventilation Air:	81,111	Btuh	6.76	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 Oil Fired Boiler 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:	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:	0.190	AC/hr	0.100	AC/hr
	287	CFM	151	CFM
Infiltration Actual:	0.190	AC/hr	0.100	AC/hr
Above Grade Volume:	X 90,737	Cu.ft.	X 90,737	Cu.ft.
	17,240	Cu.ft./hr	9,074	Cu.ft./hr
	X 0.0167		X 0.0167	
Total Building Infiltration:	287	CFM	151	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: 0.190 AC/hr (287 CFM), Construction: Semi-Tight
Summer Infiltration Specified: 0.100 AC/hr (151 CFM), Construction: Semi-Tight

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	6.76	1,008	9,443	73,416	7,695	81,111	136,390	1,793	3,379	3,379	
System 1	6.76	1,008	9,443	73,416	7,695	81,111	136,390	1,793	3,379	3,379	0*
Zone 1			9,443	73,416	7,695	81,111	136,390	1,793	3,379	3,379	
1-Lobby			684	3,341	240	3,581	13,150	173	154	154	2--0*
2-Town Clerk			364	3,546	542	4,088	6,667	88	163	163	2--0*
3-Selectmen's / Conference			672	10,602	3,184	13,786	9,047	119	488	488	5--0*
4-Tax/Water/Assessors			672	4,025	685	4,710	4,539	60	185	185	2--0*
5-Planning,Zoning,Building			720	6,324	766	7,090	8,535	112	291	291	3--0*
6-Restroom			84	288	25	313	1,221	16	13	13	1--0*
7-3rd Floor Lobby			684	3,458	173	3,631	9,492	125	159	159	2--0*
8-Finance			468	4,608	355	4,963	8,149	107	212	212	2--0*
9-Finance Director			384	3,928	504	4,432	5,433	71	181	181	2--0*
10-Town Manager			384	4,555	367	4,922	8,757	115	210	210	2--0*
11-Executive Assistant			525	4,340	260	4,600	4,323	57	200	200	2--0*
12-Welfare Office			450	6,410	381	6,791	9,641	127	295	295	3--0*
13-Server			192	8,461	121	8,582	5,977	79	389	389	4--0*
14-3rd Floor Restroom			28	4,060	17	4,077	930	12	187	187	2--0*
15-3rd Floor Copier			216	2,636	0	2,636	342	4	121	121	2--0*
16-3rd Storage			144	196	0	196	228	3	9	9	1--0*
17-Break Room			144	2,639	75	2,714	3,633	48	121	121	2--0*
18-Basement Halls & Elec			460	0	0	0	10,108	133	0	0	0--0
19-Basement East Storage			180	0	0	0	2,984	39	0	0	0--0
20-Basement South Storage			500	0	0	0	7,558	99	0	0	0--0
21-Basement West Stoage			288	0	0	0	1,971	26	0	0	0--0
22-Repair Shops			1,200	0	0	0	13,705	180	0	0	0--0

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Sanford Hills: Glazing-Extruded low e with argon, U-value 0.26, SHGC 0.25	1701.8	31,842	0	24,800	24,800
11D: Door-Wood - Solid Core, U-value 0.39	96.3	2,705	0	678	678
11D: Door-Wood - Solid Core, U-value 0.59	41.5	1,763	0	441	441
11D: Door-Wood - Solid Core, U-value 0.69	38.9	1,930	0	0	0
Brick 12": Wall-Block, Custom, Historic 12" brick walls, lathe&plaster, U-value 0.2	4873	70,171	0	5,992	5,992
R50 Blown: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Air Sealed with R50 Cellulose or Rockwool, U-value 0.022	3475	5,503	0	4,740	4,740
Subtotals for structure:		113,914	0	36,651	36,651
People:	29		5,800	6,670	12,470
Equipment:			0	24,166	24,166
Lighting:	1160			3,956	3,956
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 287, Summer CFM: 151		22,476	1,895	1,973	3,868
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Total Building Load Totals:		136,390	7,695	73,416	81,111

Check Figures

Total Building Supply CFM:	3,379	CFM Per Square ft.:	0.496	*
Square ft. of Room Area:	9,443	Square ft. Per Ton:	1,008	**
Volume (ft³):	90,737			

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	136,390	Btuh	136.390	MBH
Total Sensible Gain:	73,416	Btuh	91	%
Total Latent Gain:	7,695	Btuh	9	%
Total Cooling Required Including Ventilation Air:	81,111	Btuh	6.76	Tons (Based On Sensible + Latent)

Notes

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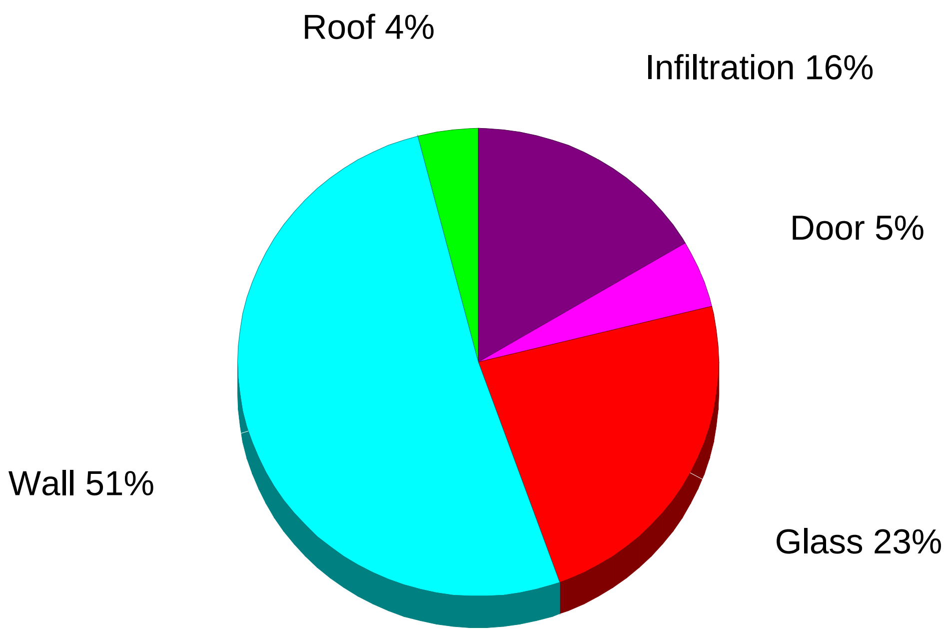
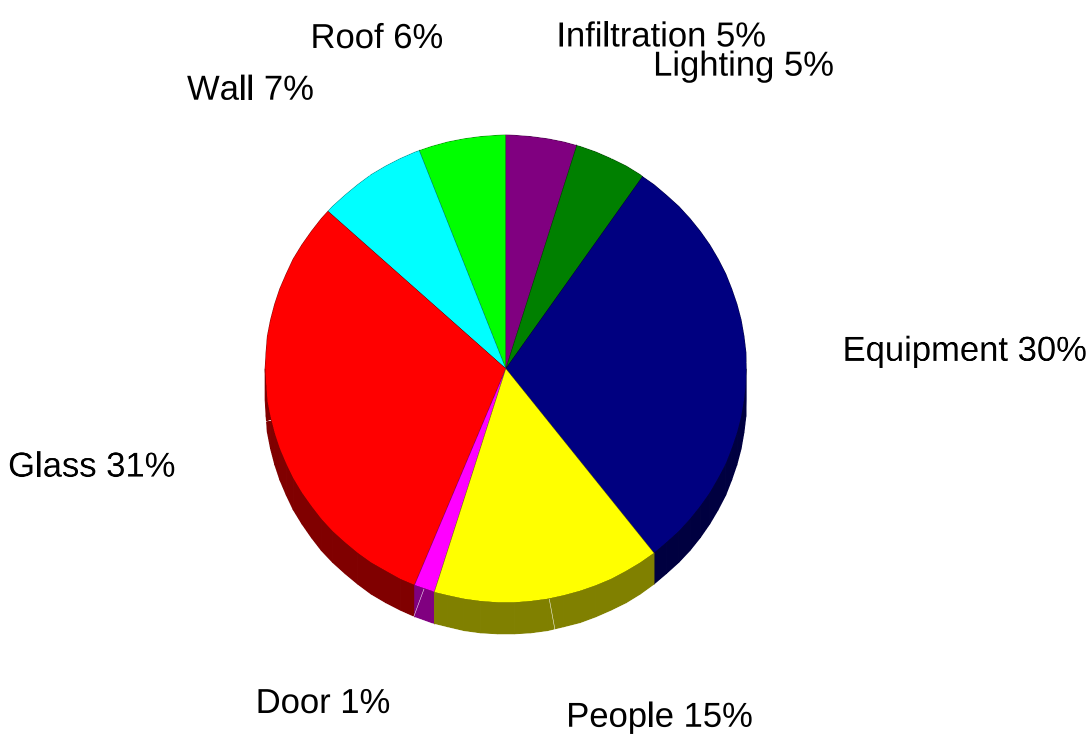
All computed results are estimates as building use and weather may vary.
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

Building Pie Chart





NEW WINDOWS & Insulate Walls
HVAC Load Calculations

for

Town Of Newport
15 Sunapee
Newport, NH

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

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

603-532-8979
Sunday, December 5, 2021

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Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

Project Report

General Project Information

Project Title:	NEW WINDOWS & Insulate Walls
Project Date:	Thursday, December 2, 2021
Client Name:	Town Of Newport
Client Address:	15 Sunapee
Client City:	Newport, NH
Company Name:	S.E.E.D.S.
Company Representative:	Margaret Dillon
Company Phone:	603-532-8979
Company E-Mail Address:	mdillon@myfairpoint.net

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:	3,195	CFM Per Square ft.:	0.469 *
Square ft. of Room Area:	9,443	Square ft. Per Ton:	1,060 **
Volume (ft³):	90,737		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

Building Loads

Total Heating Required Including Ventilation Air:	89,727	Btuh	89.727	MBH
Total Sensible Gain:	69,433	Btuh	90	%
Total Latent Gain:	7,695	Btuh	10	%
Total Cooling Required Including Ventilation Air:	77,128	Btuh	6.43	Tons (Based On Sensible + Latent)

Notes

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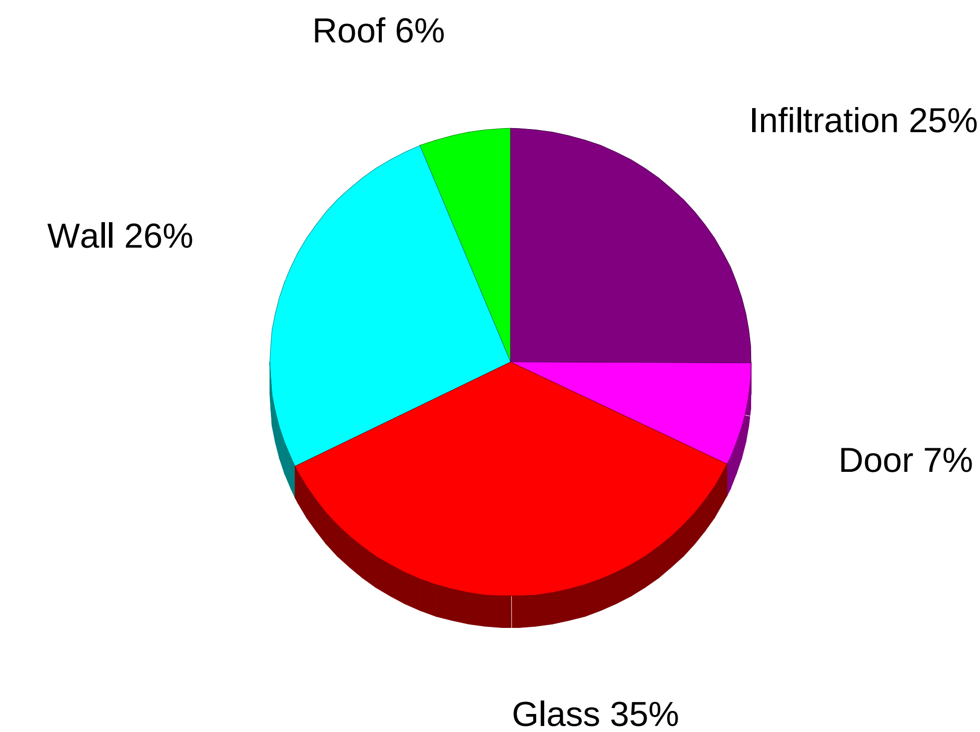
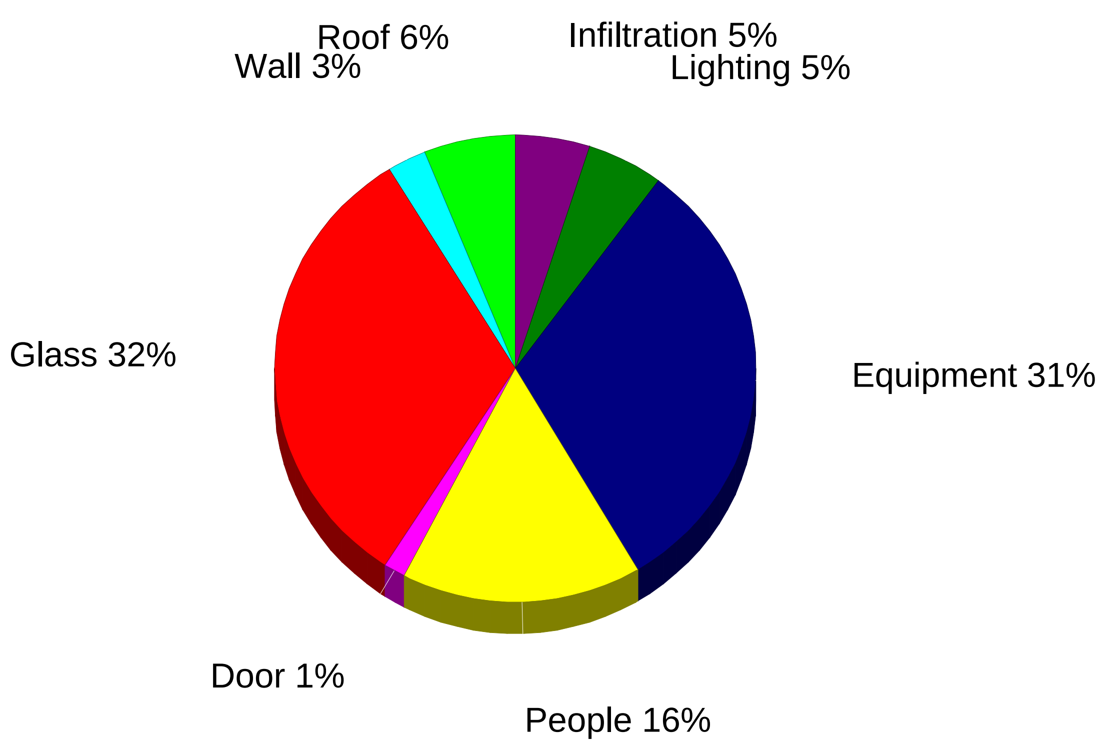
Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.

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	6.43	1,060	9,443	69,433	7,695	77,128	89,727	1,180	3,195	3,195	
System 1	6.43	1,060	9,443	69,433	7,695	77,128	89,727	1,180	3,195	3,195	0*
Zone 1			9,443	69,433	7,695	77,128	89,727	1,180	3,195	3,195	
1-Lobby			684	2,851	240	3,091	9,394	124	131	131	2--0*
2-Town Clerk			364	3,167	542	3,709	3,762	49	146	146	2--0*
3-Selectmen's / Conference			672	10,234	3,184	13,418	6,231	82	471	471	5--0*
4-Tax/Water/Assessors			672	3,908	685	4,593	3,650	48	180	180	2--0*
5-Planning,Zoning,Building			720	6,044	766	6,810	6,390	84	278	278	3--0*
6-Restroom			84	240	25	265	847	11	11	11	1--0*
7-3rd Floor Lobby			684	3,084	173	3,257	6,628	87	142	142	2--0*
8-Finance			468	4,226	355	4,581	5,219	69	194	194	2--0*
9-Finance Director			384	3,640	504	4,144	3,226	42	168	168	2--0*
10-Town Manager			384	4,205	367	4,572	6,070	80	194	194	2--0*
11-Executive Assistant			525	4,317	260	4,577	4,143	54	199	199	2--0*
12-Welfare Office			450	6,047	381	6,428	6,854	90	278	278	3--0*
13-Server			192	8,138	121	8,259	3,502	46	375	375	4--0*
14-3rd Floor Restroom			28	4,036	17	4,053	746	10	186	186	2--0*
15-3rd Floor Copier			216	2,636	0	2,636	342	4	121	121	2--0*
16-3rd Storage			144	196	0	196	228	3	9	9	1--0*
17-Break Room			144	2,465	75	2,540	2,300	30	113	113	2--0*
18-Basement Halls & Elec			460	0	0	0	4,803	63	0	0	0--0
19-Basement East Storage			180	0	0	0	1,680	22	0	0	0--0
20-Basement South Storage			500	0	0	0	3,784	50	0	0	0--0
21-Basement West Stoage			288	0	0	0	1,061	14	0	0	0--0
22-Repair Shops			1,200	0	0	0	8,867	117	0	0	0--0

Building Pie Chart





Newport Town Offices WALLS ONLY
HVAC Load Calculations

for

Town Of Newport
15 Sunapee
Newport, NH

Elite Software

RHVAC Residential HVAC Loads

Prepared By:

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

603-532-8979
Sunday, December 5, 2021

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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	10.75	634	9,443	118,859	10,156	129,015	174,863	2,299	5,470	5,470	
System 1	10.75	634	9,443	118,859	10,156	129,015	174,863	2,299	5,470	5,470	0*
Zone 1			9,443	118,859	10,156	129,015	174,863	2,299	5,470	5,470	
1-Lobby			684	4,790	552	5,342	15,475	203	220	220	3--0*
2-Town Clerk			364	4,738	726	5,464	6,758	89	218	218	2--0*
3-Selectmen's / Conference			672	16,535	3,422	19,957	12,586	165	761	761	7--0*
4-Tax/Water/Assessors			672	6,266	795	7,061	7,183	94	288	288	3--0*
5-Planning.Zoning.Building			720	11,526	982	12,508	12,708	167	530	530	5--0*
6-Restroom			84	552	57	609	1,717	23	25	25	1--0*
7-3rd Floor Lobby			684	8,463	397	8,860	14,886	196	389	389	4--0*
8-Finance			468	8,389	557	8,946	11,108	146	386	386	4--0*
9-Finance Director			384	6,529	638	7,167	6,788	89	300	300	3--0*
10-Town Manager			384	8,200	583	8,783	13,089	172	377	377	4--0*
11-Executive Assistant			525	8,786	339	9,125	9,911	130	404	404	4--0*
12-Welfare Office			450	12,976	617	13,593	14,987	197	597	597	6--0*
13-Server			192	8,045	278	8,323	6,848	90	370	370	4--0*
14-3rd Floor Restroom			28	5,168	40	5,208	1,673	22	238	238	3--0*
15-3rd Floor Copier			216	3,412	0	3,412	1,244	16	157	157	2--0*
16-3rd Storage			144	714	0	714	829	11	33	33	1--0*
17-Break Room			144	3,771	173	3,944	3,904	51	174	174	2--0*
18-Basement Halls & Elec			460	0	0	0	7,382	97	0	0	0--0
19-Basement East Storage			180	0	0	0	3,012	40	0	0	0--0
20-Basement South Storage			500	0	0	0	6,201	82	0	0	0--0
21-Basement West Stoage			288	0	0	0	1,840	24	0	0	0--0
22-Repair Shops			1,200	0	0	0	14,734	194	0	0	0--0

Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
SPwithStorm: Glazing-Wood frame with single pane and alumin storm, U-value 0.61, SHGC 0.64	1636	71,848	0	59,900	59,900
double pane: Glazing-wood thermal pane window 90s, U-value 0.47, SHGC 0.56	65.7	2,223	0	2,230	2,230
11D: Door-Wood - Solid Core, U-value 0.39	96.3	2,705	0	678	678
11D: Door-Wood - Solid Core, U-value 0.59	41.5	1,763	0	441	441
11D: Door-Wood - Solid Core, U-value 0.69	38.9	1,930	0	0	0
Brick.Int Ins: Wall-Block, Custom, Historic 12" brick walls, lathe&plaster and R10 RR, U-value 0.067	4873	23,508	0	2,009	2,009
Newport TO: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Custom, Suspended ceiling with 3.5" and some in attic above, U-value 0.08	3475	20,016	0	17,236	17,236
Subtotals for structure:		123,993	0	82,494	82,494
People:	29		5,800	6,670	12,470
Equipment:			0	21,204	21,204
Lighting:	1160			3,956	3,956
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 650, Summer CFM: 348		50,870	4,356	4,535	8,891
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Total Building Load Totals:		174,863	10,156	118,859	129,015

Check Figures

Total Building Supply CFM:	5,470	CFM Per Square ft.:	0.803	*
Square ft. of Room Area:	9,443	Square ft. Per Ton:	634	**
Volume (ft³):	90,737			

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.
** Based on area of rooms being cooled.

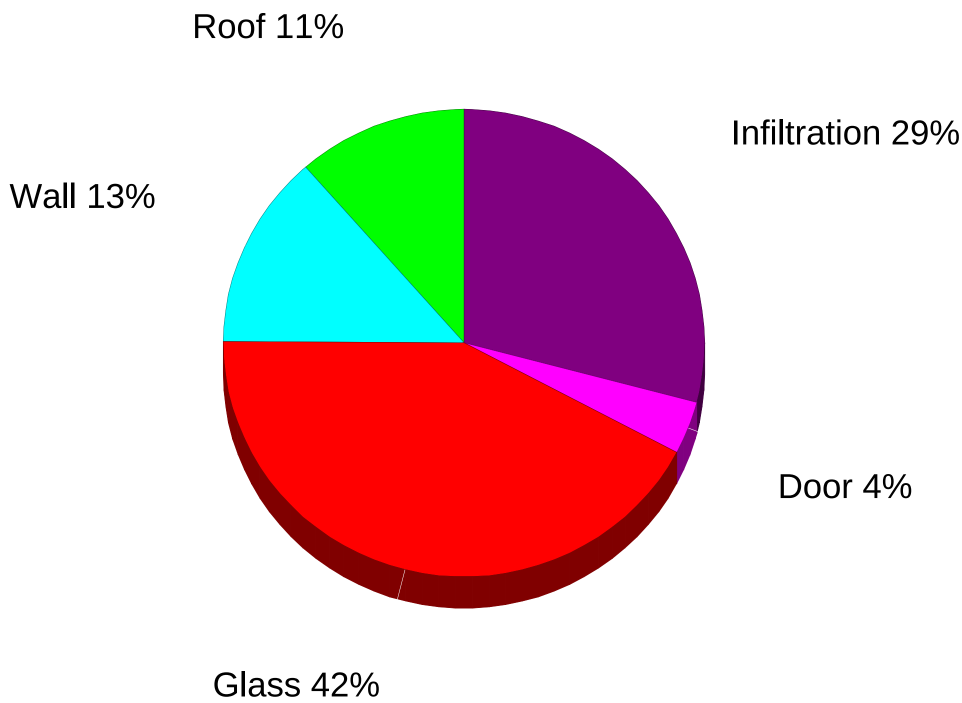
Building Loads

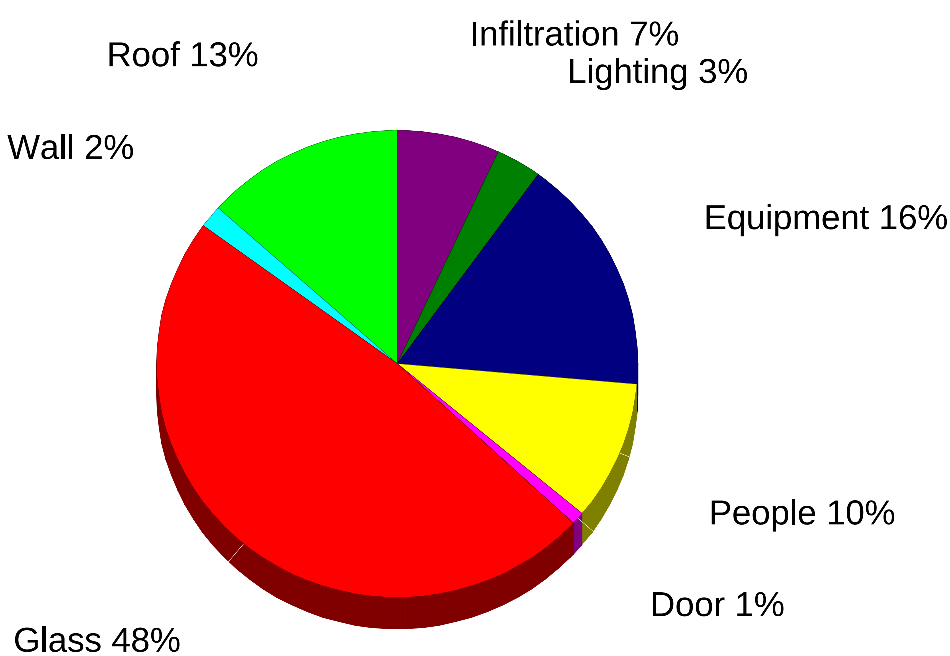
Total Heating Required Including Ventilation Air:	174,863	Btuh	174.863	MBH
Total Sensible Gain:	118,859	Btuh	92	%
Total Latent Gain:	10,156	Btuh	8	%
Total Cooling Required Including Ventilation Air:	129,015	Btuh	10.75	Tons (Based On Sensible + Latent)

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





Newport Town Offices
Energy Cost Analysis

for

Town Of Newport
15 Sunapee
Newport, NH

Elite Software

ENERGY AUDIT

Residential and Light Commercial Energy Analysis

Prepared By:

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

603-532-8979
Tuesday, December 7, 2021

Project Information

Project Title:	Newport Town Offices	Company Name:	S.E.E.D.S.
Designed By:		Company Rep.:	Margaret Dillon
Project Date:	Sunday, December 5, 2021	Company Address:	
Project Comment:		Company City:	
Client Name:	Town Of Newport	Company Phone:	603-532-8979
Client Address:	15 Sunapee	Company Fax:	
Client City:	Newport, NH	Company Comment:	
Client Phone:			
Client Fax:			
Client Comment:			

Cooling Equipment — System 1

Model Type: Standard Air Conditioner
Model Number:
Capacity: 140,000 Btuh
Efficiency: 9.5 SEER

Heating Equipment — System 1

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 633,000 Btuh
Efficiency: 82 AFUE

System Description: Existing Envelope & System

Cooling Equipment — System 2

Model Type: Standard Air Conditioner
Model Number:
Capacity: 140,000 Btuh
Efficiency: 9.5 SEER

Heating Equipment — System 2

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 633,000 Btuh
Efficiency: 82 AFUE

System Description: AS & Ceiling

Cooling Equipment — System 3

Model Type: Standard Air Conditioner
Model Number:
Capacity: 90,000 Btuh
Efficiency: 9.5 SEER

Heating Equipment — System 3

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 633,000 Btuh
Efficiency: 82 AFUE

System Description: New Windows

Cooling Equipment — System 4

Model Type: Standard Air Conditioner
Model Number:
Capacity: 90,000 Btuh
Efficiency: 9.5 SEER

Heating Equipment — System 4

Heating Equipment	System 4
Model Type:	Fuel Oil Boiler
Model Number:	
Capacity:	633,000 Btuh
Efficiency:	82 AFUE
System Description:	New Windows & Walls

Cooling Equipment	System 5
Model Type:	Standard Air Conditioner
Model Number:	
Capacity:	130,000 Btuh
Efficiency:	9.5 SEER

Heating Equipment	System 5
Model Type:	Fuel Oil Boiler
Model Number:	
Capacity:	633,000 Btuh
Efficiency:	82 AFUE
System Description:	Insulated Walls only

Cooling Equipment	System 6
Model Type:	Air Source Heat Pump
Model Number:	
Capacity:	130,000 Btuh
Efficiency:	18 SEER

Heating Equipment	System 6
Model Type:	Air Source Heat Pump
Model Number:	
Capacity:	633,000 Btuh
Efficiency:	11 HSPF
System Description:	Windows & ASHP

Project Summary

General Project Information

Project Title:	Newport Town Offices	Company Name:	S.E.E.D.S.
Project Date:	Sunday, December 5, 2021	Company Rep:	Margaret Dillon
Client Name:	Town Of Newport	Company Phone:	603-532-8979
Client Address:	15 Sunapee	Company E-Mail Address:	mdillon@myfairpoint.net
Client City:	Newport, NH		

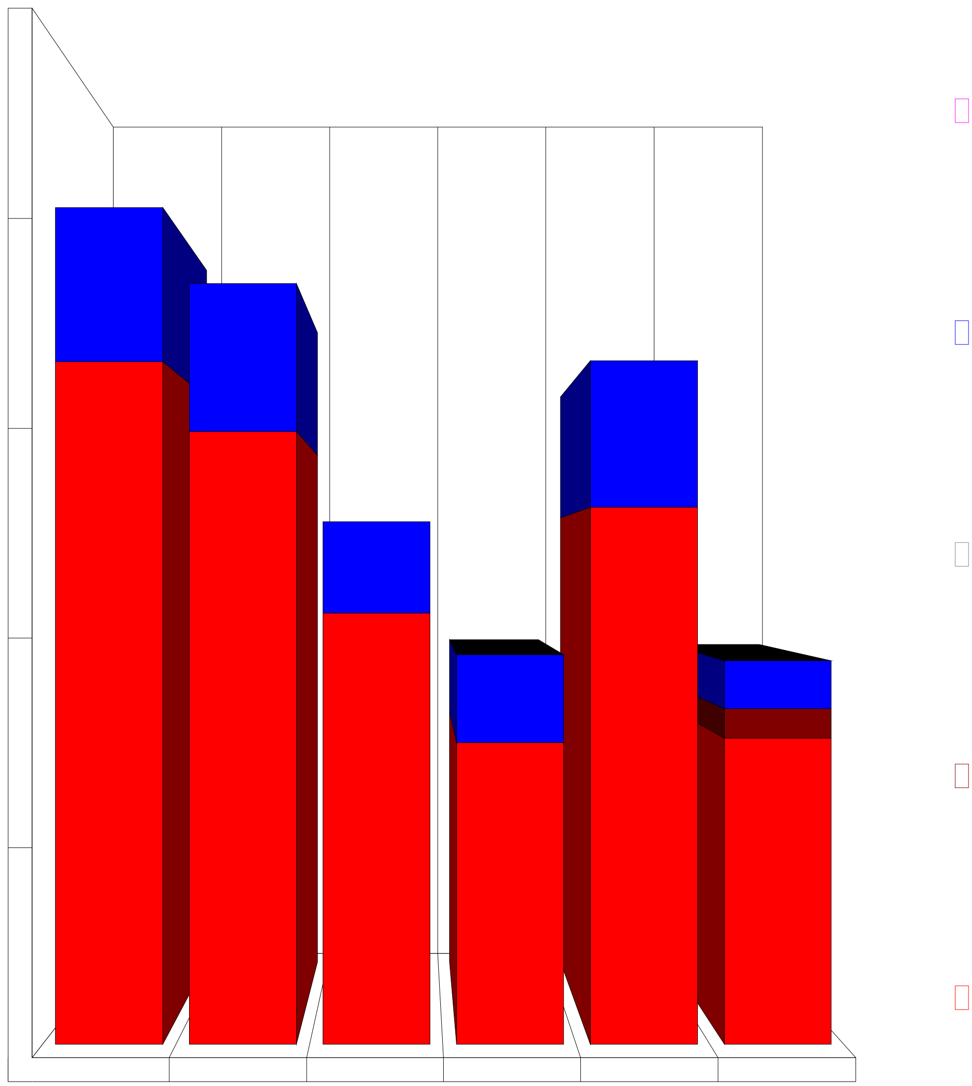
Design Data

Building Area:	9,443 sq.ft.	Cooling Load:	163,789 Btuh
People:	29	Heating Load:	221,526 Btuh
Occupancy:	10	Loads Adj. Factor:	0.77
		AC On Temp.:	74 °F
Actual City:	Concord AP, New Hampshire		
Weather Ref. City:	Concord, New Hampshire		
Summer Outdoor:	87 °F	Winter Outdoor:	-3 °F
Summer Indoor:	74 °F	Winter Indoor:	70 °F
Cooling Hours:	1,200	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 Envelope & System	1	$16,708	$3,778	$0	$20,486	$1,707
AS & Ceiling	1	$15,007	$3,610	$0	$18,617	$1,551
New Windows	1	$10,546	$2,254	$0	$12,800	$1,067
New Windows & Walls	1	$7,387	$2,143	$0	$9,530	$794
Insulated Walls only	1	$13,150	$3,585	$0	$16,735	$1,395
Windows & ASHP	1	$8,210	$1,190	$0	$9,400	$783

Project Summary Bar Chart



Input Data - System 1 - Existing Envelope & System

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:		
Efficiency:	9.50 SEER	
Capacity:	140,000 Btuh	
Cooling Load:	135,960 Btuh	
Annual Cost (Spec Cooling Hours Method):		$3,778.26
Heating		
System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	633,000 Btuh	$10,859.95
Oversize Penalty:	1.35	$5,847.66
Heating Load:	246,828 Btuh	
Annual Cost (Degree Days Method):		$16,707.61
Total Cost		
Total Annual Operating Cost:		$20,485.87

Input Data - System 2 - AS & Ceiling

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:		
Efficiency:	9.50 SEER	
Capacity:	140,000 Btuh	
Cooling Load:	129,908 Btuh	
Annual Cost (Spec Cooling Hours Method):		$3,610.07
Heating		
System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	633,000 Btuh	$9,754.45
Oversize Penalty:	1.35	$5,252.40
Heating Load:	221,702 Btuh	
Annual Cost (Degree Days Method):		$15,006.85
Total Cost		
Total Annual Operating Cost:		$18,616.93

Input Data - System 3 - New Windows

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:		
Efficiency:	9.50 SEER	
Capacity:	90,000 Btuh	
Cooling Load:	81,111 Btuh	
Annual Cost (Spec Cooling Hours Method):		$2,254.03
Heating		
System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	633,000 Btuh	$6,854.63
Oversize Penalty:	1.35	$3,690.95
Heating Load:	155,794 Btuh	
Annual Cost (Degree Days Method):		$10,545.58
Total Cost		
Total Annual Operating Cost:		$12,799.62

Input Data - System 4 - New Windows & Walls

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:		
Efficiency:	9.50 SEER	
Capacity:	90,000 Btuh	
Cooling Load:	77,128 Btuh	
Annual Cost (Spec Cooling Hours Method):		$2,143.35
Heating		
System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	633,000 Btuh	$4,801.55
Oversize Penalty:	1.35	$2,585.45
Heating Load:	109,131 Btuh	
Annual Cost (Degree Days Method):		$7,387.00
Total Cost		
Total Annual Operating Cost:		$9,530.35

Input Data - System 5 - Insulated Walls only

		Estimated Cost
Cooling		
System Type:	Standard Air Conditioner	
Model:		
Efficiency:	9.50 SEER	
Capacity:	130,000 Btuh	
Cooling Load:	129,015 Btuh	
Annual Cost (Spec Cooling Hours Method):		$3,585.26
Heating		
System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	633,000 Btuh	$8,547.37
Oversize Penalty:	1.35	$4,602.43
Heating Load:	194,267 Btuh	
Annual Cost (Degree Days Method):		$13,149.79
Total Cost		
Total Annual Operating Cost:		$16,735.05

Input Data - System 6 - Windows & ASHP

		Estimated Cost
Cooling		
System Type:	Air Source Heat Pump	
Model:		
Efficiency:	18.00 SEER	
Capacity:	130,000 Btuh	
Cooling Load:	81,111 Btuh	
Annual Cost (Spec Cooling Hours Method):		$1,189.63
Heating		
System Type:	Air Source Heat Pump	
Model:		
Efficiency:	11 HSPF	
Capacity:	633,000 Btuh	
Heating Load:	155,794 Btuh	
47° Capacity:	120,000 Btuh	
17° Capacity:	120,000 Btuh	
47° COP:	3.7	
17° COP:	2.2	
Capacity Balance Point:	14 °F	
Cutoff Temperature:	5 °F	
Annual Cost (Bin Data Method):		$7,495.80
Backup		
System Type:	Fuel Oil Boiler	
Efficiency:	82.00	
Capacity:	633,000 Btuh	
Annual Cost:		$714.18
Total Cost		
Total Annual Operating Cost:		$9,399.60

Monthly Costs - System 1 - Existing Envelope & System

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$3,005.27	100.0%	$3,005.27
February	$0.00	0.0%	$2,519.15	100.0%	$2,519.15
March	$0.00	0.0%	$2,275.32	100.0%	$2,275.32
April	$33.00	2.4%	$1,317.67	97.6%	$1,350.67
May	$350.61	34.1%	$677.22	65.9%	$1,027.83
June	$850.05	75.1%	$281.34	24.9%	$1,131.39
July	$1,238.75	91.1%	$120.59	8.9%	$1,359.34
August	$943.29	79.0%	$250.44	21.0%	$1,193.73
September	$308.52	36.6%	$535.36	63.4%	$843.88
October	$54.04	4.7%	$1,105.56	95.3%	$1,159.61
November	$0.00	0.0%	$1,766.19	100.0%	$1,766.19
December	$0.00	0.0%	$2,853.50	100.0%	$2,853.50
Total	$3,778.26	18.4%	$16,707.61	81.6%	$20,485.87

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	$3,005.27	1,001.8
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,519.15	839.7
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,275.32	758.4
April	$33.00	150.0	$0.00	0.0	$0.00	0.0	$1,317.67	439.2
May	$350.61	1,593.7	$0.00	0.0	$0.00	0.0	$677.22	225.7
June	$850.05	3,863.8	$0.00	0.0	$0.00	0.0	$281.34	93.8
July	$1,238.75	5,630.7	$0.00	0.0	$0.00	0.0	$120.59	40.2
August	$943.29	4,287.7	$0.00	0.0	$0.00	0.0	$250.44	83.5
September	$308.52	1,402.4	$0.00	0.0	$0.00	0.0	$535.36	178.5
October	$54.04	245.6	$0.00	0.0	$0.00	0.0	$1,105.56	368.5
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,766.19	588.7
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,853.50	951.2
Total	$3,778.26	17,173.9	$0.00	0.0	$0.00	0.0	$16,707.61	5,569.2

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	163,152,000 BTU
Total annual heating load energy:	606,263,680 BTU

Monthly Costs - System 2 - AS & Ceiling

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$2,699.35	100.0%	$2,699.35
February	$0.00	0.0%	$2,262.72	100.0%	$2,262.72
March	$0.00	0.0%	$2,043.70	100.0%	$2,043.70
April	$31.53	2.6%	$1,183.54	97.4%	$1,215.07
May	$335.00	35.5%	$608.28	64.5%	$943.28
June	$812.21	76.3%	$252.70	23.7%	$1,064.91
July	$1,183.61	91.6%	$108.31	8.4%	$1,291.92
August	$901.30	80.0%	$224.95	20.0%	$1,126.25
September	$294.79	38.0%	$480.86	62.0%	$775.65
October	$51.64	4.9%	$993.02	95.1%	$1,044.66
November	$0.00	0.0%	$1,586.40	100.0%	$1,586.40
December	$0.00	0.0%	$2,563.03	100.0%	$2,563.03
Total	$3,610.07	19.4%	$15,006.85	80.6%	$18,616.93

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	$2,699.34	899.8
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,262.72	754.2
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,043.70	681.2
April	$31.53	143.3	$0.00	0.0	$0.00	0.0	$1,183.54	394.5
May	$335.00	1,522.7	$0.00	0.0	$0.00	0.0	$608.28	202.8
June	$812.21	3,691.9	$0.00	0.0	$0.00	0.0	$252.70	84.2
July	$1,183.61	5,380.0	$0.00	0.0	$0.00	0.0	$108.31	36.1
August	$901.30	4,096.8	$0.00	0.0	$0.00	0.0	$224.95	75.0
September	$294.79	1,340.0	$0.00	0.0	$0.00	0.0	$480.86	160.3
October	$51.64	234.7	$0.00	0.0	$0.00	0.0	$993.02	331.0
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,586.40	528.8
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,563.03	854.3
Total	$3,610.08	16,409.4	$0.00	0.0	$0.00	0.0	$15,006.85	5,002.3

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	155,889,600 BTU
Total annual heating load energy:	544,548,736 BTU

Monthly Costs - System 3 - New Windows

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$1,896.88	100.0%	$1,896.88
February	$0.00	0.0%	$1,590.05	100.0%	$1,590.05
March	$0.00	0.0%	$1,436.15	100.0%	$1,436.15
April	$19.69	2.3%	$831.69	97.7%	$851.38
May	$209.16	32.9%	$427.45	67.1%	$636.62
June	$507.12	74.1%	$177.58	25.9%	$684.70
July	$739.01	90.7%	$76.11	9.3%	$815.13
August	$562.75	78.1%	$158.07	21.9%	$720.82
September	$184.06	35.3%	$337.91	64.7%	$521.97
October	$32.24	4.4%	$697.81	95.6%	$730.05
November	$0.00	0.0%	$1,114.79	100.0%	$1,114.79
December	$0.00	0.0%	$1,801.09	100.0%	$1,801.09
Total	$2,254.03	17.6%	$10,545.58	82.4%	$12,799.62

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	$1,896.88	632.3
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,590.05	530.0
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,436.15	478.7
April	$19.69	89.5	$0.00	0.0	$0.00	0.0	$831.69	277.2
May	$209.16	950.7	$0.00	0.0	$0.00	0.0	$427.45	142.5
June	$507.12	2,305.1	$0.00	0.0	$0.00	0.0	$177.58	59.2
July	$739.01	3,359.1	$0.00	0.0	$0.00	0.0	$76.11	25.4
August	$562.75	2,557.9	$0.00	0.0	$0.00	0.0	$158.07	52.7
September	$184.06	836.6	$0.00	0.0	$0.00	0.0	$337.91	112.6
October	$32.24	146.5	$0.00	0.0	$0.00	0.0	$697.81	232.6
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,114.79	371.6
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,801.09	600.4
Total	$2,254.03	10,245.6	$0.00	0.0	$0.00	0.0	$10,545.58	3,515.2

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	97,333,200 BTU
Total annual heating load energy:	382,664,224 BTU

Monthly Costs - System 4 - New Windows & Walls

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$1,328.73	100.0%	$1,328.73
February	$0.00	0.0%	$1,113.80	100.0%	$1,113.80
March	$0.00	0.0%	$1,006.00	100.0%	$1,006.00
April	$18.72	3.1%	$582.59	96.9%	$601.31
May	$198.89	39.9%	$299.42	60.1%	$498.32
June	$482.22	79.5%	$124.39	20.5%	$606.61
July	$702.72	92.9%	$53.32	7.1%	$756.04
August	$535.11	82.9%	$110.73	17.1%	$645.84
September	$175.02	42.5%	$236.70	57.5%	$411.72
October	$30.66	5.9%	$488.81	94.1%	$519.46
November	$0.00	0.0%	$780.89	100.0%	$780.89
December	$0.00	0.0%	$1,261.63	100.0%	$1,261.63
Total	$2,143.35	22.5%	$7,387.00	77.5%	$9,530.35

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	$1,328.73	442.9
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,113.80	371.3
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,005.99	335.3
April	$18.72	85.1	$0.00	0.0	$0.00	0.0	$582.59	194.2
May	$198.89	904.1	$0.00	0.0	$0.00	0.0	$299.42	99.8
June	$482.22	2,191.9	$0.00	0.0	$0.00	0.0	$124.39	41.5
July	$702.72	3,194.2	$0.00	0.0	$0.00	0.0	$53.32	17.8
August	$535.11	2,432.3	$0.00	0.0	$0.00	0.0	$110.73	36.9
September	$175.02	795.5	$0.00	0.0	$0.00	0.0	$236.70	78.9
October	$30.66	139.3	$0.00	0.0	$0.00	0.0	$488.81	162.9
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$780.89	260.3
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,261.63	420.5
Total	$2,143.35	9,742.5	$0.00	0.0	$0.00	0.0	$7,387.00	2,462.3

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	92,553,600 BTU
Total annual heating load energy:	268,049,648 BTU

Monthly Costs - System 5 - Insulated Walls only

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$2,365.31	100.0%	$2,365.31
February	$0.00	0.0%	$1,982.71	100.0%	$1,982.71
March	$0.00	0.0%	$1,790.80	100.0%	$1,790.80
April	$31.32	2.9%	$1,037.08	97.1%	$1,068.39
May	$332.70	38.4%	$533.01	61.6%	$865.71
June	$806.63	78.5%	$221.43	21.5%	$1,028.06
July	$1,175.47	92.5%	$94.91	7.5%	$1,270.38
August	$895.11	82.0%	$197.11	18.0%	$1,092.22
September	$292.76	41.0%	$421.36	59.0%	$714.12
October	$51.28	5.6%	$870.14	94.4%	$921.42
November	$0.00	0.0%	$1,390.08	100.0%	$1,390.08
December	$0.00	0.0%	$2,245.86	100.0%	$2,245.86
Total	$3,585.26	21.4%	$13,149.79	78.6%	$16,735.05

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	$2,365.31	788.4
February	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,982.71	660.9
March	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,790.80	596.9
April	$31.32	142.3	$0.00	0.0	$0.00	0.0	$1,037.08	345.7
May	$332.70	1,512.3	$0.00	0.0	$0.00	0.0	$533.01	177.7
June	$806.63	3,666.5	$0.00	0.0	$0.00	0.0	$221.43	73.8
July	$1,175.47	5,343.0	$0.00	0.0	$0.00	0.0	$94.91	31.6
August	$895.11	4,068.7	$0.00	0.0	$0.00	0.0	$197.11	65.7
September	$292.76	1,330.7	$0.00	0.0	$0.00	0.0	$421.36	140.5
October	$51.28	233.1	$0.00	0.0	$0.00	0.0	$870.14	290.0
November	$0.00	0.0	$0.00	0.0	$0.00	0.0	$1,390.08	463.4
December	$0.00	0.0	$0.00	0.0	$0.00	0.0	$2,245.86	748.6
Total	$3,585.26	16,296.6	$0.00	0.0	$0.00	0.0	$13,149.79	4,383.3

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	154,818,000 BTU
Total annual heating load energy:	477,162,336 BTU

Monthly Costs - System 6 - Windows & ASHP

Monthly System Cost

	Cooling		Heating		Total
Month	Cost	%	Cost	%	Cost
January	$0.00	0.0%	$1,652.56	100.0%	$1,652.56
February	$0.00	0.0%	$1,321.21	100.0%	$1,321.21
March	$0.00	0.0%	$1,090.40	100.0%	$1,090.40
April	$10.39	1.8%	$559.57	98.2%	$569.96
May	$110.39	27.8%	$286.30	72.2%	$396.69
June	$267.65	68.3%	$124.27	31.7%	$391.92
July	$390.03	87.2%	$57.48	12.8%	$447.52
August	$297.01	72.5%	$112.68	27.5%	$409.69
September	$97.14	29.3%	$233.90	70.7%	$331.04
October	$17.02	3.5%	$476.10	96.5%	$493.11
November	$0.00	0.0%	$790.17	100.0%	$790.17
December	$0.00	0.0%	$1,505.32	100.0%	$1,505.32
Total	$1,189.63	12.7%	$8,209.98	87.3%	$9,399.60

Monthly Fuel Usage and Cost

	Electricity		Natural Gas		Propane		Fuel Oil	
Month	Cost	kWh	Cost	Therm	Cost	Gallons	Cost	Gallons
January	$1,447.58	6,579.9	$0.00	0.0	$0.00	0.0	$204.99	68.3
February	$1,080.29	4,910.4	$0.00	0.0	$0.00	0.0	$240.93	80.3
March	$1,090.40	4,956.3	$0.00	0.0	$0.00	0.0	$0.00	0.0
April	$569.96	2,590.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
May	$396.69	1,803.1	$0.00	0.0	$0.00	0.0	$0.00	0.0
June	$391.92	1,781.5	$0.00	0.0	$0.00	0.0	$0.00	0.0
July	$447.52	2,034.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
August	$409.69	1,862.2	$0.00	0.0	$0.00	0.0	$0.00	0.0
September	$331.04	1,504.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
October	$493.11	2,241.4	$0.00	0.0	$0.00	0.0	$0.00	0.0
November	$790.17	3,591.7	$0.00	0.0	$0.00	0.0	$0.00	0.0
December	$1,237.05	5,623.0	$0.00	0.0	$0.00	0.0	$268.27	89.4
Total	$8,685.42	39,479.2	$0.00	0.0	$0.00	0.0	$714.18	238.1

Average Electric Cost Per kWh:	$0.220/kWh
Average Fuel Oil Cost Per Gallon:	$3.000/Gallon
Total annual cooling load energy:	97,333,200 BTU
Total annual heating load energy:	461,798,880 BTU

Bin Analysis Report - System 6 - Windows & ASHP

Bin Temp Ranges Degree F	Hours Per Bin	Heating Load Btuh	Adjusted Load (x 0.77)	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	187,807	144,611	0	0.000	144,611	0.00	3.86	3.86
-15 to -10	18	177,136	136,394	0	0.000	136,394	0.00	65.66	65.66
-10 to -5	19	166,465	128,178	0	0.000	128,178	0.00	65.32	65.32
-5 to 0	52	155,794	119,961	0	0.000	119,961	0.00	167.97	167.97
0 to 5	136	145,123	111,745	0	0.000	111,745	0.00	411.36	411.36
5 to 10	154	134,452	103,528	103,528	0.863	0	587.26	0.00	587.26
10 to 15	209	123,782	95,312	95,312	0.794	0	642.02	0.00	642.02
15 to 20	312	113,111	87,095	87,095	0.726	0	778.49	0.00	778.49
20 to 25	385	102,440	78,879	78,879	0.657	0	783.01	0.00	783.01
25 to 30	666	91,769	70,662	70,662	0.589	0	1,103.10	0.00	1,103.10
30 to 35	878	81,098	62,446	62,446	0.520	0	1,178.05	0.00	1,178.05
35 to 40	650	70,427	54,229	54,229	0.452	0	699.12	0.00	699.12
40 to 45	658	59,757	46,013	46,013	0.383	0	557.60	0.00	557.60
45 to 50	679	49,086	37,796	37,796	0.315	0	441.13	0.00	441.13
50 to 55	619	38,415	29,580	29,580	0.246	0	295.06	0.00	295.06
55 to 60	717	27,744	21,363	21,363	0.178	0	232.32	0.00	232.32
60 to 65	685	17,073	13,146	13,146	0.110	0	129.00	0.00	129.00
Totals:	6,838						$7,495.80	$714.18	$8,209.98