

Town of Fairhaven, Massachusetts

Energy Reduction Plan

Prepared by the Southeastern Regional Planning and Economic Development District (SRPEDD) with support from the Town of Fairhaven



In Fulfillment of the
Massachusetts Green Communities Grant Program
Criterion #3

October 2018

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I. Purpose and Acknowledgements

A. Letter from the General Government Verifying Adoption of the Energy Reduction Plan

Town of Fairhaven
Office of the Town Administrator
Fairhaven Town Hall
40 Center Street
Fairhaven, MA 01845

October 26, 2018

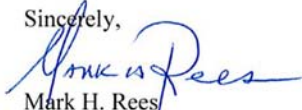
Mr. Seth Pickering
Southeast Regional Coordinator
Green Communities Division
20 Riverside Drive
Lakeville, MA

Dear Seth,

At their October 22, 2018 meeting, the Fairhaven Board of Selectmen authorized me, as Town Administrator, to adopt on their behalf the Town of Fairhaven Energy Reduction Plan for inclusion in the Town's application to the Commonwealth's Green Communities Program.

As such, please be informed that on this date, October 26, 2018, I have adopted the Energy Reduction Plan as authorized by the Board of Selectmen. The Town of Fairhaven looks forward to working the Green Communities Program as we move forward with implementing the plan.

Sincerely,


Mark H. Rees
Town Administrator
Town of Fairhaven

cc: Board of Selectmen

B. Letter from the School District Verifying Adoption of the Energy Reduction Plan

Office of the Superintendent
FAIRHAVEN PUBLIC SCHOOL DISTRICT

ADMINISTRATIVE CENTER
128 Washington Street
Fairhaven, MA 02719

Phone: 508-979-4000
Fax: 508-979-4149
Website: www.fairhavenps.org



Robert N. Baldwin, Ed.D.
Superintendent of Schools

Tara M. Kohler
Assistant Superintendent

Diane S. Sullivan
Director of Student Services

Nicole V. Potter
Director of Technology and Finance

October 26, 2018

To Whom It May Concern:

I have reviewed the Fairhaven Energy Reduction Plan. On behalf of the Fairhaven Public Schools I find this plan acceptable and support the adoption of the plan.

Sincerely,

A handwritten signature in blue ink, appearing to be 'Robert N. Baldwin', written over a horizontal line.

Robert N. Baldwin, Ed.D.
Superintendent of Schools

RNB/jt

C. List of Contributors

The collaborative efforts of the offices of Fairhaven Town Administrator Mark Rees, Board of Selectmen Clerk Robert J. Espindola, Public Works Superintendent Vincent D. Furtado, Fairhaven Schools Superintendent Robert N. Baldwin, and MA Department of Energy Resources Green Community Regional Coordinator Seth Pickering were all vital in the production this Plan.

Much of the information in this Plan was derived from energy audits performed by Energy Source, led by Dalton Ling. Additional technical assistance was provided by the Southeastern Regional Planning and Economic Development District (SRPEDD), the author of this Plan.

II. Executive Summary

A. Narrative Summary of the Town

The Town of Fairhaven is located in southeastern Massachusetts in southeastern Bristol County. Fairhaven is located 50 miles south of Boston and 35 miles east of Providence, Rhode Island. The town has an approximate area of 14.1 square miles and is bordered by Acushnet on the north; Mattapoissett on the east; Buzzards Bay on the south; and New Bedford on the west. According to the 2010 U.S. Census, Fairhaven had a population of 15,873, having experienced a 1.8% decrease in population since 2000.

The area that is now Fairhaven was first settled by white settlers in 1659. Originally part of New Bedford, the town separated and incorporated as its own community in 1812. Originally an agricultural and shipbuilding community, it's economy expanded into the whaling industry and its related marine trades in the 19th century. The 20th century saw the decline of the whaling industry and new maritime industries emerge in Fairhaven – fishing and ship maintenance, which are still part of the towns economy, although retail trade is now the leading segment of the economy.

Fairhaven is accessible to the larger southeastern Massachusetts region via the east-west Interstate 195 and Route 6.

B. Summary of Municipal Energy Uses

- Total Number of Municipal Buildings: 16
- Total Number of Municipal Vehicles: 95
- Total Number of Street Lights: XXX
- Total Number of Traffic Lights: XX
- Water & Sewer: Fairhaven is serviced for water by the Mattapoissett River Valley Water Supply District Commission (MRVWDC). The Town's Sewer Division manages the town's wastewater and includes 2 wastewater treatment plants and 15 wastewater pumping stations.

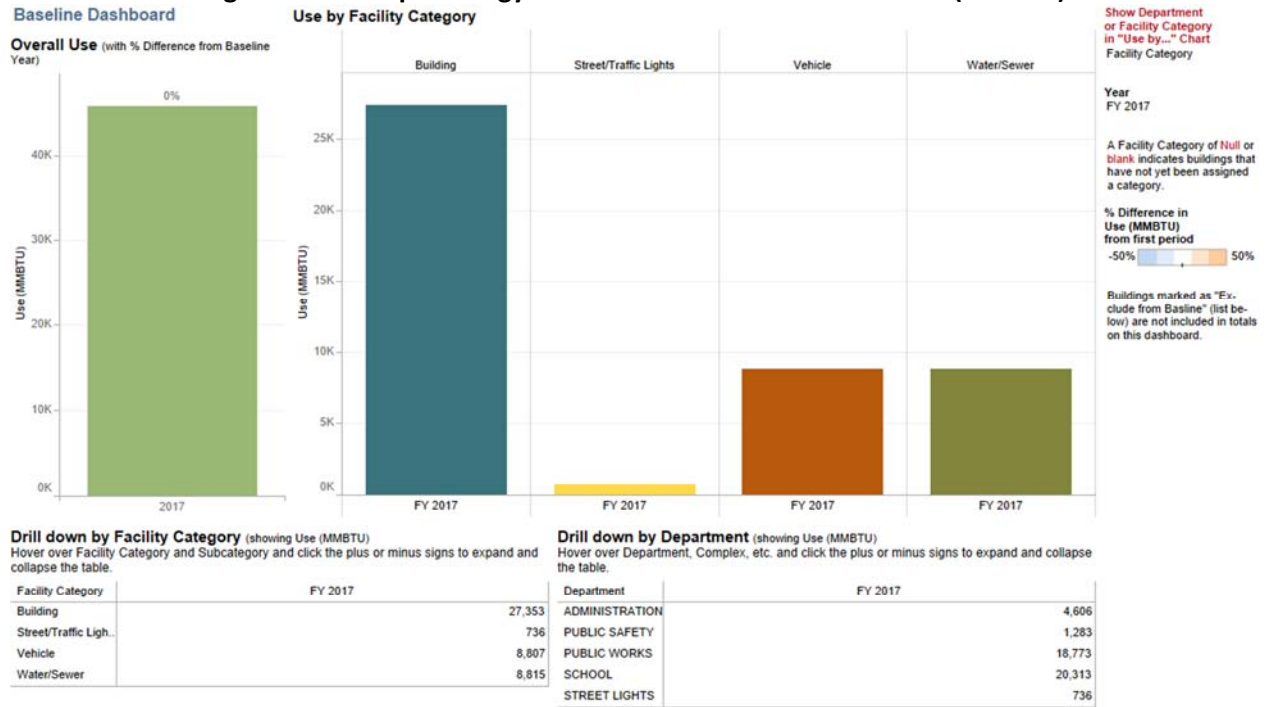
Table 1: Municipal Energy Use Summary

	Number	Ownership
Buildings	16	
Electricity	2	Municipality
Natural Gas Heat	14	Municipality
Vehicles	95	
Non-Exempt	6	Municipality
Exempt	89	Municipality
Street Lights	XXX	Municipality
Traffic Lights	XX	Municipality
Water & Sewer	17	
Wastewater Treatment Plant	2	Municipality
Wastewater Pumping Station	15	Municipality

C. Summary of Energy Use Baseline and Plans for Reductions

This Energy Reduction Plan commits Fairhaven to reduce energy use in municipal facilities by at least 20% compared to Fiscal Year 2017 over five years. In the baseline year, the town used 45,711 MMBTUs of energy, which means the town must reduce usage by at least 9,142 MMBTUs over the following five-year period.

Figure 1: Municipal Energy Use Baseline Dashboard from MEI (FY 2017)



Fairhaven has identified energy savings measures in each facility category to reduce energy use 20% based on the total baseline usage, as illustrated in Table 2.

Table 2: Summary of Municipal Energy Use and Reductions

Facility Category	MMBTU Used in Baseline Year	% of Total MMBtu Baseline Energy Consumption	Projected Planned MMBtu Savings	Savings as % of Total MMBtu Baseline Energy Consumption
Buildings	27,353	59.8%	7,346	16.1%
Vehicles	8,807	19.3%	530	1.2%
Street/Traffic Lights	736	1.6%	0	0.0%
Water/Sewer/Pumping	8,815	19.3%	649	1.4%
Total	45,711	100%	8,525	18.6%

III. Energy Use Baseline Inventory

A. Identification of the Inventory Tool Used: The Town of Fairhaven used the Department of Energy Resources (DOER) MassEnergyInsight (MEI) web-based energy inventory and analysis tool.

B. Identification of the Baseline Year: Fiscal Year (FY) 2017 will serve as the baseline year. FY 2017 ran from July 1, 2016 to June 30, 2017. This will give the Town until June 30, 2022 (FY 2018 – FY 2022) to reach its 20% energy reduction goal.

C. Municipal Energy Consumption for the Baseline Year (FY 2017): In baseline year, the town used 45,711 MMBTUs of energy. The Appendix presents energy use for each municipal facility in MMBTUs and native units.

- Buildings: Fairhaven's 16 buildings use 27,353 MMBTUs, approximately 59.8% of Fairhaven's total municipal energy use. The buildings with the largest energy use are Fairhaven High School (10,802 MMBTUs) and the Elizabeth Hastings Middle School (5,691 MMBTUs) as shown in Figure 2.
- Street/Traffic Lights: There are XX streetlights and X traffic lights in Fairhaven. These lights consume 736 MMBTUs, or 1.6% of the Town's energy use.
- Vehicles: Fairhaven's 95 municipal vehicles use 19.3% of the baseline total, or 8,807 MMBTUs.
- Water/Sewer Facilities: The Town of Fairhaven is serviced for water by the Mattapoissett River Valley Water Supply District Commission and by the Town's Water/Sewer Department for wastewater. Water/Sewer facilities consume 8,815 MMBTUs, or 19.3% of the town's energy use.

Table 3A: Municipal Energy Consumption for FY2016, Native Fuel Units
ERP Guidance Table 3a - Municipal Energy Consumption for 2017 (Native Fuel Units)

		2017			
		Electric (kWh)	Gas (therms)	Gasoline (gallons)	Diesel (gallons)
Building	Leroy Wood ES	1,496			
	Public Works Office and Gara..	26,040	10,318		
	Police Station		3,863		
	East Fairhaven ES	360,520	24,896		
	Hastings MS	293,600	46,895		
	Town Hall	79,988	12,635		
	Rogers ES	5,840	0		
	School Dept. Admin.	19,530			
	Fairhaven Hist Comm	800	844		
	Oxford ES	2,320	0		
	Dump Building (EMA)	4,913			
	LRO-Karate School	4,750			
	Fire Department	170,883	3,083		
	Fire Station #5	1,670			
	Fairhaven HS	547,995	89,325		
	Senior Center/COA	63,289	4,850		
	Recreation Center	89,280	7,262		
	Animal Shelter / Dog Kennel	14,123	1,802		
	Cushman Park Band Shell (75..	4,147			
	Millicent Library	58,641	8,057		
	Total	1,749,825	213,830		
	Street/Traffic Lights	Flood Lights	5,568		
West Island Town Beach Park..		1,856			
Streetlights		208,164			
Total		215,588			
Vehicle	Vehicles			42,053	25,845
	Total			42,053	25,845

Water/Sewer	Manhattan Ave Pumping Stati..	34,385			
	Scoticut Neck Water Tank/Gr..	702			
	Railroad Ave Sewer Pump Sta..	112,880			
	Mill Rd 'Pump Station' (Storag..	1,048			
	River Road Pump Station (Sto..	573	10,423		
	Pease Park Storm Drain Pum..	1,648			
	South Street Sewer Pumping ..	301,200			
	Pilgrim Ave Sewer Pumping S..	22,398			
	Taber Street Sewer Pumping ..	175,213			
	Abbey St Sewer Pumping Stat..	16,345			
	Bridge St Sewer Pumping Stat..	2,862			
	Tinkham Lane Well Pumping ..	111,400			
	Boston Hill Water Tank	705			
	215 Alden Sewer Pump Statio..	83			
	239 Alden Sewer Pump Statio..	438			
	240 Alden Sewer Pump Statio..	56			
	Pine Grove Sewer Pump Stati..	7,836			
	West Island Satellite Wastewa..	53,359			
	Causeway Road Pumping Sta..	10,418			
	James St Sewer Pump Station	2,210			
	Wolf Island Well Pumping Stat..	82,708			
	Rocky Point Sewer Pump Stat..	6,203			
	Marguerite Sewer Pump Stati..	6,320	20		
	Bernese St Sewer Pump Stati..	28,592	276		
	Camel St Sewer Pump Station	3,430			
	Shore Drive Sewer Pump Stat..	3,157			
	Sunrise Court Sewer Pump St..	3,575			
	Weybridge Sewer Pump Stati..	4,517			
	Rivard St Pump Station	11,532			
	Sewer Ops. Building	1,030,460	3,430		
Unassigned Water/Sewer Acc..		4,522			
Total	2,036,253	18,671			
Grand Total	4,001,666	232,501	42,053	25,845	

Table 3B: Municipal Energy Consumption for FY2016, MMBTU
ERP Guidance Table 3b - Municipal Energy Consumption for 2017
(MMBTU)

Please make sure that any data submitted to DOER contains complete Data!

		2017					
		Diesel	Electric	Gas	Gasoline	Total	
Building	Leroy Wood ES		5			5	
	Public Works Office and Gara..		89	1,032		1,121	
	Police Station			386		386	
	East Fairhaven ES		1,230	2,490		3,720	
	Hastings MS		1,002	4,690		5,691	
	Town Hall		273	1,264		1,536	
	Rogers ES		20	0		20	
	School Dept. Admin.		67			67	
	Fairhaven Hist Comm		3	84		87	
	Oxford ES		8	0		8	
	Dump Building (EMA)		17			17	
	LRO-Karate School		16			16	
	Fire Department			583	308		891
	Fire Station #5			6			6
	Fairhaven HS			1,870	8,933		10,802
	Senior Center/COA			216	485		701
	Recreation Center			305	726		1,031
	Animal Shelter / Dog Kennel			48	180		228
	Cushman Park Band Shell (75..			14			14
	Millicent Library			200	806		1,006
Total			5,970	21,383		27,353	
Street/Traffic Lights	Flood Lights		19			19	
	West Island Town Beach Park..		6			6	
	Streetlights		710			710	
	Total		736			736	
Vehicle	Vehicles	3,592			5,215	8,807	
	Total	3,592			5,215	8,807	

Water/Sewer	Manhattan Ave Pumping Stati..		117			117
	Sconticut Neck Water Tank/Gr..		2			2
	Railroad Ave Sewer Pump Sta..		385			385
	Mill Rd 'Pump Station' (Storag..		4			4
	River Road Pump Station (Sto..		2	1,042		1,044
	Pease Park Storm Drain Pum..		6			6
	South Street Sewer Pumping ..		1,028			1,028
	Pilgrim Ave Sewer Pumping S..		76			76
	Taber Street Sewer Pumping ..		598			598
	Abbey St Sewer Pumping Stat..		56			56
	Bridge St Sewer Pumping Stat..		10			10
	Tinkham Lane Well Pumping ..		380			380
	Boston Hill Water Tank		2			2
	215 Alden Sewer Pump Statio..		0			0
	239 Alden Sewer Pump Statio..		1			1
	240 Alden Sewer Pump Statio..		0			0
	Pine Grove Sewer Pump Stati..		27			27
	West Island Satellite Wastewa..		182			182
	Causeway Road Pumping Sta..		36			36
	James St Sewer Pump Station		8			8
	Wolf Island Well Pumping Stat..		282			282
	Rocky Point Sewer Pump Stat..		21			21
	Marguerite Sewer Pump Stati..		22	2		24
	Bernese St Sewer Pump Stati..		98	28		125
	Camel St Sewer Pump Station		12			12
	Shore Drive Sewer Pump Stat..		11			11
	Sunrise Court Sewer Pump St..		12			12
	Weybridge Sewer Pump Stati..		15			15
	Rivard St Pump Station		39			39
	Sewer Ops. Building		3,516	343		3,859
	Unassigned Water/Sewer Acc..			452		452
	Total		6,948	1,867		8,815
Grand Total		3,592	13,654	23,250	5,215	45,711

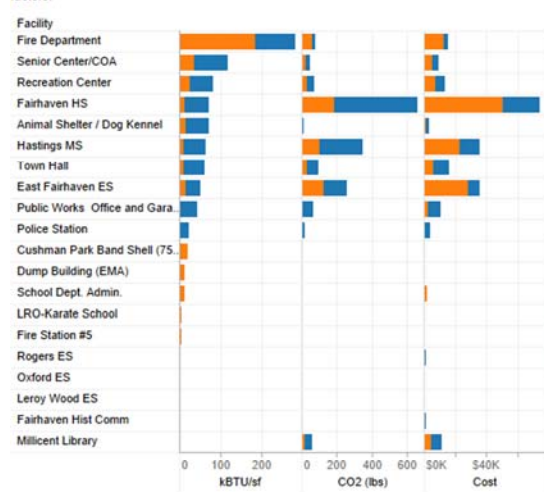
Figure 2: MEIs Buildings to Target Dashboard

In Figure 2 below, the points further to the right have a higher energy use per square foot (i.e. less energy efficient), while the points higher up use more total energy. Fairhaven High School, for example, uses the most energy of any building in Fairhaven.

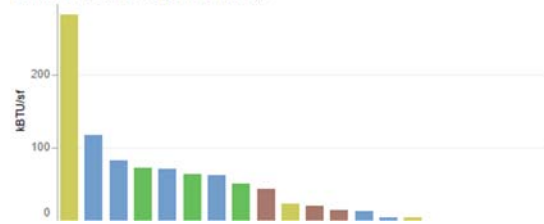
Buildings to Target

This dashboard compares buildings to one other on an energy use per area metric, measured as kBtu/square foot. In the quadrant chart on the right, buildings with the highest energy use and worst efficiency (as compared to other buildings in your portfolio) are in the upper right hand quadrant. Facilities of the types Open Space, Water/Sewer, Street/Traffic Lights, and Vehicles are not displayed. Diesel and Gasoline records attached to a building are not included in the kBtu/SF calculation.

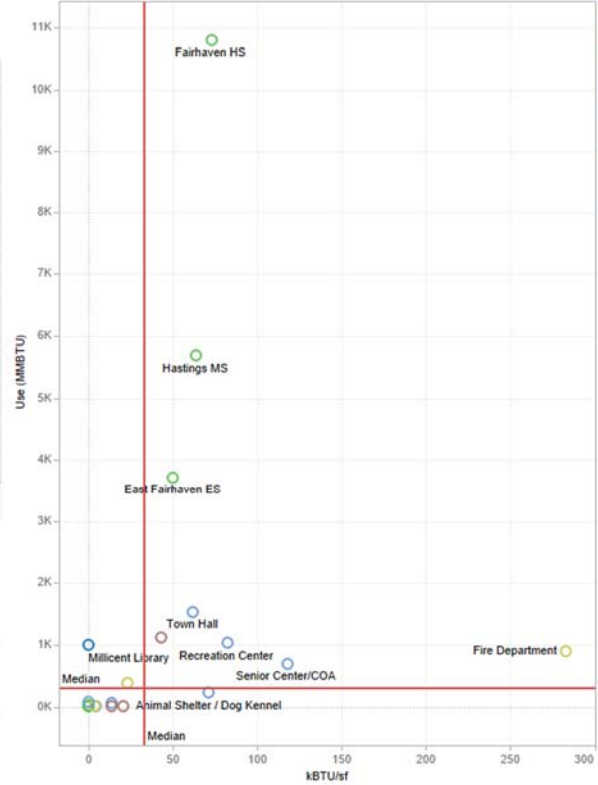
Building Efficiency, Emissions and Cost



Select a building name above to see how efficient it is compared to your other buildings. Lower numbers indicate greater efficiency.



Efficiency and Use



Building Subcategory
Click to highlight and unhighlight

- Null
- Administration
- Public Safety
- Public Works
- School

Building Subcategory All

Year FY 2017

Fuel types All

IV. Energy Reduction Plan

A. Narrative Summary

As shown below, the town has identified energy savings measures to reduce usage from FY 2017 by 8,647 MMBTUs or 18.9%.

▪ **Install Condensing Boilers**

It is recommended new condensing boilers are installed at a few buildings in Fairhaven. Condensing boilers (average efficiency 92%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%). The scope of this work includes the following:

- Supply and install Lochinvar condensing boilers
- Removal and disposal of existing boilers and all necessary piping and components of the old system no longer required
- Installation of direct venting system for combustion air and exhaust air
- Install outside air controls for maximum efficiency
- Commissioning and startup of new boiler systems

By implementing this measure at the High School, East Fairhaven Elementary School, Library, Department of Public Works, Fire Station, and Wastewater Treatment Plant, the town will save 22,005 therms and \$26,406 annually.

▪ **Install LED Lighting and Controls**

It is recommended that high efficiency LED light fixtures/kits are installed to replace the fluorescent fixtures. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology. The scope of this work includes the following:

- Supply and installing new LED lighting fixtures/kits
- Remove and recycle existing fluorescent fixtures
- Warranty on new LED lighting fixtures of seven years

By implementing this measure at the High School, Hastings Middle School, Leroy Wood Elementary School, East Fairhaven Elementary School, School Department Administration Building, Council on Aging, Recreation Center, Town Hall, Department of Public Works, Police Station, Fire Station, and Wastewater Treatment Plant, the town will save 535,908 kWh of electricity and \$91,104 annually.

▪ **Install Energy Management Systems**

It is recommended that an Energy Management System will be installed or will replace the existing obsolete systems. Energy Savings will also occur from the new furnished controls to tighten and refine building temperature conditions. In conjunction with the local controllers and their energy savings features, it will also allow for remote control, monitoring and alarming of the mechanical equipment. The full scope of work is shown below:

- Provide and install new controllers on a variety of mechanical equipment the High School, Hastings Middle School, Senior Center/Recreation Center, Town Hall, and Library.
- Provide and install a supervisory controller which will include graphics, trend data and email alerts.
- Provide and install DDC actuators/valves to replace any pneumatic actuators/valves
- Field commissioning, graphical interface and checkout
- Field Training and O&M Manuals and documentation
- Classroom Training
- Provide all necessary controls, programming and graphics to provide a fully functional control system.

By implementing this measure at the High School, Hastings Middle School, Senior Center/Recreation Center, Town Hall, and Library, the town will save 115,145 kWh of electricity, 7,227 therms of natural gas, and \$28,247 annually.

▪ **Install Advanced Rooftop Unit Controls/Replace Rooftop Units**

It is recommended that the Catalyst RTU controls are installed on eleven RTUs. This measure also includes replacing six RTUs. The RTU controller will also include a Variable Frequency Drive and following strategies will be implemented.

- “Opti-Run” Fan Control – Produces average fan energy savings of approximately 70%, while operating the unit within the manufacturer’s rated design parameters. The monitors key system variables and adjusts the fan speed as needed to ensure proper equipment operation. These combined capabilities go beyond the abilities of a typical variable frequency drive (VFD) installation.
- Integrated Economizer – Controls the economizer to allow for the simultaneous use of mechanical cooling and “free” outside air to satisfy a space. Most economizers operate on an “either/or” basis, leaving considerable energy savings unrealized.
- Advanced Economizer Logic – The controller is an Advanced Digital Economizer that is coupled with fan speed control to maximize the use of outside air for free cooling beyond traditional economizer control. It introduces the ability to sense and compare outside air and return air based on dry bulb temperature or dew point depending upon the climate. New patent-pending techniques proactively cool the interior commercial space before there is an actual call for cooling provides even greater savings.
- Demand Control Ventilation – Demand Control Ventilation (DCV) uses a self-calibrating CO2 sensor to reduce excessive ventilation commonly found on commercial spaces. The controller establishes occupancy levels and matches the amount of ventilation air delivered to the true needs of the space. This eliminates the cost required to heat and cool excess outside air. This strategy is documented in ANSI/ASHRAE Standard 62.

By implementing this measure at the East Fairhaven Elementary School, Senior Center/Recreation Center, and Police Station, the town will save 42,578 kWh of electricity, 488 therms of natural gas, and \$7,824 annually.

▪ **Install Variable Frequency Drives/Motors**

It is recommended Variable Frequency Drives (VFDs) and high efficiency motors (if applicable) are installed on each pump/fan and controlled via differential pressure, and temperature, allowing for electrical savings. This measure identifies supply fans at the High School and hot water pumps at the Hastings Middle School, Library, Department of Public Works, and Wastewater Treatment Plant. The scope of work includes the following:

- Supply and install twenty-three Variable Frequency Drives (VFDs) in place of the existing motor starters.
- Remove and replace six existing motors with new NEMA premium motors
- Start-up and testing of the new VFDs and motors
- Integrate into Energy Management System (if applicable)
- Warranty for one year

By implementing this measure at the High School, Hastings Middle School, Library, Department of Public Works, and Wastewater Treatment Plant, the town will save 86,926 kWh of electricity and \$14,777 annually.

▪ **Install High Efficiency Transformers**

It is recommended that twelve standard efficiency transformers at the High School and East Fairhaven Elementary School are replaced with Rex High Efficiency Transformers. By implementing this measure, the overall energy consumption of the transformers will decrease which will lead to annual energy cost savings. The scope of work includes the following:

- Furnish and install twelve Rex High Efficiency Transformers
- Removal of existing Transformers

By implementing this measure at the High School and East Fairhaven Elementary School, the town will save 44,074 kWh of electricity and \$7,493 annually.

▪ **Install Modulating Burners**

It is recommended new modulating burners are installed for the two steam boilers at the East Water Plant. The controls also include installation of two 5 hp Variable Frequency Drives on the

combustion blower. The scope of work for installing one Auto Flame Mini Mark Combustion Control and Boiler Management system, which include the following:

- Four (4) independent fuel characterization profiles
- Integral flame safeguard and supervision control
- Self-diagnostic error checking software
- Lockout history display
- Fuel and air servo motors with valves
- 1" x 3" VGA screen display with infrared proximity sensor and screensaver
- Internal calendar clock display and logging function

By implementing this measure at the East Water Plant the town will save 11,821 kWh of electricity, 3,573 therms, and \$6,298 annually.

▪ **Install Refrigeration Controls**

It is recommended that the refrigeration controls are installed to control the facility walk-in cooler/freezer. It is also recommended that the motors are replaced with Electronically Commutated Motors (ECMs). ECMs have a better motor efficiency compared to shaded pole motors (roughly 78%). In conjunction with the local controllers and their energy savings features, it will also allow for remote control, monitoring and alarming of the walk-in coolers/freezers. The scope of this work includes the following:

- Supply and install zones of energy savings CoolTrol refrigeration controls to cycle temperature and evaporator fans
- Replace existing shaded pole motors with high efficiency EC motors in evaporators
- Dew-point pulse control for anti-sweat door heaters
- Start-up and testing of the new controls/motors
- Installation to be performed by licensed electricians during business hours

By implementing this measure at the High School, Hastings Middle School, and Leroy Wood Elementary School, the town will save 27,539 kWh of electricity and \$4,682 annually.

▪ **Install Heat Pump System at the Fire Station**

It is recommended that condensers are installed. Heat pump systems are extremely efficient, and less energy is required to produce the necessary building cooling load than using window AC units. A great benefit of ductless split systems are separate zone controls. The full scope of work is shown below:

- Furnish and install two heat pump condenser
- Furnish and install five indoor heads
- Install all piping and electrical wiring for a complete system
- Start and test new equipment
- Provide 1-year labor warranty

By implementing this measure at the Fire Station, the town will save 5,640 kWh of electricity and \$959 annually.

▪ **Install Kitchen Fan Controls**

It is recommended a kitchen hood control system is installed on the ventilation and exhaust fans and controlled based on temperature. When the kitchen ovens and grills are turned on and the kitchen is active; the exhaust temperature will increase, and this will allow the Variable Frequency Drives to turn on to satisfy exhaust conditions. When the kitchen equipment gets turned off, the VFDs will ramp down which will reduce the schools' energy consumption. The scope of this work includes the following:

- Supply and install Variable Frequency Drives (VFDs) in place of the existing motor starters for kitchen exhaust and ventilation fans
- Install temperature/optic sensors in the kitchen exhaust ductwork
- Start-up and testing of the new VFDs
- Warranty for one year

By implementing this measure at the High School and Hastings Middle School, the town will save 11,301 kWh of electricity, 2,440 therms of natural gas, and \$4,849 annually.

▪ **Convert from Oil to Natural Gas at the School Administration Building**

It is recommended 92% gas- fired condensing is used to replace an 80% non-condensing oil-fired boiler. There are also additional cost savings since the price of natural gas (estimated \$1.2/ Therm) is cheaper than the price of oil (\$1.6/Therm). The scope of this work includes the following:

- Supply and install natural gas fired hot water boiler
- Removal and disposal of existing oil fired boilers and all necessary piping and components of the old system no longer required
- Installation of direct venting system for combustion air and exhaust air
- Commissioning and startup of new boiler systems

By implementing this measure at the School Administration Building, there will be an increase in natural gas use of 961 Therms; but a reduction in oil savings of 820 gallons. Therefore, the overall cost savings of this measure is \$979.

▪ **Retrocommissioning**

Retrocommissioning is the first stage in the building upgrade process. The staged approach accounts for the interactions among all the energy flows in a building and produces a systematic method for planning upgrades that increases energy savings. When the staged approach is adopted and performed sequentially, each stage includes changes that will affect the upgrades performed in subsequent stages, thus setting up the overall process for the greatest possible energy and cost savings. In this staged approach, retrocommissioning comes first because it provides an understanding of how closely the building comes to operating as intended. It also helps to identify improper equipment performance, what equipment or systems need to be replaced, opportunities for saving energy and money, and strategies for improving performance of the various building systems. It is recommended that Fairhaven High School, the Hastings Middle School, and the East Fairhaven Elementary School are all retrocommissioned. According to the Energy Star program <https://www.energystar.gov/sites/default/files/buildings/tools/EPA BUM CH5 RetroComm.pdf> each building that is retrocommissioned can expect to achieve a 7.5% savings in energy use.

▪ **Vehicle Policy and Maintenance Measures**

Adoption of a Town-Wide Anti-Idling Policy for Municipal Vehicles: Idling vehicles contribute significantly to air pollution and waste fuel, increasing fleet management costs. Municipalities across the Commonwealth and the nation have seen significant cost and greenhouse gas emission reductions since implementing Town-wide “no-idling” policies for municipal vehicles. According to the U.S. Department of Energy <https://www.fueleconomy.gov/feg/maintain.jsp> communities that adopt a town-wide anti-idling policy for municipal vehicles can expect to achieve a 3% savings in vehicle fuel use.

Closely Monitor Tire Pressure, Use 100% Synthetic Oil and Use Fuel Efficient Tires: By maintaining appropriate air pressure in vehicle tires, using 100% synthetic oil and fuel efficient tires, communities can expect to achieve a 3% savings in vehicle fuel use.

The above policy and maintenance measures will be managed by the town’s soon to be named Sustainability Manager.

B. Path to 20% Energy Use Reduction by the end of Fiscal Year 2022

1. Program Management Plan for Implementation, Monitoring, and Oversight

The Town Administrator's Office, in collaboration with the School Department, will be responsible both for oversight of the Energy Reduction Plan and for implementation of energy conservation measures within the Town. The Town Administrator's Office will be responsible for the annual reporting requirements to maintain designation and eligibility for annual competitive grant funding.

2. Summary of Energy Audit(s) or Other Sources for Projected Energy Savings

- Building audits were provided by Energy Source in 2018 and provide an energy savings of 6,480 MMBTUs or 14.2%. The Energy Source audits are included in the Appendix.
- Retrocommissioning of Fairhaven High School, the Hastings Middle School, and the East Fairhaven Elementary School would result in the savings of 1,515 MMBTUs or 3.3%.
- Vehicle policy and maintenance targeting overall vehicle usage would result in the savings 530 MMBTUs or 1.2%. The supporting documentation for these policy and maintenance measures are available in the Appendix.

3. Energy Conservation Measures

Table 4 lists recommended energy conservation measures. References for each measure are included in the table and these references are included as appendices to the Energy Reduction Plan. Projected annual MMBTU savings for each category (buildings, vehicles, and street and traffic lights) are subtotaled to arrive at a municipal grand total.

Table 4: Energy Conservation Measures for Fairhaven Municipal Energy Use

Measure		Status	Energy Data						Financial Data					Reference		
Category/Building	Energy Conservation Measure	Status (Completed Year or Planned Year)	Projected Annual Energy Savings						Projected Annual Cost Savings	Estimated Total Project Cost (\$)	Green Communities Grant (\$)	Estimated Utility Incentives (\$)	Estimated Cost After Utility Incentives (\$)	Estimated Payback After Incentives (Years)	Funding Source	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (Therms)	Oil Savings (Gallons)	Gasoline Savings (Gallons)	Diesel Savings (Gallons)	Propane Savings (Gallons)								
Fairhaven High School	LED Lighting	Planned/TBD	85,338	0	0	-	-	-	\$14,507	\$173,857	-	\$12,801	\$161,056		-	Energy Source Audit, 2018
Fairhaven High School	Condensing Boilers	Planned/TBD	0	9,919	0	-	-	-	\$11,902	\$358,024	-	\$10,000	\$348,024		-	Energy Source Audit, 2018
Fairhaven High School	Transformers	Planned/TBD	34,405	0	0	-	-	-	\$5,849	\$49,523	-	\$6,881	\$42,642		-	Energy Source Audit, 2018
Fairhaven High School	Refrigeration Controls	Planned/TBD	8,881	0	0	-	-	-	\$1,510	\$13,260	-	\$1,776	\$11,484		-	Energy Source Audit, 2018
Fairhaven High School	Kitchen Exhaust Fan Controls	Planned/TBD	10,878	1,573	0	-	-	-	\$3,737	\$30,831	-	\$5,160	\$25,671		-	Energy Source Audit, 2018
Fairhaven High School	Steam Modulating Controls	Planned/TBD	11,281	3,573	0	-	-	-	\$6,298	\$76,923	-	\$8,546	\$68,377		-	Energy Source Audit, 2018
Fairhaven High School	Energy Management System	Planned/TBD	41,364	3,223	0	-	-	-	\$10,946	\$54,600	-	\$6,000	\$48,600		-	Energy Source Audit, 2018
Fairhaven High School	Variable Frequency Drives/Motors	Planned/TBD	6,908	0	0	-	-	-	\$1,174	\$7,105	-	\$1,400	\$5,705		-	Energy Source Audit, 2018
Fairhaven High School	Retrocommissioning	Planned/TBD	41,100	6,699	0	-	-	-			-				-	Energy Star (www.energystar.gov)
Hastings Middle School	LED Lighting	Planned/TBD	4,890	0	0	-	-	-	\$831	\$5,218	-	\$734	\$4,485		-	Energy Source Audit, 2018
Hastings Middle School	Refrigeration Controls	Planned/TBD	10,833	0	0	-	-	-	\$1,842	\$19,890	-	\$2,167	\$17,723		-	Energy Source Audit, 2018
Hastings Middle School	Kitchen Exhaust Fan Controls	Planned/TBD	423	876	0	-	-	-	\$1,112	\$11,856	-	\$1,000	\$10,856		-	Energy Source Audit, 2018
Hastings Middle School	Energy Management System	Planned/TBD	27,114	2,237	0	-	-	-	\$7,293	\$46,800	-	\$6,000	\$40,800		-	Energy Source Audit, 2018
Hastings Middle School	Variable Frequency Drives/Motors	Planned/TBD	24,463	0	0	-	-	-	\$4,159	\$36,410	-	\$8,500	\$27,910		-	Energy Source Audit, 2018
Hastings Middle School	Retrocommissioning	Planned/TBD	22,020	3,517	0	-	-	-			-				-	Energy Star (www.energystar.gov)
Leroy Wood Elementary School	LED Lighting	Planned/TBD	73,598	0	0	-	-	-	\$12,512	\$98,405	-	\$11,040	\$87,365		-	Energy Source Audit, 2018
Leroy Wood Elementary School	Refrigeration Controls	Planned/TBD	7,825	0	0	-	-	-	\$1,330	\$13,000	-	\$1,565	\$11,435		-	Energy Source Audit, 2018
East Fairhaven Elementary School	LED Lighting	Planned/TBD	65,733	0	0	-	-	-	\$11,175	\$98,398	-	\$9,860	\$88,538		-	Energy Source Audit, 2018
East Fairhaven Elementary School	Condensing Boilers	Planned/TBD	0	5,058	0	-	-	-	\$6,070	\$99,876	-	\$8,000	\$91,876		-	Energy Source Audit, 2018
East Fairhaven Elementary School	Transformers	Planned/TBD	9,669	0	0	-	-	-	\$1,644	\$29,515	-	\$1,934	\$27,581		-	Energy Source Audit, 2018
East Fairhaven Elementary School	Advanced RTU Controls	Planned/TBD	10,009	112	0	-	-	-	\$1,836	\$23,396	-	\$4,000	\$19,396		-	Energy Source Audit, 2018

East Fairhaven Elementary School	Retrocommissioning	Planned/TBD	27,039	1,867	0	-	-	-			-			-	Energy Star (www.energystar.gov)
School Dept. Admin. Buildings	LED Lighting	Planned/TBD	1,647	0	0	-	-	-	\$280	\$1,335	-	\$247	\$1,088	-	Energy Source Audit, 2018
School Dept. Admin. Buildings	Convert Oil to Gas	Planned/TBD	0	-961	820	-	-	-	\$979	\$16,480	-	\$1,500	\$14,980	-	Energy Source Audit, 2018
Fairhaven Council on Aging/ Recreation Center	LED Lighting	Planned/TBD	86,190	0	0	-	-	-	\$14,652	\$89,304	-	\$12,929	\$76,376	-	Energy Source Audit, 2018
Fairhaven Council on Aging/ Recreation Center	Energy Management System	Planned/TBD	35,923	883	0	-	-	-	\$7,167	\$80,600	-	\$18,000	\$62,600	-	Energy Source Audit, 2018
Fairhaven Council on Aging/ Recreation Center	Advanced RTU Controls	Planned/TBD	20,426	240	0	-	-	-	\$3,760	\$160,691	-	\$6,000	\$154,691	-	Energy Source Audit, 2018
Fairhaven Town Hall	LED Lighting	Planned/TBD	14,248	0	0	-	-	-	\$2,422	\$30,215	-	\$2,137	\$28,078	-	Energy Source Audit, 2018
Fairhaven Town Hall	Energy Management System	Planned/TBD	0	553	0	-	-	-	\$664	\$19,656	-	\$1,800	\$17,856	-	Energy Source Audit, 2018
Fairhaven Library	Condensing Boilers	Planned/TBD	0	1,755	0	-	-	-	\$2,107	\$102,837	-	\$6,000	\$96,837	-	Energy Source Audit, 2018
Fairhaven Library	Energy Management System	Planned/TBD	10,474	331	0	-	-	-	\$2,178	\$54,600	-	\$6,000	\$48,600	-	Energy Source Audit, 2018
Fairhaven Library	Variable Frequency Drives/Motors	Planned/TBD	13,136	0	0	-	-	-	\$2,233	\$19,890	-	\$3,000	\$16,890	-	Energy Source Audit, 2018
Fairhaven Department of Public Works	LED Lighting	Planned/TBD	58,391	0	0	-	-	-	\$9,926	\$76,097	-	\$8,759	\$67,338	-	Energy Source Audit, 2018
Fairhaven Department of Public Works	Condensing Boilers	Planned/TBD	0	1,840	0	-	-	-	\$2,207	\$111,070	-	\$12,000	\$99,070	-	Energy Source Audit, 2018
Fairhaven Department of Public Works	Variable Frequency Drives/Motors	Planned/TBD	20,013	0	0	-	-	-	\$3,402	\$26,520	-	\$5,000	\$21,520	-	Energy Source Audit, 2018
Fairhaven Police Station	LED Lighting	Planned/TBD	43,987	0	0	-	-	-	\$7,478	\$44,889	-	\$6,598	\$38,291	-	Energy Source Audit, 2018
Fairhaven Police Station	Advanced RTU Controls	Planned/TBD	12,143	136	0	-	-	-	\$2,227	\$7,458	-	\$1,000	\$6,458	-	Energy Source Audit, 2018
Fairhaven Fire Station	LED Lighting	Planned/TBD	14,583	0	0	-	-	-	\$2,479	\$10,615	-	\$2,187	\$8,428	-	Energy Source Audit, 2018
Fairhaven Fire Station	Condensing Boilers	Planned/TBD	0	687	0	-	-	-	\$825	\$67,010	-	\$4,000	\$63,010	-	Energy Source Audit, 2018
Fairhaven Fire Station	Ductless Split System	Planned/TBD	5,640	0	0	-	-	-	\$959	\$45,500	-	\$0	\$45,500	-	Energy Source Audit, 2018
Fairhaven Wastewater Treatment Plant	LED Lighting	Planned/TBD	87,303	0	0	-	-	-	\$14,842	\$94,420	-	\$13,095	\$81,325	-	Energy Source Audit, 2018
Fairhaven Wastewater Treatment Plant	Condensing Boilers	Planned/TBD	0	2,746	0	-	-	-	\$3,295	\$108,981	-	\$9,500	\$99,481	-	Energy Source Audit, 2018
Fairhaven Wastewater Treatment Plant	Variable Frequency Drives/Motors	Planned/TBD	22,406	0	0	-	-	-	\$3,809	\$27,643	-	\$7,000	\$20,643	-	Energy Source Audit, 2018
Vehicle Maintenance	Town-wide "No Idling" policy for municipal vehicles	Planned/TBD	0	0	0	1,262	775	-	-	-	-	-	-	-	U.S. Department of Energy (www.fueleconomy.gov)
Vehicle Maintenance	Closely Monitor Tire Air Pressure, Use 100% Synthetic Oil and Use Fuel Efficient Tires	Planned/TBD	0	0	0	1,262	775	-	-	-	-	-	-	-	U.S. Department of Energy (www.fueleconomy.gov)

Totals	970,281	46,864	820	2,524	1,550	0	\$193,618	\$2,442,698	-	\$234,114	\$2,208,584	-	-	-
Total MMBTUs Saved	3,308	4,686	123	315	215	-	-	-	-	-	-	-	-	-

C. Summary of Long-Term Energy Reduction Goals – Beyond 5 Years

1. Municipal Buildings (including schools)

To better strategize for the long-term maintenance and management of municipal buildings, Fairhaven will work with internal schools and town staff as well as outside consultants, when necessary, to assess and document the condition of major municipal buildings on an annual basis. In addition to exposing continuing opportunities for energy use reductions, this effort will provide the Town with a clear, long-term asset management strategy for the effective budgeting and maintenance of buildings.

2. Vehicles (including schools)

The Fuel-Efficient Vehicle policy will have become engrained within municipal purchasing practices after five years, and the Town will seek to explore even more efficient policies and tracking systems to enable more efficiency.

3. Perpetuating Energy Efficiency

Ongoing dialogue with Town and School staff can tap into the knowledge of the employees who use and maintain the buildings every day. It can empower building staff to develop a detailed repair and management schedule and collect data on problems and inefficiencies that may be missed by traditional third party audits. The use of a web-based application system like See Click Fix creates additional real-time opportunities for efficiencies in operation and maintenance.

The Town of Fairhaven will grow its capacity to retrofit and build more efficient facilities, purchase more efficient vehicles, and illuminate the Town through more efficient lighting throughout the 5-year period. These practices will become more engrained in the culture of the Town and will provide opportunities to instill the ethos into additional policies and programs for more dedicated long-term funding streams and strategies.

V: Appendices

- Building Energy Audits – Energy Source
- SRPEDD Vehicle Calculations
- MMBTU Conversion Chart



Energy Reduction



Comprehensive Report

Dalton Ling

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October 18th, 2018

Dear Mark Rees,

Energy Source is pleased to present you with this energy conservation analysis. We trust you will find this to be a cost-effective means to reduce your energy costs and improve the comfort throughout your facilities by optimizing your lighting and HVAC systems. Other factors to consider as you evaluate this analysis are existing equipment related disruptions and maintenance costs are eliminated or minimized until the new equipment enters its end of life – typically several years.

In the attached analysis, you will find a detailed report recommending the following:

- LED Lighting
- Condensing Boilers
- Energy Management System
- Advanced RTU Controls
- Variable Frequency Drives/ Motors
- Transformers
- Steam Modulating Controls
- Refrigeration Controls
- Ductless Split System
- Kitchen Exhaust Fan Controls
- Convert Oil to Gas

Energy Source will secure incentives from the utility company which will substantially reduce the net cost of this project. The utility incentives reflected in this proposal are estimated and are subject to change until projects are reviewed by the utility company.

I hope you find this proposal informative. If you have any questions, please do not hesitate to contact me.

Sincerely,

Dalton Ling

Energy Source

Disclaimer

This report is not for general use and is the property of Energy Source.

All savings estimates, and rebates must be considered estimated until reviewed and approved by the utility companies designated within this report.

For any questions regarding this report, please contact Dalton Ling, Energy Efficiency Consultant for Energy Source, Inc. at 508-237-3275. Any additional use of this report is prohibited unless permission is given in writing from Energy Source, Inc.

Executive Summary

Energy Source recently conducted an energy survey at the following Fairhaven buildings:

- Fairhaven High School
- Hastings Middle School
- Leroy Wood Elementary School
- East Fairhaven Elementary School
- School Depart. Admin. Buildings
- Fairhaven Council of Aging/ Recreation Center
- Fairhaven Town Hall
- Fairhaven Library
- Fairhaven Department of Public Works
- Fairhaven Police Station
- Fairhaven Fire Station
- Fairhaven Wastewater Treatment Plant

Our recommendations are known as Energy Conservation Measures which are outlined in separate write-ups.

The expected energy savings were determined based on current operating hours of equipment surveyed. Poorly performing equipment will reduce the effectiveness of employing these ECMs, and the cost to repair or replace that equipment is not covered in this estimate.

Energy Conservation Measures	Total Project Cost	Estimated Incentives	Estimated Customer Cost	Electricity Savings		Gas Savings		Oil Savings		Total Cost Savings	Payback Period (years)
				kWh	Cost	Therms	Cost	Gallons	Cost		
Condensing Boilers	\$847,798	\$49,500	\$798,298	0	\$0	22,005	\$26,406	0	\$0	\$26,406	30.2
LED Lighting	\$722,753	\$80,386	\$642,367	535,908	\$91,104	0	\$0	0	\$0	\$91,104	7.1
Energy Management System	\$256,256	\$37,800	\$218,456	115,145	\$19,575	7,227	\$8,673	0	\$0	\$28,248	7.7
Advanced RTU Controls	\$191,545	\$11,000	\$180,545	42,578	\$7,238	488	\$585	0	\$0	\$7,823	23.1
Variable Frequency Drives/ Motors	\$117,568	\$24,900	\$92,668	86,926	\$14,777	0	\$0	0	\$0	\$14,777	6.3
Transformers	\$79,038	\$8,815	\$70,223	44,074	\$7,493	0	\$0	0	\$0	\$7,493	9.4
Steam Modulating Controls	\$76,923	\$8,546	\$68,377	11,821	\$2,010	3,573	\$4,288	0	\$0	\$6,298	10.9
Refrigeration Controls	\$46,150	\$5,508	\$40,642	27,539	\$4,682	0	\$0	0	\$0	\$4,682	8.7
Ductless Split System	\$45,500	\$0	\$45,500	5,640	\$959	0	\$0	0	\$0	\$959	47.5
Kitchen Exhaust Fan Controls	\$42,687	\$6,160	\$36,527	11,301	\$1,921	2,440	\$2,928	0	\$0	\$4,849	7.5
Convert Oil to Gas	\$16,480	\$1,500	\$14,980	0	\$0	-961	-\$1,153	820	\$2,132	\$979	15.3
Total	\$2,442,698	\$234,114	\$2,208,584	880,932	\$149,759	34,772	\$41,727	820	\$2,132	\$193,618	11.4

ECM #1- Install Condensing Boilers

Existing Conditions

This measure involves the installation of new condensing boilers. Currently, the hot water at the buildings is being supplied from non-condensing boilers and delivered to baseboards, unit ventilators, and Air Handler Units (AHUs).

Energy Conservation Measure Details

It is recommended new condensing boilers are installed at a few buildings in Fairhaven. Condensing boilers (average efficiency 92%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%). The scope of this work includes the following:

- Supply and install Lochinvar condensing boilers
- Removal and disposal of existing boilers and all necessary piping and components of the old system no longer required
- Installation of direct venting system for combustion air and exhaust air
- Install outside air controls for maximum efficiency
- Commissioning and startup of new boiler systems

The annual energy cost savings summary and the proposed conditions are shown below,

Building	Condensing Boiler Qty	Annual Energy Savings (Therms)	Annual Energy Cost Savings
Fairhaven High School	1	9,919	\$11,902
East Fairhaven Elementary School	2	5,058	\$6,070
Fairhaven Library	3	1,755	\$2,107
Fairhaven Department of Public Works	3	1,840	\$2,207
Fairhaven Fire Station	1	687	\$825
Fairhaven Wastwater Treatment Plant	3	2,746	\$3,295
Total		22,005	\$26,406

Implementation

The implementation of this measure requires the purchase and installation of condensing boilers. It should be noted that the boilers that are being replaced only satisfy the primary boilers. The total material and installation cost breakdown along with incentives are shown on the table below,

Building	Condensing Boiler Qty	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	1	\$358,024	\$10,000	\$348,024	29.2
East Fairhaven Elementary School	2	\$99,876	\$8,000	\$91,876	15.1
Fairhaven Library	3	\$102,837	\$6,000	\$96,837	46
Fairhaven Department of Public Works	3	\$111,070	\$12,000	\$99,070	44.9
Fairhaven Fire Station	1	\$67,010	\$4,000	\$63,010	76.4
Fairhaven Wastewater Treatment Plant	3	\$108,981	\$9,500	\$99,481	30.2
Total		\$847,798	\$49,500	\$798,298	30.2

Approximately \$49,500 can be obtained from utility rebates; therefore, the adjusted Customer Cost is \$798,298. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$798,298}{\$26,406} = 30.2 \text{ years}$$

ECM #2- Install LED Lighting and Controls

Existing Conditions

This measure involves the installation of LED fixtures/kits and integrated smart controls where applicable. Currently, Fairhaven town/school buildings have 28 Watt or 32 Watt T-8 fluorescent and compact fluorescent fixtures.

Energy Conservation Measure Details

It is recommended that high efficiency LED light fixtures/ kits are installed to replace the fluorescent fixtures. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology. The scope of this work includes the following:

- Supply and installing new LED lighting fixtures/ kits
- Remove and recycle existing fluorescent fixtures
- Warranty on new LED lighting fixtures of seven years

By implementing this measure, the following Annual Energy Savings can be obtained:

Building	Electricity Savings	
	kWh	Cost
Fairhaven High School	85,338	\$14,507
Hastings Middle School	4,890	\$831
Leroy Wood Elementary School	73,598	\$12,512
East Fairhaven Elementary School	65,733	\$11,175
School Depart. Admin. Building	1,647	\$280
Fairhaven Council of Aging	14,400	\$2,448
Fairhaven Recreation Center	71,790	\$12,204
Fairhaven Town Hall	14,248	\$2,422
Fairhaven Department of Public Works	58,391	\$9,926
Fairhaven Police Station	43,987	\$7,478
Fairhaven Fire Station	14,583	\$2,479
Fairhaven Wastewater Treatment Plant	87,303	\$14,842
Total	535,908	\$91,104

Annual energy savings of 535,908 kWh can be realized from this measure which will lead to an annual total cost savings of \$91,104.

Implementation

The implementation of this measure requires the purchase and installation LED fixtures/kits to replace the fluorescent fixtures. The total implementation cost is displayed on the table below:

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	\$173,857	\$12,801	\$161,056	11.1
Hastings Middle School	\$5,218	\$734	\$4,485	5.4
Leroy Wood Elementary School	\$98,405	\$11,040	\$87,365	7.0
East Fairhaven Elementary School	\$98,398	\$9,860	\$88,538	7.9
School Depart. Admin. Building	\$1,335	\$247	\$1,088	3.9
Fairhaven Council of Aging	\$22,679	\$2,160	\$20,519	8.4
Fairhaven Recreation Center	\$66,625	\$10,769	\$55,857	4.6
Fairhaven Town Hall	\$30,215	\$2,137	\$28,078	11.6
Fairhaven Department of Public Works	\$76,097	\$8,759	\$67,338	6.8
Fairhaven Police Station	\$44,889	\$6,598	\$38,291	5.1
Fairhaven Fire Station	\$10,615	\$2,187	\$8,428	3.4
Fairhaven Wastwater Treatment Plant	\$94,420	\$13,095	\$81,325	5.5
Total	\$722,753	\$80,386	\$642,367	7.1

It was estimated approximately \$80,386 can be obtained from the utility program; therefore, the adjusted customer cost is \$642,367. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$642,367}{\$91,104} = 7.1 \text{ years}$$

ECM #3- Install Energy Management System

Existing Conditions

This measure includes installing an Energy Management Systems to refine and tighten the buildings temperature controls. Currently, the current controls for the schools are pneumatic and have failed. The following mechanical equipment at each building will be controlled:

FAIRHAVEN HIGH SCHOOL	
Qty.	Mechanical Equipment
6	Common Area Rooftop Units
HASTINGS MIDDLE SCHOOL	
Qty.	Mechanical Equipment
4	Cafeteria HVs
2	Gym AHUs
1	Audtiorium AHU
4	Exhaust Fans
FAIRHAVEN SENIOR CENTER/ RECREATION CENTER	
Qty.	Mechanical Equipment
6	RTUs
3	AHUS
8	Zones
FAIRHAVEN TOWN HALL	
Qty.	Mechanical Equipment
1	Steam Boiler
FAIRHAVEN LIBRARY	
Qty.	Mechanical Equipment
1	Non Condensing Boiler
16	Fan Coil Units
2	Rooftop Unit

Energy Conservation Measure Details

It is recommended that an Energy Management System will be installed or will replace the existing obsolete systems. Energy Savings will also occur from the new furnished controls to tighten and refine building temperature conditions. In conjunction with the local controllers and their energy savings features, it will also allow for remote control, monitoring and alarming of the mechanical equipment. The full scope of work is shown below:

- Provide and install new controllers for the listed mechanical equipment above

- Provide and install a supervisory controller which will include graphics, trend data and email alerts.
- Provide and install DDC actuators/valves to replace any pneumatic actuators/valves
- Field commissioning, graphical interface and checkout.
- Field Training and O&M Manuals and documentation.
- Classroom Training
- Provide all necessary controls, programming and graphics to provide a fully functional control system.

The savings from this measure will result in the following control strategies:

- Temperature Setback which will reduce the facility temperature setpoint during unoccupied hour
- The pumps/fans will turn off during unoccupied hours unless temperature drops below 35°F in which they will turn on to maintain night setback temperature.
- Demand Control Ventilation (DCV) which allows the minimum required outside air to be delivered to each room during the heating/cooling months.

The table below shows the annual energy cost savings for each building:

Location	Electricity Savings		Natural Gas Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
Fairhaven High School	41,634	\$7,078	3,223	\$3,868	\$10,945
Hastings Middle School	27,114	\$4,609	2,237	\$2,684	\$7,294
Fairhaven Senior Center/ Recreation Center	35,923	\$6,107	883	\$1,060	\$7,167
Fairhaven Town Hall	0	\$0	553	\$664	\$664
Fairhaven Library	10,474	\$1,781	331	\$397	\$2,178
Total	115,145	\$19,575	7,227	\$8,672	\$28,247

Annual energy savings of 115,145 kWh and 7,227 Therms can be realized from this measure; therefore, total annual cost savings of \$28,248 can be obtained.

Implementation

The implementation of this measure requires the purchase and the installation of the necessary sensors, actuators, valves, and controllers. Programming and training is also included in this scope of work. The total material and installation cost of the control system for each facility is shown below:

Location	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	\$54,600	\$6,000	\$48,600	4.4
Hastings Middle School	\$46,800	\$6,000	\$40,800	5.6
Fairhaven Senior Center/ Recreation Center	\$80,600	\$18,000	\$62,600	8.7
Fairhaven Town Hall	\$19,656	\$1,800	\$17,856	26.9
Fairhaven Library	\$54,600	\$6,000	\$48,600	22.3
Total	\$256,256	\$37,800	\$218,456	7.7

It is estimated \$37,800 can be obtained in incentives; therefore, the customer cost for this measure is \$218,456. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$218,456}{\$28,248} = 7.7 \text{ years}$$

ECM #4- Install Advanced Rooftop Unit Controls/ Replace Rooftop Units

Existing Conditions

This measure includes installing the installation of the Catalyst Rooftop Unit (RTU) controller on Rooftop Units to refine and tighten the buildings temperature controls. This measure also includes replacing the six RTUs located at the Council of Aging/ Recreation Center building. Currently, the station uses standard thermostats to operate the RTUs. Below are specifications of each RTU,

Building	Quantity	Replace RTUs?	Total Fan Capacity (hp)	Total Capacity	
				Cooling (Tons)	Heating (Btu/hr)
East Fairhaven Elementary School	2	No	3	12.5	250,000
	1	No	2	8.5	-
	1	No	1	5	60,000
Fairhaven Council of Aging/ Rec Center	5	Yes	1	5	125,000
	1	Yes	1.5	7.5	180,000
Fairhaven Police Station	1	No	3	7.5	180,000

Energy Conservation Measure Details

It is recommended that the Catalyst RTU controls are installed on eleven RTUs. This measure also includes replacing six RTUs. The RTU controller will also include a Variable Frequency Drive and following strategies will be implemented.

- **Opti-Run” Fan Control** – Produces average fan energy savings of approximately 70%, while operating the unit within the manufacturer’s rated design parameters. The monitors key system variables and adjusts the fan speed as needed to ensure proper equipment operation. These combined capabilities go beyond the abilities of a typical variable frequency drive (VFD) installation.
- **Integrated Economizer** – Controls the economizer to allow for the simultaneous use of mechanical cooling and “free” outside air to satisfy a space. Most economizers operate on an “either/or” basis, leaving considerable energy savings unrealized.
- **Advanced Economizer Logic** – The controller is an Advanced Digital Economizer that is coupled with fan speed control to maximize the use of outside air for free cooling beyond traditional economizer control. It introduces the ability to sense and compare outside air and return air based on dry bulb temperature or dew point depending upon the climate. New patent-pending techniques proactively cool the interior commercial space before there is an actual call for cooling provides even greater savings.

- **Demand Control Ventilation** – Demand Control Ventilation (DCV) uses a self-calibrating CO₂ sensor to reduce excessive ventilation commonly found on commercial spaces. The controller establishes occupancy levels and matches the amount of ventilation air delivered to the true needs of the space. This eliminates the cost required to heat and cool excess outside air. This strategy is documented in ANSI/ASHRAE Standard 62.

By implementing this measure, energy savings are shown below,

Building	Electricity Savings		Natural Gas Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
East Fairhaven Elementary School	10,009	\$1,702	112	\$134	\$1,836
Fairhaven Council of Aging/ Rec Center	20,426	\$3,472	240	\$288	\$3,760
Fairhaven Police Station	12,143	\$2,064	136	\$163	\$2,228
Total	42,578	\$7,238	488	\$586	\$7,824

Approximately 42,578 kWh and 488 Therms can be realized, resulting in an annual energy cost savings of \$7,824.

Implementation

The implementation of this measure requires the purchase and the installation of eleven RTU controllers and six Rooftop Units. Programming and training is also included in this scope of work. The total material and installation cost for each building is shown,

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
East Fairhaven Elementary School	\$23,396	\$4,000	\$19,396	10.6
Fairhaven Council of Aging/ Rec Center	\$160,691	\$6,000	\$154,691	41.1
Fairhaven Police Station	\$7,458	\$1,000	\$6,458	2.9
Total	\$191,545	\$11,000	\$180,545	23.1

It is estimated \$11,000 can be obtained in incentives; therefore, the customer cost for this measure is \$180,545. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$180,545}{\$7,824} = 23.1 \text{ years}$$

ECM #5- Install Variable Frequency Drives/Motors

Existing Conditions

This measure involves the installation of Variable Frequency Drives and motors. The circulators are being used to supply heating and cooling coils throughout the Fairhaven facilities. When adequate flow is met, the remaining water runs through a bypass loop which recirculates the water; therefore, the circulating pumps operate at a constant speed regardless of the load conditions needed for each hot/chilled water coil. If the hot/chilled water systems are constant loop system; then the loops will be run off differential temperature.

Energy Conservation Measure Details

It is recommended Variable Frequency Drives (VFDs) and high efficiency motors (if applicable) are installed on each pump/fan and controlled via differential pressure, and temperature, allowing for electrical savings. The specifications for each pump/fan system is shown below:

Building	VFD Application	Quantity	Size (hp)	Controlling Parameter	Install New Motor?
Fairhaven High School	Supply Fans	1	7.5	Diff. Pressure	No
Hastings Middle School	Hot Water Pumps	2	3	Diff. Temp	Yes
	Hot Water Pumps	6	0.75	Diff. Temp	No
Fairhaven Library	Hot Water Pumps	3	2	Diff. Temp	No
Fairhaven Department of Public Works	Hot Water Pumps	2	3	Diff. Temp	Yes
	Hot Water Pumps	2	1	Diff. Temp	Yes
Fairhaven Wastewater Treatment Plant	Hot Water Pumps	2	3	Diff. Temp	No
	Hot Water Pumps	4	0.75	Diff. Temp	No
	Hot Water Pumps	1	0.5	Diff. Temp	No
Total		23			

The scope of this work includes the following:

- Supply and install twenty-three Variable Frequency Drives (VFDs) in place of the existing motor starters
- Remove and replace six existing motors with new NEMA premium motors
- Start-up and testing of the new VFDs, and motors
- Integrate into Energy Management System (if applicable)
- Warranty for one year

The table below shows the annual energy cost savings for each building:

Building	VFD Application	Quantity	Size (hp)	Controlling Parameter	Annual Energy Savings	
					kWh	Cost
Fairhaven High School	Supply Fans	1	7.5	Diff. Pressure	6,908	\$1,174
Hastings Middle School	Hot Water Pumps	2	3	Diff. Temp	14,282	\$2,428
	Hot Water Pumps	6	0.75	Diff. Temp	10,181	\$1,731
Fairhaven Library	Hot Water Pumps	3	2	Diff. Temp	13,136	\$2,233
Fairhaven Department of Public Works	Hot Water Pumps	2	3	Diff. Temp	15,142	\$2,574
	Hot Water Pumps	2	1	Diff. Temp	4,870	\$828
Fairhaven Wastewater Treatment Plant	Hot Water Pumps	2	3	Diff. Temp	13,882	\$2,360
	Hot Water Pumps	4	0.75	Diff. Temp	7,306	\$1,242
	Hot Water Pumps	1	0.5	Diff. Temp	1,218	\$207
Total		23			86,926	\$14,777

Annual energy savings of 86,926 kWh can be realized from this measure; therefore, total annual cost savings of \$14,777 can be obtained.

Implementation

The implementation of this measure requires the purchase and installation of twenty-three VFDs and six motors controlled by differential pressures or temperature. The implementation also requires a controller, pressure/temperature sensors and electrical wiring. The total material and installation cost of the drives, motors and control system for this measure is \$117,568. Approximately \$24,900 can be obtained from rebates by the utility company; therefore, the adjusted customer cost is \$92,668. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$92,668}{\$14,777} = 6.3 \text{ years}$$

ECM #6- Install High Efficiency Transformers

Existing Condition

Fairhaven High School and East Fairhaven Elementary School use low voltage transformers to step voltage up or down. Transformer process is not 100% efficient; therefore, there are two different types of losses associated with the process; core losses and winding losses. Transformer efficiency has improved over time and transformers are have a higher efficiency.

Energy Conservation Measure Details

It is recommended that twelve standard efficiency transformers are replaced with Rex High Efficiency Transformers. By implementing this measure, the overall energy consumption of the transformers will decrease which will lead to annual energy cost savings. The scope of work includes the following:

- Furnish and install twelve Rex High Efficiency Transformers
- Removal of existing Transformers

An annual savings breakdown for each building can be seen below,

Building	Transformer Size (kVA)	Qty.
Fairhaven High School	75	4
	30	2
	15	1
East Fairhaven Elementary School	30	2
	45	1
	75	2
Total		12

Annual energy savings of 44,074 kWh can be realized from this measure; therefore, total cost savings of \$7,493 can be obtained.

Implementation

The implementation of this measure requires the purchase and the installation of twelve Rex Transformers. The total material and installation cost of the transformers for this measure is shown below,



Building	Transformer Size (kVA)	Qty.	Pre-TP-1?	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	75	4	Yes	49,523	\$6,881	\$42,642	7.3
	30	2					
	15	1					
East Fairhaven Elementary School	30	2	No	\$29,515	\$1,934	\$27,581	16.8
	45	1					
	75	2					
Total		12		\$79,038	\$8,815	\$70,223	9.4

Utility incentives of \$8,815 are estimated to be obtained as well; therefore, the adjusted customer cost is \$70,233. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$70,223}{\$7,493} = 9.4\ years$$



ECM #7-Install Modulating Burners

Existing Conditions

This measure involves the installation of modulating burners for the High School steam boilers. Currently, the facility has two large steam boilers that are used to space heat. The current burners are non-modulating; therefore, there are periods where the boilers are idling and providing excess heat to the steam system.

Energy Conservation Measure Details

It is recommended new modulating burners are installed for the two steam boilers at the East Water Plant. The controls also include installation of two 5 hp Variable Frequency Drives on the combustion blower. The scope of work for installing one Auto Flame Mini Mark Combustion Control and Boiler Management system, which include the following:

- Four (4) independent fuel characterization profiles.
- Integral flame safeguard and super vision control
- Self-diagnostic error checking software
- Lockout history display
- Fuel and air servo motors with valves
- 1"x 3" VGA screen display with infrared proximity sensor and screen saver
- Internal calendar clock display and logging function

For completing this measure, annual energy savings and annual cost savings of 11,821 kWh and 3,573 Therms, and \$6,298 can be realized.

Implementation

The implementation of this measure requires the purchase and installation of an Auto Flame Mini Mark Combustion Controls and Boiler Management System. The total cost of this project is approximately \$76,923. It is estimated approximately \$8,546 can be obtained in incentives; therefore, the customer cost is \$68,377. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$68,377}{\$6,298} = 10.9 \text{ years}$$



ECM #8- Install Refrigeration Controls

Existing Conditions

This measure involves the installation of refrigeration controllers to control door heaters, fan cycling and associated Cooler/Freezer compressors. Currently, the facility has evaporator fans motors which circulates/transfers cool energy from the cooling coils to the coolers/freezers. The evaporator fans are equipped with shaded pole motors which have a full load efficiency of around 30% efficient. The existing evaporator fan motors and the anti-sweat door heaters run 24/7. The current inventory of the facilities that require controls are shown below,

Building	Number of Motors	Walk-in Zones
Fairhaven High School	5	2
Hastings Middle School	5	3
Leroy Wood Elementary School	4	2
Total	14	7

Energy Conservation Measure Details

It is recommended that the refrigeration controls are installed to control the facility walk-in cooler/freezer. It is also recommended that the motors are replaced with Electronically Commutated Motors (ECMs). ECMs have a better motor efficiency compared to shaded pole motors (roughly 78%). In conjunction with the local controllers and their energy savings features, it will also allow for remote control, monitoring and alarming of the walk-in coolers/freezers. The scope of this work includes the following:

- Supply and install zones of energy savings CoolTrol refrigeration controls to cycle temperature and evaporator fans.
- Replace existing shaded pole motors with high efficiency EC motors in evaporators.
- Dew-point pulse control for anti-sweat door heaters.
- Start-up and testing of the new controls/motors
- Installation to be performed by licensed electricians during business hours.

The table below shows the annual energy cost savings for each building:



Building	Number of Motors	Walk-in Zones	Electricity Savings	
			kWh	Cost
Fairhaven High School	5	2	8,881	\$1,510
Hastings Middle School	5	3	10,833	\$1,842
Leroy Wood Elementary School	4	2	7,825	\$1,330
Total	14	7	27,539	\$4,682

Annual energy savings of 27,539 kWh can be realized from this measure; therefore, total annual cost savings of \$4,682 can be obtained.

Implementation

The implementation of this measure requires the purchase and installation of refrigeration controls to control walk-in coolers/freezers door heaters and evaporator fans. This measure also consists of replacing shaded pole motors with Electronically Commutated Magnetic Motors (ECMs). The total material and installation cost for each building is shown below,

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	\$13,260	\$1,776	\$11,484	7.6
Hastings Middle School	\$19,890	\$2,167	\$17,723	9.6
Leroy Wood Elementary School	\$13,000	\$1,565	\$11,435	8.6
Total	\$46,150	\$5,508	\$40,642	8.7

The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$40,642}{\$4,682} = 8.7 \text{ years}$$



ECM #9- Install Heat Pump System at the Fire Station

Existing Conditions

This measure includes installing a Heat Pump System to replace window air conditioning units. The building uses window air conditioning to cool in the summer.

Energy Conservation Measure Details

It is recommended that condensers are installed. Heat pump systems are extremely efficient, and less energy is required to produce the necessary building cooling load than using window AC units. A great benefit of ductless split systems are separate zone controls. The full scope of work is shown below:

- Furnish and install two heat pump condenser
- Furnish and install five indoor heads
- Install all piping, and electrical wiring for a complete system
- Start and test new equipment
- Provide 1-year labor warranty

By implementing this measure, there will be an annual electrical savings of 5,640 kWh with cost savings of \$959.

Implementation

The implementation of this measure requires the purchase and installation of one condenser and three heads. The total material and installation cost of the ductless split for this measure is approximately \$45,500. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$45,500}{\$959} = 47.5 \text{ years}$$



ECM #10- Install Kitchen Fan Controls

Existing Conditions

This measure involves the install of kitchen hood systems to automatically control the kitchen ventilation and exhaust. Currently, the kitchen exhaust and the make-up air units stay on through the day even when there is no activity in the kitchen. The specifications for the fans that will be controlled for each building are shown below:

Building	Supply Fan (hp)	Exhaust Fan (hp)	Total Fan Capacity (hp)
Fairhaven High School	7.5	7.5	15
Hastings Middle School	-	1.5	1.5
Total			16.5

Energy Conservation Measure Details

It is recommended a kitchen hood control system is installed on the ventilation and exhaust fans and controlled based on temperature. When the kitchen ovens and grills are turned on and the kitchen is active; the exhaust temperature will increase, and this will allow the Variable Frequency Drives to turn on to satisfy exhaust conditions. When the kitchen equipment gets turned off, the VFDs will ramp down which will reduce the schools' energy consumption.

The scope of this work includes the following:

- Supply and install Variable Frequency Drives (VFDs) in place of the existing motor starters for kitchen exhaust and ventilation fans
- Install temperature/optic sensors in the kitchen exhaust ductwork
- Start-up and testing of the new VFDs
- Warranty for one year

The table below shows the annual energy cost savings for each building:

Building	Electricity Savings		Natural Gas Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
Fairhaven High School	10,878	\$1,849	1,573	\$1,888	\$3,737
Hastings Middle School	423	\$72	867	\$1,040	\$1,112
Total	11,301	\$1,921	2,440	\$2,928	\$4,849



Annual energy savings of 11,301 kWh and 2,440 Therms can be realized from this measure; therefore, total cost savings of \$4,849 are estimated.

Implementation

The implementation of this measure requires the purchase and installation of VFDs controlled by differential temperature. The implementation also requires a controller, temperature sensors and electrical wiring. The VFDs will also need to be programmed. The total material and installation cost for each site is show below:

Building	Supply Fan (hp)	Exhaust Fan (hp)	Total Fan Capacity (hp)	Total Cost Savings	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Fairhaven High School	7.5	7.5	15	\$3,737	\$30,831	\$5,160	\$25,671	6.9
Hastings Middle School	-	1.5	1.5	\$1,112	\$11,856	\$1,000	\$10,856	9.8
Total			16.5	\$4,849	\$42,687	\$6,160	\$36,527	7.5

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$36,527}{\$4,849} = 7.5\ years$$



ECM #11- Convert from Oil to Natural Gas at the School Admin Building

Existing Conditions

This measure involves the installation of natural gas condensing boiler to replace oil non-condensing boiler. Currently, the steam boilers are being used to supply radiators.

Energy Conservation Measure Details

It is recommended 92% gas- fired condensing is used to replace an 80% non-condensing oil-fired boiler. There are also additional cost savings since the price of natural gas (estimated \$1.2/Therm) is cheaper than the price of oil (\$1.6/Therm). The scope of this work includes the following:

- Supply and install natural gas fired hot water boiler
- Removal and disposal of existing oil fired boilers and all necessary piping and components of the old system no longer required
- Installation of direct venting system for combustion air and exhaust air
- Commissioning and startup of new boiler systems

There will be an increase in natural gas use of 961 Therms; but a reduction in oil savings of 820 gallons. Therefore the overall cost savings of this measure is \$979.

Implementation

The implementation of this measure requires the purchase and installation of a natural gas fired hot water boiler; the total project cost of this measure is \$16,480. The estimated incentives for this measure is \$1,500; therefore, the customer cost of this is \$14,980. The simple payback is calculated as follows:

$$\text{Payback Period} = \frac{\text{Customer Cost}}{\text{Cost Savings}} = \frac{\$14,980}{\$979} = 15.3 \text{ years}$$



Installation and Warranty Information

If you decide to proceed with this proposal, Energy Source will be responsible for the following tasks:

- Develop final equipment specifications and equipment layout
- Processing and filing application for utility incentives
- Material ordering and receiving
- Dismantling and removing existing systems from premises
- Construction
- Final walk-through with you
- Development and delivery of comprehensive project completion manual.

Installation

All installation staff will agree to submit to a CORI check before proceeding with project.

The removal and disposal of asbestos and toxic materials if present are the owner's responsibility and should be determined before proceeding with the project.

Warranty

Included with your project is a one-year warranty on all labor and materials provided by Energy Source. At the end of the first-year materials remain covered by standard warranties provided by their manufacturers. Warranty periods begin when the installation is completed. The owner has a one-month period following the completion of the installation to accept or reject work performed by Energy Source, after which time we will assume that the work has been accepted.

Due to the fluctuation in commodities this proposal is valid for a period of 30 days from the date shown at the top of this proposal, after which time we will be happy to provide an adjusted quote if necessary.

Policies that Affect Fleet Gas and Diesel Usage

Anti-Idling Policy		
All FY 2017 Gasoline Usage (Gallons)	42,053	
All FY 2017 Diesel Usage (Gallons)	25,845	
Percent Savings	3%	Idling vehicles contribute significantly to air pollution and waste fuel, increasing fleet management costs. Municipalities across the Commonwealth and the nation have seen significant cost and greenhouse gas emission reductions since implementing Town-wide “no-idling” policies for municipal vehicles. In many cases this has been as much as a 3% decrease.
Gallons of Gasoline Saved per Year	1,262	
Gallons of Diesel Saved per Year	775	
MMBTUs Saved per Year	265	
Closely Monitor Tire Air Pressure, Use 100% Synthetic Oil & Use Fuel Efficient Tires		
All FY 2017 Gasoline Usage (Gallons)	42,053	
All FY 2017 Diesel Usage (Gallons)	25,845	
Percent Savings	3%	Maintaining appropriate air pressure in vehicle tires, using 100% synthetic oil and using fuel efficient tires can decrease a vehicles fuel consumption by as much as 3%.
Gallons of Gasoline Saved per Year	1,262	
Gallons of Diesel Saved per Year	775	
MMBTUs Saved per Year	265	
Total MMBTUs Saved	530	

MMBtu Conversion Chart

Fuel Energy Content of Common Fossil Fuels per DOE/EIA

BTU Content of Common Energy Units – (1 million Btu equals 1 MMBtu)

- 1 kilowatt hour of electricity = 0.003412 MMBtu
- 1 therm = 0.1 MMBtu
- 1 ccf (100 cubic foot) of natural gas = 0.1028 MMBtu (based on U.S. consumption, 2007)
- 1 gallon heating oil = 0.139 MMBtu
- 1 gallon of propane = 0.091 MMBtu
- 1 cord of wood = 20 MMBtu
- 1 gallon of gasoline = 0.124 MMBtu (based on U.S. Consumption, 2007)
- 1 gallon of E100 ethanol = 0.084 MMBtu
- 1 gallon of E85 ethanol = 0.095 MMBtu
- 1 gallon of diesel fuel = 0.139 MMBtu
- 1 gallon of B100 biodiesel = 0.129 MMBtu
- 1 gallon of B20 biodiesel = 0.136 MMBtu
- 1 gallon of B10 biodiesel = 0.137 MMBtu
- 1 gallon of B5 biodiesel = 0.138 MMBtu
- 1 barrel of residual fuel oil = 6.287 MMBtu