Town of Mansfield, Massachusetts
Energy Reduction Plan

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

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

March 28, 2022

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I. Purpose and Acknowledgements

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

Town of Mansfield
6 Park Row, Mansfield, Massachusetts 02048
Select Board
Neil Rhein, Chairman

January 6, 2022

MA Department of Energy Resources
Green Communities Division
100 Cambridge Street – Suite 1040
Boston, MA 02114

At a public Select Board meeting held on January 5, 2022, the Select Board voted to adopt the attached Energy Reduction Plan.

Sincerely,

Neil Rhein
Chairman, Select Board

Phone (508)261-7372 • Fax (508)261-7498 • Email selectboard@mansfieldma.com

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

MANSFIELD SCHOOL COMMITTEE

MANSFIELD PUBLIC SCHOOLS

January 12, 2022

MA Department of Energy Resources
Green Communities Division
100 Cambridge Street – Suite 1040
Boston, MA 02114

To Whom It May Concern:

At an open School Committee meeting held on January 11, 2022, the School Committee voted to adopt the attached Energy Reduction Plan.

Sincerely,

Kiera O'Neil
Chair, Mansfield School Committee

2 Park Row • Mansfield, Massachusetts 02048 • Tel: (508) 261-7500 • Fax: (508) 261-7509

C. List of Contributors

The collaborative efforts of Mansfield Town Manager Kevin J. Dumas, Assistant Town Manager/Finance Director Barry LaCasse, Executive Secretary to the Select Board Carrie Champagne, Select Board Chairman Neil Rhein, Mansfield Public Schools Superintendent Teresa Murphy, and School Committee Chairwoman Kiera O'Neil, as well as MA Department of Energy Resources Green Community Regional Coordinator Lisa Sullivan 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 Rich Finn. 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 Mansfield is located in southeastern Massachusetts in northern Bristol County. It is located approximately 40 miles southwest of Boston and 35 miles north of Providence, Rhode Island. The town has an approximate land area of 20.5 square miles and is bordered by Foxborough and Sharon on the north; Easton on the east; Norton on the south; and Attleboro and North Attleborough on the west. According to the 2020 U.S. Decennial Census, Mansfield had an estimated population of 23,860 persons, having experienced a 3% increase in population since 2010.

Mansfield was first settled by Europeans in 1685 when Mansfield (along with neighboring Easton and Norton) was part of the Taunton North Purchase. It was incorporated as its own community a little less than a century later in 1775. In its earliest years, Mansfield was primarily an agricultural community and the rivers flowing through town brought the town its earliest mills – gristmills, cotton mills as well as tack factories and machine foundries. Agriculture, however, continued to dominate Mansfield's landscape in the 19th and early 20th centuries. The construction of Interstate 95, 495 and the 850-acre Cabot Business Park transformed Mansfield from an agricultural community into the attractive suburban community it is today with its bustling downtown, charming residential neighborhoods and convenient commuter rail service to Boston and Providence.

B. Summary of Municipal Energy Users

Table 1: Summary of Municipal Energy Users

	Number	Ownership
Buildings		
Oil Heat	0	
Natural Gas Heat	14	Muni
Propane Heat	1	Muni
Biomass Heat	0	
Electric Heat	6	Muni
Unheated	7	Muni
Vehicles		
Non-Exempt	17	Muni
Exempt	117	Muni
Street Lights	2,838	Muni
Traffic Lights	11	Muni
Water & Sewer		Muni
Pumping Stations	3	Muni
Water Supply Treatment Plant	1	Muni
Wastewater Treatment Plant	0	(regional, located in Norton)

Facility / Item Details by MEI Major Category

- Total Number of Municipal Buildings: **28**

Municipal Buildings included in MEI by Type	
Schools	Roland Green School Jordan/Jackson Elementary School Robinson Elementary School Qualters Middle School Mansfield High School School Administration
Administration	Town Hall
Essential Operations	Water Division Treatment Facility (Municipal Complex) DPW Garage (Municipal Complex) – known as Highway Division in MEI Joint Police and Fire Public Safety Building (Municipal Complex) Police Shooting Range Shed Hatheway-Patterson Office Building (Emergency Management) Plymouth Street Fire Station

	Former Police Station Former Fire Station Animal Control Airport Building G Airport Building H Airport Hangar C Airport Hangar D Municipal Electric Department Office Recycling Center Brine Building
Community Facilities	Library/Council on Aging Fisher-Richardson House
Electrical Substations	Municipal Electric Station East Mansfield Substation Gilbert Street Substation

- Total Number of Municipal Vehicles: **134 (17 non-exempt and 117 exempt)**
- Total Number of Street Lights: **2,838**
- Total Number of Traffic Lights: **11**
    - With an additional **3** airport traffic control lighting types: rotating beacon, runway lights, and ramp outlet
- Total Number of Open Space Facilities: **15**

Municipal Open Space Facilities	
Fields	Memorial Park Plymouth Street Recreation Facility Town Center Common Mansfield Little League West Mansfield Square Hutchason Field Keach Memorial Mansfield East Common Qualters Middle School Field Varsity Softball Fields
Ponds	Fulton Pond Duck Pond
Support Infrastructure	High School Scoreboard East Street Field Pump House Irrigation Parking Machine River Street

- Total Number of Water & Sewer Facilities: **15**

Municipal Water and Sewer Facilities	
Water Supply	Cate Springs Well #1 Albertini Wells #2, #3, #4 Mahana Well #6 and Morrison Well #10

	Dustin Well #7 Prescott Well #8, #9 Walsh Wellfield #11 Foolish Hill/Belcher Road Pump North Main Street Pump Route 106 Underpass Pump Oxford Street Water Storage Tank
Wastewater Treatment	Leonard Street Sewage Lift Mill Street Sewage Lift Highway Garage Sewage Lift Union Street Extension Sewer Essex Street Meter Pit

C. Summary of Energy Use Baseline and Plans for Reductions

This Energy Reduction Plan commits Mansfield to reduce energy use in municipal facilities by at least 20% compared to Fiscal Year 2021 over five years. In the baseline year, the town used 92,058 MMBTUs of energy, which means the town must reduce usage by at least 18,412 MMBTUs over the following five-year period.

Figure 1: Municipal Energy Use Baseline Dashboard from MEI (FY2021)

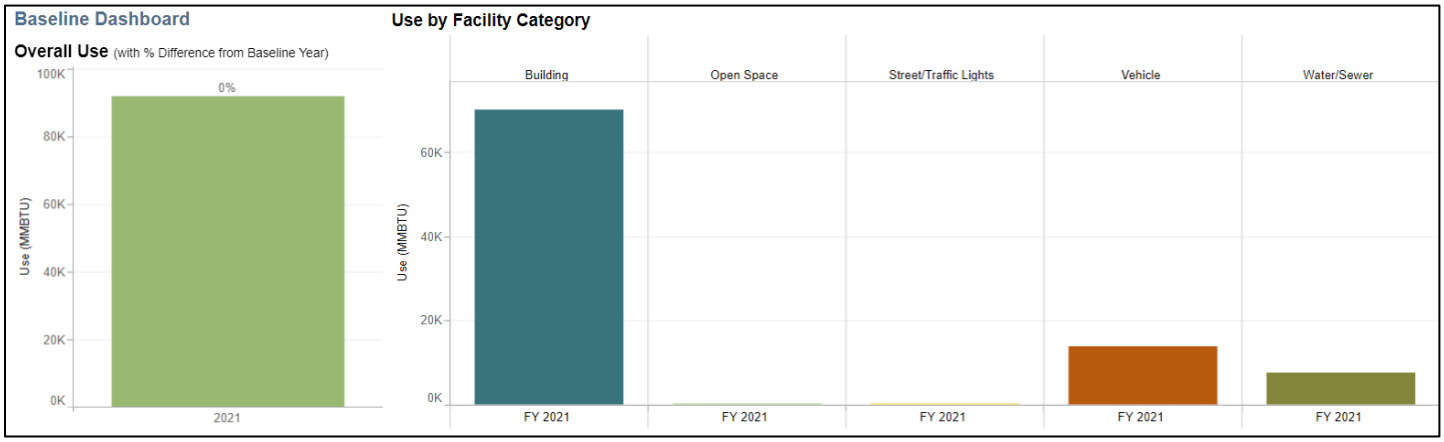


Table 2: Summary of Municipal Energy Use and Reductions

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 – Audit Measures	70,187	76.24%	17,326	18.8%
Buildings – Retro Commissioning	-	-	2,814	3.0%
Open Space	322	0.35%	0	0.0%
Street/Traffic Lights	162	0.18%	0	0.0%
Vehicles	13,821	15.01%	0	0.0%
Water & Sewer	7,565	8.22%	51	> 0.1%
Total	**92,058**	**100%**	**20,191**	**21.9%**

III. Energy Use Baseline Inventory

A. Identification of the Inventory Tool Used

The Town of Mansfield 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) 2021 will serve as the baseline year. FY2021 ran from July 1, 2020 to June 30, 2021. This will give the Town until June 30, 2026 (FY2022 - FY2026) to reach its 20% energy reduction goal.

C. Municipal Energy Consumption for the Baseline Year (FY2021)

In the baseline year, the town used 92,058 MMBTUs of energy. ***Tables 3A*** and ***3B*** presents energy use for each municipal facility in native fuel units and MMBTUs.

- **Buildings:** Mansfield's 28 buildings consumed 70,187 MMBTUs, approximately 76% of Mansfield's total municipal energy use. The three buildings with the largest energy use were Qualters Middle School (22,021 MMBTUs), Mansfield High School (15,524 MMBTUs), and Jordan/Jackson Elementary School (11,695 MMBTUs), as shown in ***Figure 2***.

- **Open Space:** Mansfield's open space facilities consumed 322 MMBTUs, or 0.35% of the town's energy use.

- **Street/Traffic Lights:** There are 2,838 streetlights and 11 traffic lights in Mansfield. Additionally, Mansfield is unique in that it hosts a municipal airport. In this case, we consider traffic lights to include the traffic control lighting for airplanes that is present at the airport. These three main categories of lights (street, traffic, and air traffic control) consumed 162 MMBTUs, or 0.18% of the Town's energy use.

- **Vehicles:** Mansfield's municipal vehicles used 15% of the baseline total, or 13,821 MMBTUs.

- **Water & Sewer:** Mansfield's non-building water and sewer operations consumed 7,565 MMBTUs or 8.2% of the town's energy.

Table 3A: Municipal Energy Consumption for Baseline Year FY2021 (Native Fuel Units)

ERP Guidance Table 3a - Municipal Energy Consumption for 2021 (Native Fuel Units)

		2021				
		Electric (kWh)	Gas (therms)	Gasoline (gallons)	Diesel (gallons)	Propane (gallons)
Building	Town Hall	237,357	11,901			
	Public Library & Council on Ag..	156,200	8,481			
	Police & Fire Station	368,240	22,480			
	Emergency Management Age..	33,812				
	Highway Division	167,440				
	Mansfield High School	1,396,400	107,594			
	Qualters Middle School	1,045,078	184,547			
	Robinson Elementary School	631,560	0			
	Jordan/Jackson Elementary S..	1,119,224	78,766			
	Roland Green Pre-School	43,793	8,558			
	Hangar C	3,934				
	Hangar D	4,740				
	Building H	4,434				
	Building G	147,264				
	Animal Control	37,099				
	Police Shooting Range Shed	137				
	Plymouth Street Fire Station	64,900	4,137			
	School Administration	75,037	2,780			
	Municipal Electric Office	41,807	6,255			
	Recycling Center	10,846				
	Fisher-Richardson House	108				
	Former Police Station	68,340	4,912			
	Former Fire Station	14,823	4,035			
	Municipal Electric Station	11,329				
	Brine Building/Compost Contr..	86,220				
	East Mansfield Substation (Bir..	65,224				
	Water Division Treatment Faci..	132,160	26,137			
	Gilbert Street Substation		27,679			
	Total	**5,967,506**	**498,262**			
Open Space	Memorial Park	35,836				
	Plymouth Street Recreation F..	27,529				
	Town Center Common	6,170				
	Mansfield Little League	20,399				
	West Mansfield Square (West ..	0				
	Hutchason Field	1,748				
	Fulton Pond	158				
	Duck Pond	1,355				
	Keach Memorial	542				
	Mansfield East Common (Che..	46				
	Field Behind Qualters Middle ..	2				
	Varsity Softball Fields	0				
	High School Scoreboard	121				

Table 3A [continued]: Municipal Energy Consumption for Baseline Year FY2021 (Native Fuel Units)

ERP Guidance Table 3a - Municipal Energy Consumption for 2021 (Native Fuel Units)

		2021				
		Electric (kWh)	Gas (therms)	Gasoline (gallons)	Diesel (gallons)	Propane (gallons)
Open Space	East Street Field Pump House..	67				
	Parking Machine (River Street)	519				
	Total	**94,492**				
Street/Traffic Lights	Streetlights	22,503				
	Traffic Lights	15,221				
	Rotating Beacon	1,319				
	Runway Lights	5,177				
	Ramp Outlet	3,377				
	Total	**47,597**				
Vehicle	Vehicles			75,946	31,679	
	Total			**75,946**	**31,679**	
Water/Sewer	Cate Springs Well #1	72,849			110	
	Albertini Wells #2, #3, #4	537,400	12,414		205	
	Mahana Well #6 & Morrison ..	212,940				617
	Dustin Well #7	331,160				
	Robert F. Walsh Well #11	198,320	1,875		104	
	Prescott Well #8, #9	324,960				
	Oxford Street Water Storage ..	10,347				
	Mill Street Sewage Lift Station	27,711				
	Leonard Street Sewage Lift St..	1,035				
	Sewage Lift Station-Highway ..	12,415				
	Groundwater Pumps-North M..	114				
	Groundwater Pumps-Route 1..	59				
	Essex Street Meter Pit	374				
	Union Street Extension Sewer	1,608				
	Foolish Hill/Belcher Road Pu..	33,530				
	Total	**1,764,822**	**14,289**		**419**	**617**
Grand Total		**7,874,417**	**512,551**	**75,946**	**32,098**	**617**

Table 3B: Municipal Energy Consumption for Baseline Year FY2021 (MMBTU)

ERP Guidance Table 3b - Municipal Energy Consumption for 2021 (MMBTU)

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

		2021					
		Diesel	Electric	Gas	Gasoline	Propane	Total
Building	Town Hall		810	1,190			**2,000**
	Public Library & Council on Ag..		533	848			**1,381**
	Police & Fire Station		1,256	2,248			**3,504**
	Emergency Management Age..		115				**115**
	Highway Division		571				**571**
	Mansfield High School		4,765	10,759			**15,524**
	Qualters Middle School		3,566	18,455			**22,021**
	Robinson Elementary School		2,155	0			**2,155**
	Jordan/Jackson Elementary S..		3,819	7,877			**11,695**
	Roland Green Pre-School		149	856			**1,005**
	Hangar C		13				**13**
	Hangar D		16				**16**
	Building H		15				**15**
	Building G		502				**502**
	Animal Control		127				**127**
	Police Shooting Range Shed		0				**0**
	Plymouth Street Fire Station		221	414			**635**
	School Administration		256	278			**534**
	Municipal Electric Office		143	626			**768**
	Recycling Center		37				**37**
	Fisher-Richardson House		0				**0**
	Former Police Station		233	491			**724**
	Former Fire Station		51	404			**454**
	Municipal Electric Station		39				**39**
	Brine Building/Compost Contr..		294				**294**
	East Mansfield Substation (Bir..		223				**223**
	Water Division Treatment Faci..		451	2,614			**3,065**
	Gilbert Street Substation			2,768			**2,768**
	Total		**20,361**	**49,826**			**70,187**
Open Space	Memorial Park		122				**122**
	Plymouth Street Recreation F..		94				**94**
	Town Center Common		21				**21**
	Mansfield Little League		70				**70**
	West Mansfield Square (West ..		0				**0**
	Hutchason Field		6				**6**
	Fulton Pond		1				**1**
	Duck Pond		5				**5**
	Keach Memorial		2				**2**
	Mansfield East Common (Che..		0				**0**
	Field Behind Qualters Middle ..		0				**0**
	Varsity Softball Fields		0				**0**
	High School Scoreboard		0				**0**

Table 3B [continued]: Municipal Energy Consumption for Baseline Year FY2021 (MMBTU)

ERP Guidance Table 3b - Municipal Energy Consumption for 2021 (MMBTU)

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

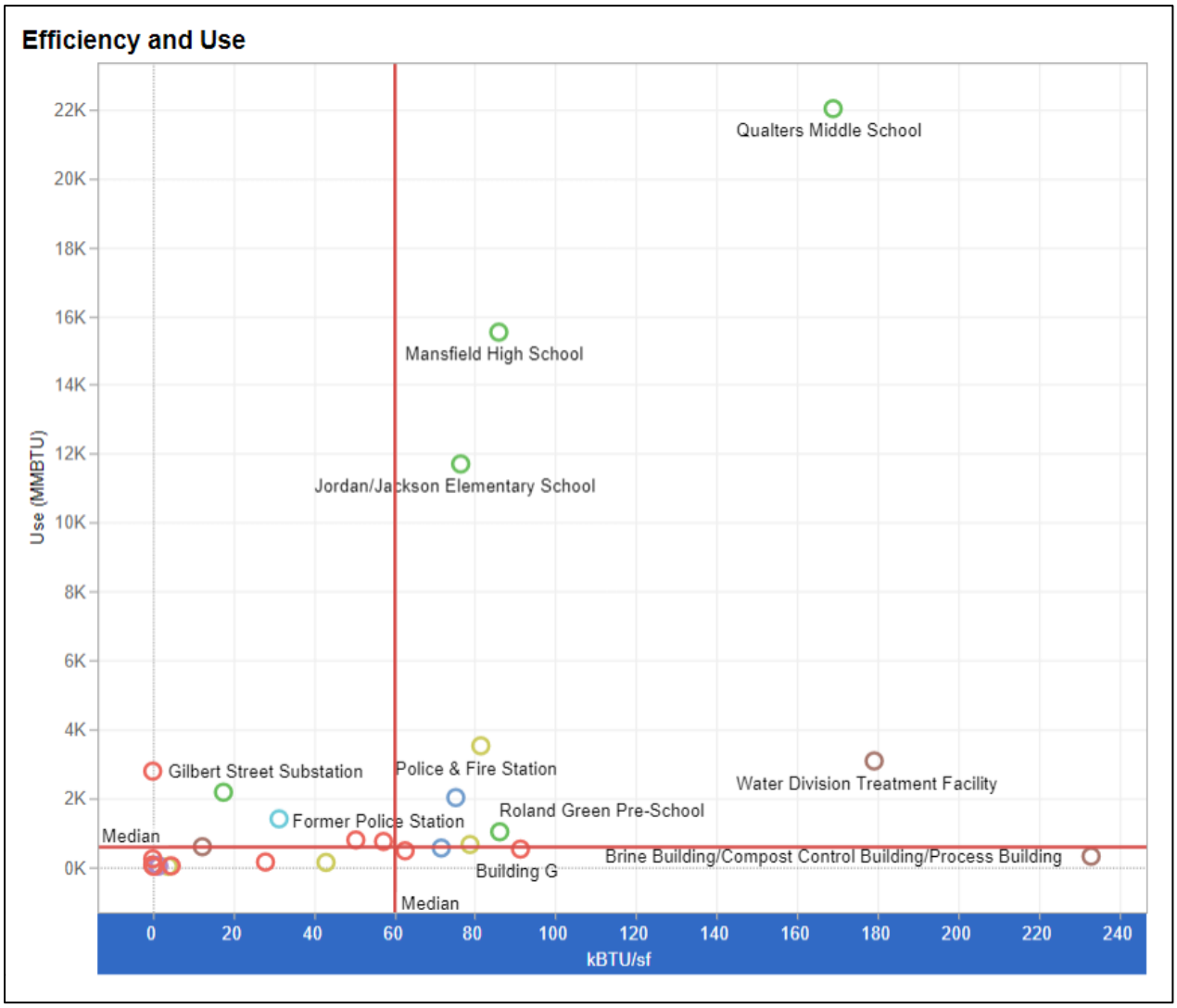
		2021					
		Diesel	Electric	Gas	Gasoline	Propane	Total
Open Space	East Street Field Pump House..		0				**0**
	Parking Machine (River Street)		2				**2**
	Total		**322**				**322**
Street/Traffic Lights	Streetlights		77				**77**
	Traffic Lights		52				**52**
	Rotating Beacon		5				**5**
	Runway Lights		18				**18**
	Ramp Outlet		12				**12**
	Total		**162**				**162**
Vehicle	Vehicles	4,403			9,417		**13,821**
	Total	**4,403**			**9,417**		**13,821**
Water/Sewer	Cate Springs Well #1	15	249				**264**
	Albertini Wells #2, #3, #4	28	1,834	1,241			**3,104**
	Mahana Well #6 & Morrison ..		727			56	**783**
	Dustin Well #7		1,130				**1,130**
	Robert F. Walsh Well #11	14	677	188			**879**
	Prescott Well #8, #9		1,109				**1,109**
	Oxford Street Water Storage ..		35				**35**
	Mill Street Sewage Lift Station		95				**95**
	Leonard Street Sewage Lift St..		4				**4**
	Sewage Lift Station-Highway ..		42				**42**
	Groundwater Pumps-North M..		0				**0**
	Groundwater Pumps-Route 1..		0				**0**
	Essex Street Meter Pit		1				**1**
	Union Street Extension Sewer		5				**5**
	Foolish Hill/Belcher Road Pu..		114				**114**
	Total	**58**	**6,022**	**1,429**		**56**	**7,565**
Grand Total		**4,462**	**26,868**	**51,255**	**9,417**	**56**	**92,058**

Figure 2: MEIs Buildings to Target Dashboard

In ***Figure 2*** below, the buildings represented by points further to the right have a higher energy use per square foot (i.e. are less energy efficient), while the points higher up use more total energy. Qualters Middle School uses the most total energy of any building in town (it is the furthest to the top) at 22,021 MMBTU, and it is the third least energy efficient building (third in from the right) at 169 kBTU/sf. The two least energy efficient buildings are associated with public works operations. The Brine building is least energy efficient (233.1 kBTU/sf), but uses a very small amount of energy overall (294 MMTBU), and thus is not a prime target for energy efficiency improvements.

High priority buildings that are both relatively high energy users and less relatively efficient (shown in the upper right had quadrant of ***Figure 2)*** are prime buildings to target, including Qualters Middle School, the Water Division Treatment Facility, Mansfield High School, Roland Green Pre-School, Town Hall, the Police and Fire Station, and Jordan/Jackson Elementary School.

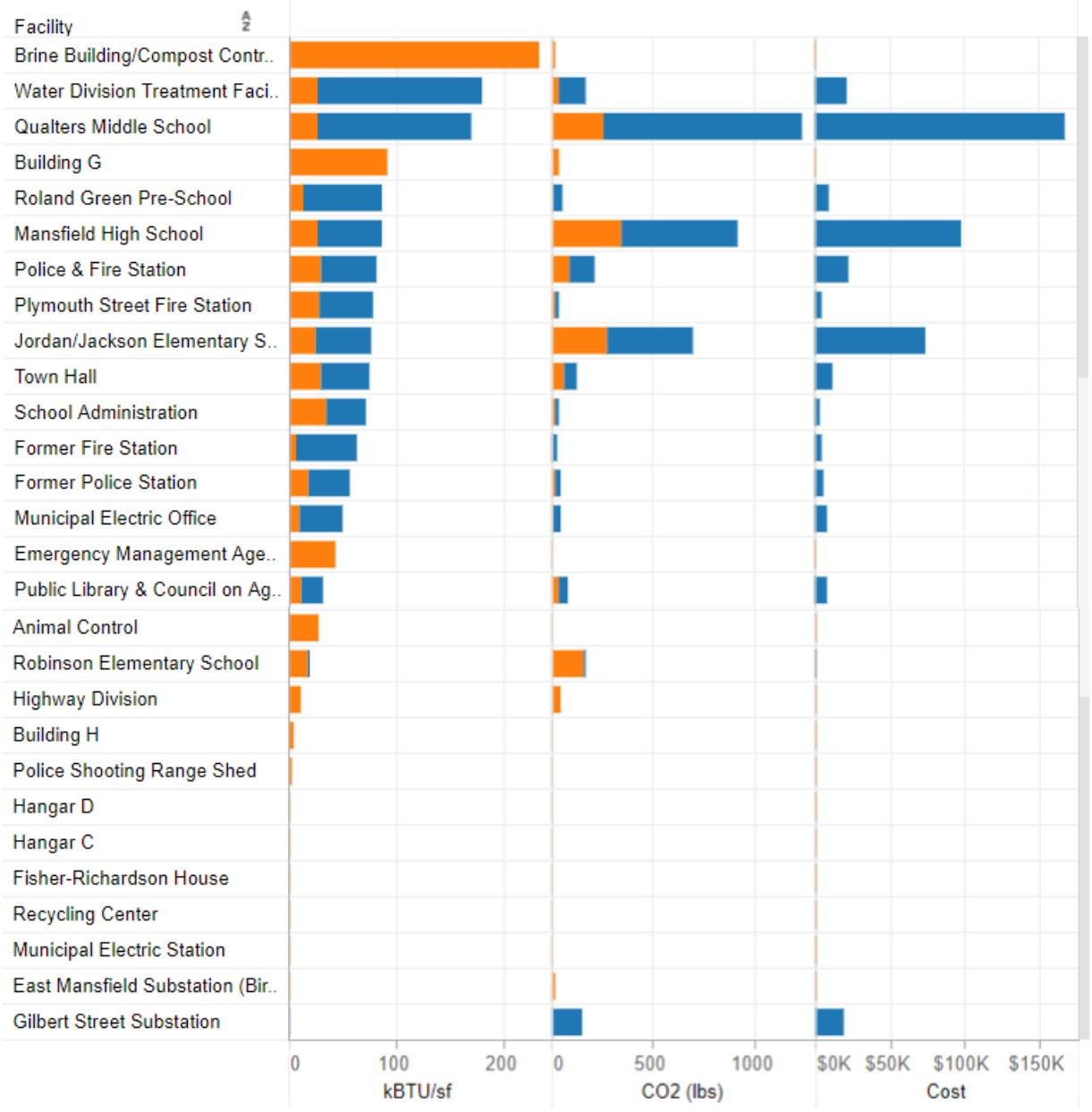
Figure 2: Building to Target Dashboard Components for FY21



Building Efficiency, Emissions and Cost

Heating Electric

Emissions factors updated 1/4/2012 using Massachusetts-specific greenhouse gas emssions factors.



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

IV. Energy Reduction Plan

A. Narrative Summary

As shown below, the town has identified energy savings measures to reduce usage from FY2021 by 20,191 MMBTUs or 21.9%. It is important to note that the schedule below can be modified to accommodate the changing goals and priorities of the community and that projects outside the scope of this Energy Reduction Plan may be eligible for grant funding as long as they are in a building that is listed in this Plan.

1. Overview of Plan Goals Years 1-3:

- **Water Treatment Facility**

  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Weatherization: The following weatherization measures are recommended:

  - Caulk 34 LF. This measure resolves cracks and holes found at individual window and door systems, which allow air to find its way into the wall and window frame cavities or directly from outside to inside resulting in unwanted energy losses.
  - Install weather-stripping to 2 single doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install an attic air barrier retrofit over 5,280 SF.

  New Condensing Boilers: This measure involves the installation of new natural gas condensing boilers. Currently, the hot water is being supplied by non-condensing boilers and delivered to baseboards, unit ventilators, fan coil units, etc. Condensing boilers (average efficiency 97%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%).

  Pump VFDs: Facilities have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to install variable frequency drives, which allow the pumps to modulate based on actual need/conditions. It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. At the Water Treatment Facility, 4 3-HP hot water pumps would be installed.

  Mechanical Insulation: This measure involves the insulation of pipes, tanks, valves & fittings.

- **Mansfield High School**

  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency.

This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Animal Control Facility**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Qualters Middle School**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Weatherization: The following weatherization measures are recommended:
  - Install weather stripping along 6 double doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install weather stripping along 1 single doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install 82 LF and 523 SF of roof-wall intersection air sealing. The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/exfiltration.

  New Steam Boilers: This measure involves the installation of new energy efficient steam boilers. Currently, the steam boilers that are being used at each building to supply radiators, heat exchangers and air handling units are antiquated, inefficient and at end of life.

- **Library/COA Building**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Plymouth Street Fire Station**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency.

This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Town Hall**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Pump VFDs: Facilities have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to install variable frequency drives, which allow the pumps to modulate based on actual need/conditions. It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. At Town Hall, 2 5-HP hot water pumps would be installed.

- **Jordan/Jackson Elementary School**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

2. Overview of Plan Goals Years 4-5:

- **Airport**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Weatherization: The following weatherization measures are recommended:
  - Install 6,296 SF of roof insulation. Roof insulation is also crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced the biggest remaining form of heat loss becomes conduction. No insulation on a roof will result in excessive energy loss due to the lack of a properly insulated thermal barrier. Due to the personnel protective equipment required while installing spray polyurethane foam, no building occupants will be allowed in the building during insulation installation and for a period of 24 hours after installation is complete. All planes will need to be removed from the work area on a daily basis to ensure safety of the planes.

- **Brine Building**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency.

This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

High Efficiency Transformers: The Brine building uses low voltage transformers to step voltage down from 480V to 120/208V. The 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 newer transformers are now available with much lower losses.

- **Hatheway-Patterson Office Building**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Weatherization: The following weatherization measures are recommended:
  - Install attic bypass air sealing over 1,200 SF. Access hatches, interior walls, plumbing, electrical, and HVAC penetrations entering the attic are not properly sealed, allowing conditioned air to escape into the vented attic space. Since warm air rises, sealing the attic from the conditioned space is crucial to maintaining an efficient building. The air movement reduces the effectiveness of the existing insulation.
  - Install 1,072 SF of attic flat insulation. Attic insulation is crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced, the biggest remaining form of heat loss becomes conduction. The lack of insulation or inadequate insulation in an attic will result in excessive energy loss due to the lack of a properly insulated thermal barrier.
  - Construct 128 SF walkway.
  - Insulation of 60 (UT) soffit baffles
  - Retrofit one pull down stair

- Heat Pump Conversion: This measure involves installing a Heat Pump System to replace window air conditioning units and electric baseboard heaters at the Hathaway-Patterson building. The building uses window air conditioning units to cool in the summer and electric baseboard heat to heat in the winter.

- **Qualters Middle School**
  Pump VFDs: Facilities have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to install variable frequency drives, which allow the pumps to modulate based on actual need/conditions. It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. At Qualters Middle School, 2 15-HP hot water pumps would be installed.

  Mechanical Insulation: This measure involves the insulation of pipes, tanks, valves & fittings.

  Walk-in Cooler Controls: This measure involves the installation of refrigeration controllers to control door heaters, fan cycling and associated cooler/freezer compressors. Currently, the

facilities have evaporator fan motors which circulate/transfer 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.

- **Roland Green School**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Steam Traps: Roland Green School heats the building with gas-fired steam boilers. Throughout the steam piping system there are a number of steam traps, which are a type of valve that filter out condensate and non-condensable gases (such as air) without letting steam escape. Over time steam traps can fail. One consequence is a loss of steam from the system, leading to a significant amount of wasted energy. It is recommended that steam traps are repaired and/or replaced to make sure that the steam that is being produced by the boilers stays in the system to heat the spaces of the building.

  New Steam Boilers: This measure involves the installation of new energy efficient steam boilers. Currently, the steam boilers that are being used at each building to supply radiators, heat exchangers and air handling units are antiquated, inefficient and at end of life.

- **Electric Department**
  Weatherization: The following weatherization measures are recommended:
  - Caulk 64 LF. This measure resolves cracks and holes found at individual window and door systems, which allow air to find its way into the wall and window frame cavities or directly from outside to inside resulting in unwanted energy losses.
  - Door weather stripping on 2 single doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install 240 SF of roof insulation. Roof insulation is also crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced the biggest remaining form of heat loss becomes conduction. No insulation on a roof will result in excessive energy loss due to the lack of a properly insulated thermal barrier.
  - Install 5,027 SF of wall insulation. A wall assembly that does not have an effective air barrier in place allows unnecessary air leakage. Select areas of poorly insulated and sealed wall assemblies create bypasses for air leakage and heat loss that force the heating and cooling systems to work harder than necessary. Storage at walls at the mezzanine level will need to be moved by others prior to insulation installation. During installation in the garage bays Energy Source will need full access to the space for lifts and ladders without interruption by traffic from trucks.

- **Mansfield High School**
  Weatherization: The following weatherization measures are recommended:

- Run 53 LF of buck frame air sealing. The buck frame is the area above the window frame, where framing members attach the frame to the wall of the building. Gaps are often left between these areas, and also above and below them, resulting in large weakness areas for air infiltration.
- Install weather stripping along 13 double doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
- Install weather stripping along 3 single doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
- Install 2 units of overhead door weather stripping. With low grade, none, or deteriorating materials in place overhead and roll-up doors are a major air leakage source in any building with one these systems.
- Install 1,046 LF and 671 SF of roof-wall intersection air sealing. The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/exfiltration.
- Install 503 SF of wall air sealing. A wall assembly that does not have an effective air barrier in place allows unnecessary air leakage. Select areas of poorly insulated and sealed wall assemblies create bypasses for air leakage and heat loss that force the heating and cooling systems to work harder than necessary.

New Condensing Boilers: This measure involves the installation of new natural gas condensing boilers. Currently, the hot water is being supplied by non-condensing boilers and delivered to baseboards, unit ventilators, fan coil units, etc. Condensing boilers (average efficiency 97%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%). In the school, a hybrid approach is suggested, which would leave one non-condensing boiler in place and replace the remainder with a condensing equivalent. The new condensing boiler will be primarily used, the older boiler will only be utilized for long cold stretches where one boiler will not be sufficient to trim the load required.

Mechanical Insulation: This measure involves the insulation of pipes, tanks, valves & fittings.

Heat Pump Domestic Water Heater: Mansfield High School currently has a natural gas-fired Raypak atmospheric domestic hot water boiler with a rating of 1,124 MBH. The boiler serves a large Patterson Kelley vertical water tank for all the school's domestic hot water needs. It is recommended that the boiler be retrofitted with an AO Smith Hybrid Electric Domestic Hot Water Heater to serve all domestic needs. Heat pump water heaters use electricity to move heat from one place to another instead of generating heat directly. Therefore, they can be two to three times more energy efficient than conventional electric resistance water heaters. By converting the DHW to electric, the High School will solely utilize electric for its water heating needs.

Walk-in Cooler Controls: This measure involves the installation of refrigeration controllers to control door heaters, fan cycling and associated cooler/freezer compressors. Currently, the

facilities have evaporator fan motors which circulate/transfer 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.

- **Robinson School**

  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

  Weatherization: The following weatherization measures are recommended:

  - Install weather stripping along 14 double doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install weather stripping along 5 single doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install 1,000 LF and 205 SF of roof-wall intersection air sealing. The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/exfiltration.
  - Install 28 SF of overhang air sealing. Overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly “connected” to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.

  Mechanical Insulation: This measure involves the insulation of pipes, tanks, valves & fittings.

  New Condensing Boilers: This measure involves the installation of new natural gas condensing boilers. Currently, the hot water is being supplied by non-condensing boilers and delivered to baseboards, unit ventilators, fan coil units, etc. Condensing boilers (average efficiency 97%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%). In the school, a hybrid approach is suggested, which would leave one non-condensing boiler in place and replace the remainder with a condensing equivalent. The new condensing boiler will be primarily used, the older boiler will only be utilized for long cold stretches where one boiler will not be sufficient to trim the load required.

  Pump VFDs: Facilities have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to

install variable frequency drives, which allow the pumps to modulate based on actual need/conditions. It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. At Robinson Elementary School, 1 25-HP hot water pump would be installed.

Walk-in Cooler Controls: This measure involves the installation of refrigeration controllers to control door heaters, fan cycling and associated cooler/freezer compressors. Currently, the facilities have evaporator fan motors which circulate/transfer 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.

- **Albertini Well**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Jordan/Jackson Elementary School**
  Weatherization: The following weatherization measures are recommended:
  - Run 5,945 LF of caulking. This measure resolves cracks and holes found at individual window and door systems, which allow air to find its way into the wall and window frame cavities or directly from outside to inside resulting in unwanted energy losses.
  - Weather stripping of 4 double doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Weather stripping of 13 double doors. This measure addresses deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems, which create direct pathways for unwanted infiltration/exfiltration.
  - Install 52 LF and 73 SF of overhang air sealing. Overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly “connected” to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.
  - Install 97 SF of roof-wall intersection air sealing. The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/exfiltration.

  Mechanical Insulation: This measure involves the insulation of pipes, tanks, valves & fittings.

New Condensing Boilers: This measure involves the installation of new natural gas condensing boilers. Currently, the hot water is being supplied by non-condensing boilers and delivered to baseboards, unit ventilators, fan coil units, etc. Condensing boilers (average efficiency 97%) can obtain a much higher efficiency than the standard non-condensing boiler (average efficiency 80%). In the school, a hybrid approach is suggested, which would leave one non-condensing boiler in place and replace the remainder with a condensing equivalent. The new condensing boiler will be primarily used, the older boiler will only be utilized for long cold stretches where one boiler will not be sufficient to trim the load required.

Pump VFDs: Facilities have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to install variable frequency drives, which allow the pumps to modulate based on actual need/conditions. It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. At Jordan/Jackson Elementary School, 1 5-HP condenser water pump and 1 15-HP chilled water pump would be installed.

High Efficiency Transformers: The Jordan/Jackson Elementary School uses low voltage transformers to step voltage down from 480V to 120/208V. The 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 newer transformers are now available with much lower losses.

Demand Control Ventilation: This measure includes the installation of demand control ventilation (DCV) at Jordan/Jackson Elementary School to refine and tighten the building's temperature controls. The building has several Air Handler Units and/or Rooftop Units that deliver fresh air into the larger common spaces. Currently, these units bring in a fixed amount of outside air that then has to be heated/cooled. There is an opportunity to monitor space occupancy via CO2 levels and only bring in the required amount of outside air to meet proper ventilation requirements.

- **Walsh Well**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient incandescent and fluorescent lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Train Parking Lot**
  LED Lighting: This measure involves the installation of LED fixtures/kits and controls where applicable. The scope is to replace the existing inefficient HID lighting technology with high efficiency LED bulbs. This will result in up to a 90% increase in efficiency. This measure will reduce the energy consumption based on the decrease in lighting power output and the use of adaptive control technology (where applicable/practical).

- **Building Operator Certification**
  The Town intends to have a staff person attend the Building Operator Certification (BOC) Program. Energy-savings evaluations show that an individual Certified Building Operator (CBO) can reduce

energy use by more than one (1) percent of a building's building electricity demand.[1] By certifying operators in building systems efficiency, the town will realize savings in energy use and related costs, improvements in comfort and safety, and may continue to experience these benefits for up to five (5) years following certification (based on program estimates).[2]

- **Retrocommissioning**
  Retrocommissioning provides an understanding of how closely a building comes to operating as intended. It 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.[3] Mansfield plans to perform retrocommissioning for the Qualters Middle and High School buildings, for a total projected energy savings of 2,815 MMTBU's from the FY21 baseline in these buildings.

	FY2021 Energy Usage (therms)	FY2021 Energy Usage (kWh)	Rate of energy savings from RC	Therms savings from FY2021 levels	kWh savings from FY2021 levels	Annual Cost Savings
Qualters Middle School	184,547	1,045,078	7.50%	13,841	78,381	$29,250.32
Mansfield High School	107,594	1,396,400	7.50%	8,070	104,730	$28,033.50
$0.19 per kWh		per Energy Source Audit				
$1.06 per Therm		per Energy Source Audit				

- **Vehicle Measures**

  1. **Town-Wide "Anti-Idling" Policy:** 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. Implementing such a policy can reduce vehicle fuel consumption by as much as 10%.[4] Assistant Town Manager Barry LaCasse will be responsible for advancing this energy conservation measure.

  2. **Monitor Tire Air Pressure & Use Fuel Efficient Tires:** Maintaining appropriate air pressure in vehicle tires can decrease that vehicles fuel consumption by as much as 4%.[5]

[1] Energy Savings for the Building Operator Certification (BOC®) Program. http://www.theboc.info/wp-content/uploads/2017/02/BOC-EnergySavings-FAQ-2.0-web.pdf
[2] 8 Building Operator Certification Program. https://www.theboc.info/certifications/
[3] https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH5_RetroComm.pdf
[4] https://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf
[5] https://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf

Assistant Town Manager Barry LaCasse will be responsible for advancing this energy conservation measure.

3. **Use 100% Synthetic Oil:** The use of 100% synthetic oils reduces fuel consumption, the number of annual oil change and labor costs. This can reduce vehicle fuel consumption by as much as 2%.[6] Assistant Town Manager Barry LaCasse will be responsible for advancing this energy conservation measure.

4. **Replacement of Automobiles**[7]
   The replacement of conventional vehicles with hybrid and/or electric vehicles would result in an energy savings from reduced gasoline consumption within the town's vehicle fleet. Mansfield has already started to replace vehicles in its fleet with more energy efficient options. The town's Electric Department purchased a 2020 Chevrolet Bolt to replace an old gasoline car,[8] and the police department purchased three hybrid cruisers to replace conventional cruisers in January 2022. The police department expects these replacements to continue in years to come, and is going to conduct a six-month and one-year comparison for fuel consumption and costs to inform vehicle replacement decisions going forward.[9]

B. Path to 20% Energy Use Reduction by the end of Fiscal Year 2026

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

The Town Manager's Office will be responsible both for oversight of the Energy Reduction Plan and for the implementation of energy conservation measures within the Town. The Town Manager's Office will also 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 conducted by Energy Source in 2021. The full Energy Audit performed by Energy Source is included as an attachment in Appendix A. These audit measures, together with retrocommissioning at Mansfield High School and Qualters Middle School, will result in an additional 20,314 MMBTUs or 22.07% energy savings from total FY21 energy usage over the next five years. Table 4 details these energy conservation measures. In addition to implementing the measures calculated toward the 22.07% energy savings identified in Table 4, the town will further reduce their municipal energy use by having staff become Building Operator Certified, implementing behavioral vehicle measures (anti-idling policy, monitoring tire air pressure, and the use of 100% synthetic oil), and purchasing hybrid and electric vehicles as conventional vehicles and the town fleet are retired.

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, Mansfield will work with internal schools and town staff as well as outside consultants, when necessary, to assess

[6] https://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf
[7] https://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf; https://afdc.energy.gov/fuels/
[8] https://www.thesunchronicle.com/news/local_news/mansfield-department-goes-electric-as-it-drives-to-become-green-community/article_647a434e-d99e-514d-9c06-14a93bf334f2.html
[9] https://www.thesunchronicle.com/news/local_news/mansfield-police-department-going-green-with-hybrid-cruisers/article_8503f567-4af8-55a5-aa00-58daf6f5123f.html

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 SeeClickFix creates additional real-time opportunities for efficiencies in operation and maintenance.

The Town of Mansfield 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.

Appendix A: Building Energy Audits – Energy Source

Energy Reduction Plan

Rich Finn
781-267-8495
Richard.finn@energysource.com
www.energysource.com

September 22nd, 2021

Dear Barry LaCasse,

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 & Controls
- Condensing Boilers
- High-Efficiency Steam Boilers
- Weatherization Improvements
- Variable Frequency Drives
- Mechanical Insulation
- Heat Pump Conversion
- Demand Control Ventilation
- Walk-in Cooler Controls
- Heat Pump Water Heater
- High Efficiency Transformers
- Steam Traps

Energy Source will secure incentives from the utility companies wherever applicable. The utility incentives reflected in this proposal are estimated and are subject to change until projects are reviewed by the utility company. Much of the pricing in this report is budgetary and will need to be finalized prior to moving forward with contracts/construction.

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

Sincerely,

Rich Finn

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.

Pre-existing conditions beyond energy conservation measures are above and beyond these scopes will need to be submitted and approved as additional money may be incurred.

For any questions regarding this report, please contact Rich Finn, Director of Project Development for Energy Source, Inc. at 781-267-8495. Any additional use of this report is prohibited unless permission is given in writing from Energy Source, Inc.

energysource

Executive Summary

Energy Source recently conducted an energy survey at the town of Mansfield's municipal facilities.

Our recommendations are known as Energy Conservation Measures (ECM's) 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.

Below is a summary of recommended measures:

Energy Conservation Measures	Total Project Cost	Estimated Incentives	Estimated Customer Cost	Electricity Savings		Gas Savings		Total Cost Savings	Payback Period (years)
				kWh	Cost	Therms	Cost		
LED Lighting	$1,640,887	$0	$1,640,887	1,209,206	$224,912	0	$0	$224,912	7.3
New Condensing Boilers	$897,000	$38,000	$859,000	0	$0	51,900	$55,014	$55,014	15.6
New Steam Boilers	$455,000	$0	$455,000	0	$0	29,028	$30,770	$30,770	14.8
Weatherization	$411,770	$24,576	$387,194	30,936	$5,754	16,384	$17,367	$23,121	16.7
Pump VFDs	$116,350	$0	$116,350	191,024	$35,530	0	$0	$35,530	3.3
Mechanical Insulation	$89,071	$14,610	$74,461	0	$0	9,740	$10,324	$10,324	7.2
Heat Pump Conversion	$60,000	$0	$60,000	12,620	$2,347	0	$0	$2,347	25.6
Demand Control Ventilation	$52,000	$0	$52,000	2,951	$549	12,582	$13,337	$13,886	3.7
Walk-in Cooler Controls	$49,500	$0	$49,500	36,000	$6,696	0	$0	$6,696	7.4
Heat Pump Water Heater	$39,000	$0	$39,000	0	$0	2,191	$2,322	$2,322	16.8
High Efficiency Transformers	$28,488	$0	$28,488	15,146	$2,817	0	$0	$2,817	10.1
Steam Traps	$9,750	$750	$9,000	0	$0	823	$872	$872	10.3
Total	**$3,848,816**	**$77,936**	**$3,770,880**	**1,497,883**	**$278,605**	**122,648**	**$130,006**	**$408,611**	**9.2**

ECM #1- LED Lighting and Controls

Existing Conditions

This measure involves the installation of LED fixtures/kits and controls where applicable. Currently, the majority of town buildings are using incandescent & fluorescent lighting technology for interior spaces and HID lighting for exterior spaces. However, the town has upgraded some areas/buildings already to LED's.

Energy Conservation Measure Details

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

- Supply and install new LED fixtures and/or kits
- Remove and recycle old fluorescent lamps & ballasts
- Remove and dispose of old fluorescent fixtures where applicable
- Warranty on new LED lighting (typically 5-10 years)

By implementing this measure, the following annual energy savings can be obtained:

Building	Electricity Savings	
	kWh	Cost
Animal Control	6,449	$1,200
Airport	18,082	$3,363
Albertini Well	6,921	$1,287
Walsh Well	8,034	$1,494
Brine Building	1,985	$369
Hatheway-Patterson/Emergency Management	8,631	$1,605
Library/Council on Aging	57,974	$10,783
Town Hall/Memorial Hall	22,927	$4,264
Plymouth St Fire Station	11,554	$2,149
Train Parking (River St/Winthrop St)	14,752	$2,744

Water Treatment Facility	24,087	$4,480
Robinson School	223,519	$41,575
Jordan-Jackson Elementary	170,162	$31,650
Qualters Middle School	279,972	$52,075
Mansfield High School	332,028	$61,757
Roland Green School	22,129	$4,116
Total	**1,209,206**	**$224,912**

Annual energy savings of 1,209,206 kWh can be realized from this measure which will lead to an estimated annual total cost savings of $224,912.

Implementation

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

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback (years)
Animal Control	$10,976	$0	$10,976	9.2
Airport	$24,526	$0	$24,526	7.3
Albertini Well	$15,420	$0	$15,420	12.0
Walsh Well	$12,426	$0	$12,426	8.3
Brine Building	$5,396	$0	$5,396	14.6
Hatheway-Patterson/Emergency Management	$20,740	$0	$20,740	12.9
Library/Council on Aging	$57,845	$0	$57,845	5.4
Town Hall/Memorial Hall	$33,611	$0	$33,611	7.9
Plymouth St Fire Station	$14,924	$0	$14,924	6.9
Train Parking (River St/Winthrop St)	$10,613	$0	$10,613	3.9
Water Treatment Facility	$29,796	$0	$29,796	6.7
Robinson School	$250,535	$0	$250,535	6.0
Jordan-Jackson Elementary	$284,321	$0	$284,321	9.0
Qualters Middle School	$360,209	$0	$360,209	6.9
Mansfield High School	$480,838	$0	$480,838	7.8
Roland Green School	$28,711	$0	$28,711	7.0
Total	**$1,640,887**	**$0**	**$1,640,887**	**7.3**

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$1{,}640{,}887}{\$224{,}912} = 7.3\ years$$

ECM #2- Condensing Boilers

Existing Conditions

This measure involves the installation of new natural gas condensing boilers at various buildings outlined below. Currently, the hot water is being supplied by non-condensing boilers and delivered to baseboards, unit ventilators, fan coil units, etc. The existing boiler quantities and outputs are shown below:

Building	Existing Boiler Qty	Proposed Boiler Replacement Qty	Total Output (MBH)
Water Treatment Facility	5	2	1,525
Mansfield High School	2	1	10,976
Jordan/Jackson Elementary School	2	1	10,248
Robinson School	2	1	9,034
Total	**11**	**5**	**31,783**

Energy Conservation Measure Details

It is recommended that new condensing boilers are installed at the sites referenced above. In the three schools we are suggesting a hybrid approach, leaving one non-condensing boiler in place and replacing the remainder with a condensing equivalent. The new condensing boiler will be primarily used, the older boiler will only be utilized for long cold stretches where one boiler will not be sufficient to trim the load required. Condensing boilers (average efficiency 97%) 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 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

An estimated annual energy savings of 51,900 Therms and an energy cost savings of $55,014 can be realized from this measure.

Building	Heat Savings	
	Therms	Cost
Water Treatment Facility	2,906	$3,080
Mansfield High School	23,611	$25,028
Jordan/Jackson Elementary School	11,534	$12,226
Robinson School	13,849	$14,680
Total	**51,900**	**$55,014**

Implementation

The implementation cost of this measure is $897,000. It is estimated that the rebates for this measure are approximately $38,000; therefore, the total customer cost is $859,000. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$859{,}000}{\$55{,}014} = 15.6\ years$$

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Water Treatment Facility	$52,000	$8,000	$44,000	14.3
Mansfield High School	$292,500	$10,000	$282,500	11.3
Jordan/Jackson Elementary School	$292,500	$10,000	$282,500	26.1
Robinson School	$260,000	$10,000	$250,000	17
Total	**$897,000**	**$38,000**	**$859,000**	**15.6**

ECM # 3 – Energy-Efficient Steam Boilers

Existing Conditions

This measure involves the installation of new energy efficient steam boilers at two of the schools. Currently, the steam boilers are being used at each building to supply radiators, heat exchangers and air handling units. The existing boiler quantities and outputs are shown below:

Building	Existing Boiler Qty	Proposed Boiler Replacement Qty	Total Output (MBH)
Roland Green School	1	1	2,163
Qualters Middle School	3	3	13,422
Total	**4**	**4**	**15,585**

Energy Conservation Measure Details

It is recommended new energy efficient steam boilers are installed at the schools because the existing steam boilers are antiquated, inefficient and at end of life. The scope of this work includes the following:

- Supply and install steam boilers
- Removal and disposal of existing boilers and all necessary piping and components of the old system no longer required
- Commissioning and startup of new boiler systems

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

Building	Heat Savings	
	Therms	Cost
Roland Green School	1,243	$1,318
Qualters Middle School	27,785	$29,452
Total	**29,028**	**$30,770**

Implementation

The implementation of this measure requires the purchase and installation of energy efficient steam boilers. The estimated total material and installation cost breakdown are shown on the table below:

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Roland Green School	$32,500	$0	$32,500	24.7
Qualters Middle School	$422,500	$0	$422,500	14.3
Total	**$455,000**	**$0**	**$455,000**	**14.8**

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$455{,}000}{\$30{,}770} = 14.8\ years$$

ECM #4 - Weatherization Improvements

Existing Conditions

This measure involves a variety of building envelope improvements. Below is a description of each weatherization measure that is being proposed:

- **Attic Bypass Air Sealing** – Access hatches, interior walls, plumbing, electrical, and HVAC penetrations entering the attic are not properly sealed, allowing conditioned air to escape into the vented attic space. Since warm air rises, sealing the attic from the conditioned space is crucial to maintaining an efficient building. The air movement reduces the effectiveness of the existing insulation.
- **Attic Flat Insulation** – Attic insulation is crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced, the biggest remaining form of heat loss becomes conduction. The lack of insulation or inadequate insulation in an attic will result in excessive energy loss due to the lack of a properly insulated thermal barrier.
- **Buck Frame Air Sealing** – The buck frame is the area above the window frame, where framing members attach the frame to the wall of the building. Gaps are often left between these areas, and also above and below them, resulting in large weakness areas for air infiltration.
- **Caulking** – There are cracks and holes found at individual window and door systems. These gaps allow air to find its way into the wall and window frame cavities or directly from outside to inside resulting in unwanted energy losses.
- **Door Weather Stripping** – Deteriorated weather-stripping materials, ineffective weather-stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/exfiltration.
- **Overhang Air Sealing** – Overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.
- **Overhead Door Weather Stripping** – With low grade, none, or deteriorating materials in place overhead and roll-up doors are a major air leakage source in any building with one these systems.

- **Roof Insulation** – Roof insulation is also crucial for controlling conductive heat loss in a building. After air gaps are sealed and convective air loss is reduced the biggest remaining form of heat loss becomes conduction. No insulation on a roof will result in excessive energy loss due to the lack of a properly insulated thermal barrier.
- **Roof-Wall Intersection Air Sealing** – The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/exfiltration.
- **Wall Air Sealing/Insulation** – A wall assembly that does not have an effective air barrier in place allows unnecessary air leakage. Select areas of poorly insulated and sealed wall assemblies create bypasses for air leakage and heat loss that force the heating and cooling systems to work harder than necessary.

Energy Conservation Measure Details

By implementing the measures described above to address the various building envelope issues, a reduction in heat loss/heat gain will occur which will lead to energy savings. Below is a scope of work summary as well as some supporting floor plans showing locations of proposed work:

Task	Electric Department	Hathaway-Patterson Office Building	Jordon Jackson Elementary School	Mansfield Airport	Mansfield High School	Qualters Middle School	Robinson Elementary School	Water Treatment Facility	Total Quantity
Building Envelope Improvement									
Attic Bypass Air Sealing (SF)		1,200							1,200
Attic Flat Insulation (SF)		1,072							1,072
Buck Frame Air Sealing (LF)					53				53
Caulking (LF)	64		5,945					34	6,043
Construct Walkway (SF)		128							128
Door Weather Striping - Doubles (Units)			4		13	6	14		37
Door Weather Stripping - Singles (Units)	2		13		3	1	5	2	26
Insulation Soffit Baffles (UT)		60							60
Overhang Air Sealing (LF)			52						52
Overhang Air Sealing (SF)			73				28		101
Overhead Door Weather Stripping (Units)					2				2
Retrofit Pull Down Stairs (Units)		1							1
Roof-Wall Intersection Air Sealing (LF)					1,046	82	1,000		2,128
Roof-Wall Intersection Air Sealing (SF)			97		671	523	205		1,496
Wall Air Sealing (SF)					503				503
Capital Improvement									
Attic Air Barrier Retrofit (SF)								5,280	5,280
Roof Insulation (SF)	240			6,296					6,536
Wall Insulation (SF)	5,027								5,027

Implementation

By implementing this measure approximately 30,936 kWh and 16,384 therms of natural gas can be realized; therefore, a total annual cost savings of $23,121 was estimated.

Building	Electricity Savings		Natural Gas Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
Electric Department	2,632	$490	1,120	$1,187	$1,677
Hatheway-Patterson Bldg	12,111	$2,253	0	$0	$2,253
Airport	2,766	$514	1,070	$1,134	$1,649
Water Treatment Facility	1,078	$201	1,139	$1,207	$1,408
Jordan-Jackson Elementary	2,572	$478	2,719	$2,882	$3,361
Mansfield High School	5,386	$1,002	5,694	$6,036	$7,037
Qualters Middle School	1,699	$316	1,796	$1,904	$2,220
Robinson Elementary	2,692	$501	2,846	$3,017	$3,517
Total	**30,936**	**$5,754**	**16,384**	**$17,367**	**$23,121**

The total material and installation cost for weatherizing each town building is shown below:

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Electric Department	$98,179	$1,680	$96,499	57.6
Hatheway-Patterson Bldg	$14,251	$0	$14,251	6.3
Airport	$103,870	$1,605	$102,265	62.0
Water Treatment Facility	$74,699	$1,709	$72,990	51.8
Jordan-Jackson Elementary	$24,191	$4,079	$20,113	6.0
Mansfield High School	$48,810	$8,541	$40,269	5.7
Qualters Middle School	$16,347	$2,694	$13,653	6.2
Robinson Elementary	$31,421	$4,269	$27,152	7.7
Total	**$411,770**	**$24,576**	**$387,194**	**16.7**

The estimated customer cost for implementing this measure is $387,194. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$387{,}194}{\$23{,}121} = 16.7\ years$$

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Assumptions & Exclusions

- Prevailing Wage– all pricing in this Report includes prevailing wage rates.
- Electrical Hazards – testing and/ or repair of hazardous electrical components (knob and tube wiring, open junction boxes, etc) that are encountered are excluded from the Energy Source scope of work and pricing. Others are responsible for testing and/ or repair of electrical hazards.
- Hazardous Materials – testing, remediation and/ or removal of any potentially hazardous material that is encountered is excluded from the Energy Source scope of work and pricing. Others are responsible for testing, remediation and/ or removal of potentially hazardous material.
- Debris & Storage Removal – this report does not include recommendations or pricing calculations to remove, relocate, or dispose of debris or storage in spaces included in this scope of work. Energy Source is able to discuss removal alternatives with the client if self-removal is not a viable option for some or all of the areas to be treated.
- Building-specific notes:
    - Electric Department – storage at walls at the mezzanine level will need to be moved by others prior to insulation installation. During installation in the garage bays Energy Source will need full access to the space for lifts and ladders without interruption by traffic from trucks.
    - Hathaway-Patterson Office Building – replacing doors and windows is excluded from the scope of work; this work should be pursued outside of the energy savings project.
    - Mansfield Airport Spray Polyurethane Foam – due to the personnel protective equipment required while installing spray polyurethane foam, no building occupants will be allowed in the building during insulation installation and for a period of 24 hours after installation is complete. All planes will need to be removed from the work area on a daily basis to ensure safety of the planes.

ECM #5 – Pump VFD's

Existing Conditions

This measure involves the installation of variable frequency drives (VFD's). Many of the facilities in Mansfield have HVAC systems that utilize pumps to pump hot water, chilled water, etc. Many of these pumps operate at a fixed speed regardless of need. There is an opportunity to install variable frequency drives, which allow the pumps to modulate based on actual need/conditions.

Energy Conservation Measure Details

It is recommended that variable frequency drives are installed on each pump and controlled via differential pressure or temperature, allowing for electrical savings. The specifications for each pump system is shown below:

Building	VFD Application	Quantity	Size (HP)
Water Treatment Facility	Hot Water Pumps	4	3
Town Hall/Memorial Hall	Hot Water Pumps	2	5
Qualters Middle School	Hot Water Pumps	2	15
Jordan/Jackson Elementary	Condenser Water Pumps	1	5
	Chilled Water Pumps	1	15
Robinson Elementary	Hot Water Pumps	1	25
Total		**11**	

The scope of this work includes the following:

- Supply and install variable frequency drives in place of the existing motor starters
- Supply and install any necessary sensors
- Start-up and testing of the new VFDs, motors, and pumps
- Integrate into Energy Management System (if applicable)
- Warranty for one year

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

Building	Annual Energy Savings	
	kWh	Cost
Water Treatment Facility	24,465	$4,550
Town Hall/Memorial Hall	21,303	$3,962
Qualters Middle School	71,598	$13,317
Jordan/Jackson Elementary	14,355	$2,670
Robinson Elementary	59,303	$11,030
Total	**191,024**	**$35,530**

Annual energy savings of 191,024 kWh can be realized from this measure; therefore, total annual cost savings of $35,530 can be obtained.

Implementation

The implementation of this measure requires the purchase and installation of the above VFD's. The implementation may also require controllers, pressure/temperature sensors and electrical wiring. The total material and installation cost for this measure is estimated at $116,350 as shown below:

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Water Treatment Facility	$32,500	$0	$32,500	7.1
Town Hall/Memorial Hall	$16,900	$0	$16,900	4.3
Qualters Middle School	$19,500	$0	$19,500	1.5
Jordan/Jackson Elementary	$8,450	$0	$8,450	3.2
Robinson Elementary	$39,000	$0	$39,000	3.5
Total	**$116,350**	**$0**	**$116,350**	**3.3**

. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$116{,}350}{\$35{,}530} = 3.3\ years$$

ECM #6 - Mechanical Insulation

Existing Conditions

This measure involves the insulation of pipes, tanks, valves & fittings at several buildings in Mansfield. Below is a description of each measure that is being proposed:

- **Pipe Insulation** – Un-insulated pipes in the heating systems are leading to unnecessary distribution losses and wasted energy.
- **Valve & Fitting Insulation** – Valves and fittings are difficult components of a mechanical system to insulate and as a result are frequently left un-insulated. These un-insulated or poorly insulated components have the same temperature fluids passing through them as the pipes that are more likely to be insulated; un-insulated components of the distribution system lead to unnecessary distribution losses and wasted energy.
- **Tank Insulation** – Tanks are difficult components of a mechanical system to insulate and as a result are frequently left un-insulated. Un-insulated or poorly insulated tanks or equipment have the same temperature fluids passing through them as the pipes that are more likely to be insulated; un-insulated components of the distribution system lead to unnecessary distribution losses and wasted energy.

Energy Conservation Measure Details

It is recommended that bare pipes, valves, fittings, and tanks are insulated. By implementing this measure, a reduction in heat loss will occur, which will lead to energy savings. The scope of work includes the following:

Task	Jordon Jackson Elementary School	Mansfield High School	Qualters Middle School	Robinson Elementary School	Water Treatment Facility
3-Way Valve Insulation (Units)				2	
Ball Valve Insulation (Units)	2	1	2		
Bonnet Inuslation (Units)			10		
Butterfly Valve Insulation (Units)	8	4	3	6	
Control Valve Insulation (Units)	1	1	15		
End Cap Insulation (Units)	1	3	5	2	
Flange Insulation (Units)	24	6	18	26	2
Flex Fitting Insulation (UT)	4			8	
Gate Valve Insulation (Units)	2		21	8	
Pipe Fitting Insulation (Units)	13	11	30	4	1
Pipe Reducer Insulation (Units)			3	6	
Pump Insulation (Units)	2	4	2	4	4
Steam Trap Insulation (Units)			5		
Straight Pipe Insulation (LF)	29	22	150	5	10
Strainer Insulation (Units)			9		4
Suction Diffuser Insulation (Units)	2		2	2	
Tank Insulation (Units)	1		2	15	1
Triple Duty Valve Insulation (Units)	4		2		

By implementing this measure approximately 9,740 Therms of natural gas can be realized, resulting in an annual energy cost savings of $10,324.

Building	Natural Gas Savings		Total Cost Savings
	Therms	Cost	
Water Treatment Facility	260	$276	$276
Jordan-Jackson Elementary	1,950	$2,067	$2,067
Mansfield High School	1,120	$1,187	$1,187
Qualters Middle School	4,990	$5,289	$5,289
Robinson Elementary	1,420	$1,505	$1,505
Total	**9,740**	**$10,324**	**$10,324**

Implementation

The implementation of this measure requires the insulation of bare hot water tanks, valves, pipes and fittings. The total material and installation cost of this measure is $89,071.

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Water Treatment Facility	$2,764	$390	$2,374	8.6
Jordan-Jackson Elementary	$16,107	$2,925	$13,182	6.4
Mansfield High School	$8,719	$1,680	$7,039	5.9
Qualters Middle School	$45,203	$7,485	$37,718	7.1
Robinson Elementary	$16,279	$2,130	$14,149	9.4
Total	**$89,071**	**$14,610**	**$74,461**	**7.2**

It is estimated that $14,610 can be obtained in incentives; therefore, the estimated customer cost for this measure is $74,461. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$74{,}461}{\$10{,}324} = 7.2\ years$$

Assumptions & Exclusions

- Prevailing Wage– all pricing in this Report includes the Heat and Frost Insulator trade classification assuming first shift access throughout the project.
- Asbestos in the Work Area – it is assumed that no comprehensive asbestos remediation project is planned; as a result, it is assumed that all of the areas of asbestos insulation that were found during Energy Source's on-site inspections will remain in place. Under these assumptions, work areas that are directly adjacent to likely asbestos-containing material cannot be included in the scope of work because installing the retrofit insulation would disrupt potentially hazardous material. Any work areas that are directly adjacent to likely asbestos-containing material or would potentially disrupt asbestos-containing material are excluded from the scope of work.
- Electrical Hazards – testing and/ or repair of hazardous electrical components (knob and tube wiring, open junction boxes, etc) that are encountered are excluded from the Energy Source scope of work and pricing. Others are responsible for testing and/ or repair of electrical hazards.
- Hazardous Materials – testing, remediation and/ or removal of any potentially hazardous material that is encountered is excluded from the Energy Source scope of work and pricing. Others are responsible for testing, remediation and/ or removal of potentially hazardous material.

ECM #7 - Heat Pump Conversion

Existing Conditions

This measure involves installing a Heat Pump System to replace window air conditioning units and electric baseboard heaters at the Hathaway-Patterson building. The building uses window air conditioning units to cool in the summer and electric baseboard heat to heat in the winter.

Energy Conservation Measure Details

It is recommended that a mini split heat pump heating and cooling system is 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 heat pump condenser on a pad outside the building
- Furnish and install indoor heads at each individual location
- 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 12,620 kWh with cost savings of $2,347.

Implementation

The implementation of this measure requires the purchase and installation of one condenser and multiple heads. The total material and installation cost of the ductless split for this measure is approximately $60,000. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$60{,}000}{\$2{,}347} = 25.6\ years$$

ECM #8 - Demand Control Ventilation

Existing Conditions

This measure includes the installation of demand control ventilation (DCV) at Jordan/Jackson Elementary School to refine and tighten the building's temperature controls. The building has several Air Handler Units and/or Rooftop Units that deliver fresh air into the larger common spaces. Currently, these units bring in a fixed amount of outside air that then has to be heated/cooled. There is an opportunity to monitor space occupancy via CO2 levels and only bring in the required amount of outside air to meet proper ventilation requirements.

Energy Conservation Measure Details

It is recommended that the current Energy Management System at Jordan/Jackson Elementary School are expanded to include Demand Control Ventilation. This will also include furnishing and installing duct CO^2 sensors for any Air Handler Units/ Rooftop Units. The scope of work includes the following:

- Each HVAC equipment will include a non-proprietary field controller (if applicable)
- Furnish and Install a CO^2 Sensor for each Air Handling Units or Rooftop Units
- Programming and front end graphics

Annual energy savings of 2,951 kWh and 12,582 therms can be realized from this measure; therefore, total cost savings of $13,886 are estimated as shown below:

Location	Electricity Savings		Natural Gas Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
Jordan/Jackson Elementary	2,951	$549	12,582	$13,337	$13,886

Implementation

The implementation of this measure requires the purchase and the installation of the necessary sensors, and controllers. Programming and training is also included in this scope of

work. The total material and installation cost of the control system for this measure is approximately $52,000 as shown below:

Location	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Jordan/Jackson Elementary	$52,000	$0	$52,000	3.7

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$52{,}000}{\$13{,}886} = 3.7\ years$$

ECM #9 – Walk-in Cooler Controls

Existing Conditions

This measure involves the installation of refrigeration controllers to control door heaters, fan cycling and associated cooler/freezer compressors at Qualters Middle School, Mansfield High School, and Robinson Elementary School. Currently, the facilities have evaporator fan motors which circulate/transfer 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.

Energy Conservation Measure Details

It is recommended that refrigeration controls are installed to control the facilitys' walk-in coolers and freezers. 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 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 this measure:

Building	Electricity Savings	
	kWh	Cost
Qualters Middle School	12,000	$2,232
Mansfield High School	12,000	$2,232
Robinson Elementary School	12,000	$2,232
Total	**36,000**	**$6,696**

Annual energy savings of 36,000 kWh can be realized from this measure; therefore, total annual cost savings of $6,696 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 (years)
Qualters Middle School	$16,500	$0	$16,500	7.4
Mansfield High School	$16,500	$0	$16,500	7.4
Robinson Elementary School	$16,500	$0	$16,500	7.4
Total	**$49,500**	**$0**	**$49,500**	**7.4**

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$45{,}900}{\$6{,}696} = 7.4\ years$$

ECM #10 – Heat Pump Domestic Water Heater

Existing Conditions

Mansfield High School currently has a natural gas-fired Raypak atmospheric domestic hot water boiler with a rating of 1,124 MBH. The boiler serves a large Patterson Kelley vertical water tank for all the school's domestic hot water needs.

Energy Conservation Measure Details

It is recommended that the boiler be retrofitted with an AO Smith Hybrid Electric Domestic Hot Water Heater to serve all domestic needs. Heat pump water heaters use electricity to move heat from one place to another instead of generating heat directly. Therefore, they can be two to three times more energy efficient than conventional electric resistance water heaters. To move the heat, heat pumps work like a refrigerator in reverse. Electric tankless water heaters are more energy efficient than standard tank style water heaters, but they don't touch the energy efficiency of a hybrid water heater. While a tankless electric water heater runs at about 99% efficiency, a hybrid water heater can easily operate at 370% efficiency and your gas fired boiler currently operates at approximately a 79% efficiency. In addition to the cost savings, the new DHW heater will vastly be more efficient in its fuel consumption. By converting the DHW to electric, the High School will solely utilize electric for its water heating needs. The new heater will save approximately 2,191 Therms per year. The efficiency savings of the new heater is estimated at $2,322 annually.

Implementation

The implementation of this measure requires the purchase and installation of the new hybrid DHW heater, as well as startup and testing of the new heater. The estimated total material and installation cost of this measure is $39,000. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$39{,}000}{\$2{,}322} = 16.8\ years$$

ECM #11 - High Efficiency Transformers

Existing Conditions

The Brine building and Jordan/Jackson Elementary School use low voltage transformers to step voltage down from 480V to 120/208V. The 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 newer transformers are now available with much lower losses.

Energy Conservation Measure Details

It is recommended that four standard efficiency transformers are replaced with new 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 four high efficiency transformers
- Removal of existing transformers
- Power shutdown will be required

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

Building	Transformer Size (kVA)	Qty	Electricity Savings	
			kWh	Cost
Brine Building	45	1	4,161	$774
Jordan/Jackson Elementary	30	1	10,985	$2,043
	45	2		
Total	**165**	**4**	**15,146**	**$2,817**

Estimated annual energy savings of 15,146 kWh can be realized from this measure; therefore, a total cost savings of $2,817 can be obtained.

Implementation

The implementation of this measure requires the purchase and installation of four high efficiency transformers. The total material and installation cost of the transformers for this measure is shown below:

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback (years)
Brine Building	$6,838	$0	$6,838	8.8
Jordan/Jackson Elementary	$21,650	$0	$21,650	10.6
Total	**$28,488**	**$0**	**$28,488**	**10.1**

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$28{,}488}{\$2{,}817} = 10.1\ years$$

ECM #12 - Steam Trap Repair/Replacement

Existing Conditions

Roland Green School heats the building with gas-fired steam boilers. Throughout the steam piping system there are a number of steam traps, which are a type of valve that filter out condensate and non-condensable gases (such as air) without letting steam escape. Over time steam traps can fail. One consequence is a loss of steam from the system, leading to a significant amount of wasted energy.

Energy Conservation Measure Details

It is recommended that steam traps are repaired and/or replaced to make sure that the steam that is being produced by the boilers stays in the system to heat the spaces of the building. There are a few different ways this can be approached and Energy Source will work with the town to determine the best approach. An estimated 823 therms can be saved from this measure, as shown below:

Location	Natural Gas Savings	
	Therms	Cost
Roland Green School	823	$872

Implementation

The implementation of this measure requires the purchase and installation of the proper steam trap replacements. A survey can be completed if desired to identify particular failed traps. Or, conversely, all traps can be replaced at once. The total estimated material and installation cost breakdown is shown below:

Location	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Roland Green School	$9,750	$750	$9,000	10.3

It is estimated that $750 can be obtained in utility incentives; therefore, the estimated customer cost for this measure is $9,000. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$9{,}000}{\$872} = 10.3\ years$$

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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

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.

Appendix B: Table 4: Energy Conservation Measures

Criterion 3 Step 4: Complete Table 4 - ECMs

Click here to view a sample version of this table

Table 4
Energy Conservation Measures Data

ECMs			Status		Energy Data						Financial Data					Reference Data	
Building/Site Name	Energy Conservation Measure Name	ECM Type (select one from drop-down)	Status (select one from drop-down)	Status Date (Completed with month/year or planned month/year)	Projected Annual Electricity Savings (kWh)	Projected Annual Natural Gas Savings (therms)	Projected Annual Oil Savings (gallons)	Projected Annual Propane Savings (gallons)	Projected Annual Gasoline Savings (gallons)	Projected Annual Diesel Savings (gallons)	Projected Annual Cost Savings ($)	Total Installed Cost ($)	Green Community Grant ($)	Utility Incentives ($)	Net Cost ($)	Funding Source(s) for Net Costs	Source for Projected Savings
Hatheway-Patterson Office Building/ Emergency Management Agency	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 4-5	8,631	0	0	0	0	0	$1,605	$20,740		$0	$20,740		Energy Source Audit
Hatheway-Patterson Office Building/ Emergency Management Agency	Weatherization	Weatherization	Planned	Years 4-5	12,111	0	0	0	0	0	$2,253	$14,251		$0	$14,251		Energy Source Audit
Hatheway-Patterson Office Building/ Emergency Management Agency	Heat Pump Conversion	Pump/Motor/Drive	Planned	Years 4-5	12,620	0	0	0	0	0	$2,347	$60,000		$0	$60,000		Energy Source Audit
Albertini Well	LED Lighting Upgrades & Controls	Exterior Lighting	Planned	Years 4-5	6,921	0	0	0	0	0	$1,287	$15,420		$0	$15,420		Energy Source Audit
Water Treatment Facility	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	24,087	0	0	0	0	0	$4,480	$29,796		$0	$29,796		Energy Source Audit
Water Treatment Facility	Weatherization	Weatherization	Planned	Years 1-3	1,078	1,139	0	0	0	0	$1,408	$74,699		$1,709	$72,990		Energy Source Audit
Water Treatment Facility	New Condensing Boilers	HVAC	Planned	Years 1-3	0	2,906	0	0	0	0	$3,080	$52,000		$8,000	$44,000		Energy Source Audit
Water Treatment Facility	Pump VFDs	Pump/Motor/Drive	Planned	Years 1-3	24,465	0	0	0	0	0	$4,550	$32,500		$0	$32,500		Energy Source Audit
Water Treatment Facility	Mechanical Insulation	Hot Water	Planned	Years 1-3	0	260	0	0	0	0	$276	$2,764		$390	$2,374		Energy Source Audit
Animal Control	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	6,449	0	0	0	0	0	$1,200	$10,976		$0	$10,976		Energy Source Audit
Airport	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 4-5	18,082	0	0	0	0	0	$3,363	$24,526		$0	$24,526		Energy Source Audit
Airport	Weatherization	Weatherization	Planned	Years 4-5	2,766	1,070	0	0	0	0	$1,648	$103,870		$1,605	$102,265		Energy Source Audit
Brine Building	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 4-5	1,985	0	0	0	0	0	$369	$5,396		$0	$5,396		Energy Source Audit
Brine Building	High Efficiency Transformers	Building Control	Planned	Years 4-5	4,161	0	0	0	0	0	$774	$6,838		$0	$6,838		Energy Source Audit
Electric Department	Weatherization	Weatherization	Planned	Years 4-5	2,632	1,120	0	0	0	0	$1,677	$98,179		$1,680	$96,499		Energy Source Audit
Library/Council on Aging	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	57,974	0	0	0	0	0	$10,783	$57,845		$0	$57,845		Energy Source Audit
Plymouth Street Fire Station	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	11,554	0	0	0	0	0	$2,149	$14,924		$0	$14,924		Energy Source Audit
Memorial Hall/Town Hall	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	22,927	0	0	0	0	0	$4,264	$33,611		$0	$33,611		Energy Source Audit
Memorial Hall/Town Hall	Pump VFDs	Pump/Motor/Drive	Planned	Years 1-3	21,303	0	0	0	0	0	$3,962	$16,900		$0	$16,900		Energy Source Audit
Train Parking Lot (River St/Winthrop St)	LED Lighting Upgrades & Controls	Exterior Lighting	Planned	Years 4-5	14,752	0	0	0	0	0	$2,744	$10,613		$0	$10,613		Energy Source Audit
Roland Green School	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 4-5	22,129	0	0	0	0	0	$4,116	$28,711		$0	$28,711		Energy Source Audit
Roland Green School	New Steam Boilers	HVAC	Planned	Years 4-5	0	1,243	0	0	0	0	$1,318	$32,500		$0	$32,500		Energy Source Audit
Roland Green School	Steam Trap	HVAC	Planned	Years 4-5	0	823	0	0	0	0	$872	$9,750		$750	$9,000		Energy Source Audit
Qualters Middle School	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	279,972	0	0	0	0	0	$52,075	$360,209		$0	$360,209		Energy Source Audit
Qualters Middle School	Weatherization	Weatherization	Planned	Years 1-3	1,699	1,796	0	0	0	0	$2,220	$16,347		$2,694	$13,653		Energy Source Audit
Qualters Middle School	Mechanical Insulation	Hot Water	Planned	Years 4-5	0	4,990	0	0	0	0	$5,289	$45,203		$7,485	$37,718		Energy Source Audit
Qualters Middle School	New Steam Boilers	HVAC	Planned	Years 1-3	0	27,785	0	0	0	0	$29,452	$422,500		$0	$422,500		Energy Source Audit
Qualters Middle School	Pump VFDs	Pump/Motor/Drive	Planned	Years 4-5	71,598	0	0	0	0	0	$13,317	$19,500		$0	$19,500		Energy Source Audit
Qualters Middle School	Walk-in Cooler Controls	Refrigeration	Planned	Years 4-5	12,000	0	0	0	0	0	$2,232	$16,500		$0	$16,500		Energy Source Audit
Mansfield High School	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	332,028	0	0	0	0	0	$61,757	$480,838		$0	$480,838		Energy Source Audit
Mansfield High School	Weatherization	Weatherization	Planned	Years 4-5	5,386	5,694	0	0	0	0	$7,038	$48,810		$8,541	$40,269		Energy Source Audit
Mansfield High School	Mechanical Insulation	Hot Water	Planned	Years 4-5	0	1,120	0	0	0	0	$1,187	$8,719		$1,680	$7,039		Energy Source Audit
Mansfield High School	New Condensing Boilers	HVAC	Planned	Years 4-5	0	23,611	0	0	0	0	$25,028	$292,500		$10,000	$282,500		Energy Source Audit
Mansfield High School	Heat Pump Water Heater	Hot Water	Planned	Years 4-5	0	2,191	0	0	0	0	$2,322	$39,000		$0	$39,000		Energy Source Audit
Mansfield High School	Walk-in Cooler Controls	Refrigeration	Planned	Years 4-5	12,000	0	0	0	0	0	$2,232	$16,500		$0	$16,500		Energy Source Audit
Jordan/Jackson Elementary School	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 1-3	170,162	0	0	0	0	0	$31,650	$284,321		$0	$284,321		Energy Source Audit
Jordan/Jackson Elementary School	Weatherization	Weatherization	Planned	Years 4-5	2,572	2,719	0	0	0	0	$3,360	$24,191		$4,079	$20,113		Energy Source Audit
Jordan/Jackson Elementary School	Mechanical Insulation	Hot Water	Planned	Years 4-5	0	1,950	0	0	0	0	$2,067	$16,107		$2,925	$13,182		Energy Source Audit
Jordan/Jackson Elementary School	New Condensing Boilers	HVAC	Planned	Years 4-5	0	11,534	0	0	0	0	$12,226	$292,500		$10,000	$282,500		Energy Source Audit
Jordan/Jackson Elementary School	Pump VFDs	Pump/Motor/Drive	Planned	Years 4-5	14,355	0	0	0	0	0	$2,670	$8,450		$0	$8,450		Energy Source Audit
Jordan/Jackson Elementary School	High Efficiency Transformers	Building Control	Planned	Years 4-5	10,985	0	0	0	0	0	$2,043	$21,650		$0	$21,650		Energy Source Audit
Jordan/Jackson Elementary School	Demand Control Ventilation	HVAC	Planned	Years 4-5	2,951	12,582	0	0	0	0	$13,886	$52,000		$0	$52,000		Energy Source Audit
Robinson School	LED Lighting Upgrades & Controls	Interior Lighting	Planned	Years 4-5	223,519		0	0	0	0	$41,575	$250,535		$0	$250,535		Energy Source Audit
Robinson School	Weatherization	Weatherization	Planned	Years 4-5	2,692	2,846	0	0	0	0	$3,518	$31,421		$4,269	$27,152		Energy Source Audit
Robinson School	Mechanical Insulation	Hot Water	Planned	Years 4-5	0	1,420	0	0	0	0	$1,505	$16,279		$2,130	$14,149		Energy Source Audit

Robinson School	New Condensing Boilers	HVAC	Planned	Years 4-5	0	13,849	0	0	0	0	$14,680	$260,000		$10,000	$250,000		Energy Source Audit
Robinson School	Pump VFDs	Pump/Motor/Drive	Planned	Years 4-5	59,303	0	0	0	0	0	$11,030	$39,000		$0	$39,000		Energy Source Audit
Robinson School	Walk-in Cooler Controls	Refrigeration	Planned	Years 4-5	12,000	0	0	0	0	0	$2,232	$16,500		$0	$16,500		Energy Source Audit
Walsh Well	LED Lighting Upgrades & Controls	Exterior Lighting	Planned	Years 4-5	8,034	0	0	0	0	0	$1,494	$12,426		$0	$12,426		Energy Source Audit
Qualters Middle School	Retrocommissioning	Retrocommission	Planned	Years 4-5	78,380	13,841	0	0	0	0				$0			SRPEDD Calculations in ERP p. 27
Mansfield High School	Retrocommissioning	Retrocommission	Planned	Years 4-5	104,730	8,069	0	0	0	0				$0			SRPEDD Calculations in ERP p. 27
Memorial Hall/Town Hall	Building Operator Certification	Behav & Training	Planned	Years 4-5													
Town-wide no idling policy for municipal vehciles	Anti-Idlling Policy	Vehicles	Planned	Years 4-5													
Monior Tire Air Pressure & Use Fuel Efficient Tires in municipal vehicles	Monior Tire Air Pressure & Use Fuel Efficient Tires	Vehicles	Planned	Years 4-5													
Use 100% Synthetic Oil in municipal vehicles	Use 100% Synthetic Oil	Vehicles	Planned	Years 4-5													
Hybrid and Electric Vehicle Replacements	Vehcile Replacement	Vehicles	Planned	Years 4-5													
					1,680,993	**144,558**	**0**	**0**	**0**	**0**	**408,611**	**3,848,816**	**0**	**77,936**	**3,770,880**		
		TOTAL MMBtu SAVINGS	**20,191**		**5735.548116**	**14455.8**	**0**	**0**	**0**	**0**							