The Town of Franklin Energy Reduction Plan

Prepared by the Metropolitan Area Planning Council with support from the Town of Franklin

In fulfillment of the
Massachusetts Green Communities Grant Program
Criterion 3

October 2017

I. Plan Adoption & Acknowledgements

Letters from General Government and School District Verifying Adoption of the ERP

Town of Franklin

Town Administrator
Tel: (508) 520-4949

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355 East Central Street
Franklin, Massachusetts 02038-1352

October 17, 2017

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

Please be advised that the Town of Franklin, MA hereby accepts the attached Fuel Efficiency Vehicle Policy and Energy Reduction Plan.

Thank you,

Jeffrey D. Nutting
Town Administrator

Franklin Public Schools
Office of the Superintendent
355 East Central Street; Suite 3
Franklin, Massachusetts 02038
Phone: 508-553-4819

September 25, 2017

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

Please be advised that the Franklin Public Schools in Franklin, MA hereby accepts the attached Fuel Efficiency Vehicle Policy and Energy Reduction Plan.

Thank you,

Sara E. Ahern, Ed.D.
Superintendent of Schools

List of Contributors:

The collaborative efforts of the offices of Town Administrator Jeffrey D. Nutting, Deputy Town Administrator Jamie Hellen, and Public Facilities Director Mike D'Angelo served to produce this plan.

This plan was produced primarily by the Metropolitan Area Planning Council (MAPC), with significant involvement and assistance from Franklin municipal staff.

Much of the information in this plan was derived from energy audits performed by Energy Source, led by Gabriel Andreson. Additional research and calculations – specifically around streetlight retrofits, vehicle fuel efficiency technologies, behavior-based programs, and certifications – were conducted by MAPC.

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II. Executive Summary

Narrative Summary for the Town

The Town of Franklin is a city in Norfolk County, Massachusetts, United States. Franklin is one of fourteen Massachusetts municipalities that have applied for, and been granted, city forms of government but wish to retain "The town of" in their official names. As of 2012, the Town's population was 33,092. It is home to the country's first library, with its first books donated by Benjamin Franklin.

Franklin has over 1.2 million square feet of municipal building space, with schools accounting for about 1 million of the total. Franklin has a committed facilities staff that has implemented a variety of energy efficiency upgrades over the past few years in collaboration with National Grid and their Project Expediter (PEX), Energy Source. Franklin began a municipality-wide lighting upgrade project in 2015, and is looking to conclude the retrofit to LEDs by early 2018. A more detailed list of municipal energy efficiency efforts is outlined in the table below:

Municipal Energy Efficiency Efforts

Facility	Year Built	Square Footage	Energy Efficiency Efforts
Small Elementary - Davis-Thayer	1924	43,000	This is the original Franklin High School; oldest equipment overall; lighting retrofitted to LED; updated windows in 2007
Small Elementary - Kennedy	1964	50,000	Entire mechanical systems replaced in 2012; updated windows in 2007; 100% LED lighting
Small Elementary - Parmenter	1989	50,000	Controls installed; CO_2 sensors installed in the classrooms; 8.5kW solar; 100% LED lighting
Police Station	1991	8,000	Controls installed; Variable Air Volume systems
Middle-Elementary School - Remington-Jefferson	1996	150,000	2/3^{rds} of lighting converted to LED; CO_2 sensors installed in the classrooms
Middle-Elementary School - Keller Sullivan	2001	180,000	Scheduled for LED retrofit, 70% completed; Variable Frequency Drives; Demand Ventilation Controls for the classrooms
Fire Substation	2001	10,000	Structure is mostly a vehicle bay; controls installed

Middle-Elementary School & Childhood Development Center	2004	200,000	Scheduled for LED retrofit, 2/3rds completed; full Variable Frequency Drives; unit ventilators, damper controlled by CO_2 sensors
Municipal Office Building	2004	30,000	Full controls; Variable Air Volume systems; 100% LED lighting; CO_2 sensors installed; damper controls
DPW Facility	2007	50,000	Mostly garages; retrofitted to LED in 2016
Senior Center	2007	22,000	Small cast-iron boilers, staged; central chiller; air handlers; full controls; CO_2 sensors installed; scheduled for LED retrofit
Fryar Height Quarters	2008	22,000	Full VDCs; lock-var modular boilers; CO_2 sensors installed; VX cooling rooftops; Variable Air Volume systems; scheduled for LED retrofit
High School	2014	300,000	Modular boilers with controls; scheduled for retrofit to 100% LED; Variable Frequency Drives installed; recycled greywater for toilets

These efforts have resulted in Franklin's municipal facilities exhibiting a weighted-average energy use intensity (EUI) of just over 67 kBTU per square foot. Additionally, a testament to Franklin's commitment to clean energy is the fact that the municipality purchases virtually all of its electricity through a power purchase agreement (PPA) with a 10.5MW solar farm. With the Town consuming around 12.9 million kWh of electricity annually, Franklin has already made a drastic impact on its municipal carbon footprint by relying on renewable sources of energy.

Summary of Municipal Energy Uses

Total Number of Municipal Buildings – 24

Four of the school buildings – the Franklin High School, Keller Sullivan School, the Horace Mann School, and Remington Jefferson School – account for over 50 percent of total building energy use in FY16.

Total Number of Municipal Vehicles – 149

Vehicles are the second largest energy consumer for the Town, accounting for 13 percent of the Town's energy use in FY16. 23 of the Town's fleet vehicles are subject to Franklin's Fuel Efficient Vehicle Policy.

Total Number of Street Lights and Traffic Lights – 1,648 streetlights and 25 traffic lights.

The most common streetlight is a 50-watt High Pressure Sodium fixture.

Water and Sewer – 22 waste water pumping stations, 1 storm water pumping station, and 1 booster.

The water and sewer pumping stations account for 10 percent of the Town's energy use in FY16.

Table 1: Municipal Energy Use Summary

	Number	Ownership
Buildings	24	
Natural Gas Heat	17	Municipality
Electric or No Heat	7	Municipality
Oil Heat	-	Municipality
Vehicles	149	
Non-Exempt	23	Municipality
Exempt	126	Municipality
Street Lights	1,648	Municipality
Traffic Lights	25	
Traffic lights	12	State
Traffic lights	13	Municipality
Water and Sewer	24	
Waste Water Pumping Stations	22	Municipality
Storm Water Pumping Stations	1	Municipality
Booster Stations	1	Municipality

Summary of Energy Use Baseline and Plans for Reduction

This Energy Reduction Plan commits Franklin to reduce energy use in municipal facilities by at least 20 percent compared to Fiscal Year 2016 over five years. In the baseline year, the Town used 107,097 MMBTUs of energy. The weather-normalized usage, however, is 112,027 MMTBUs. Weather normalization adjusts the usage data to remove the influence of unusually hot or cold weather, which allows for better "apples-to-apples" comparison of the data between years. However, because weather-normalized energy consumption data is not available at the facility level; the analysis and recommendations that follow in this document are based on non-weather-normalized data, unless indicated otherwise.

As shown in **Figure 1**, buildings make up 74 percent of the Town's usage by facility type (e.g. building, vehicles, street & traffic lights, water & sewer, and open space). As shown in **Figure 2**, the School Department makes up over half (58 percent) of the Town usage by department category (e.g. school buildings; town buildings; vehicles; water and sewer; street and traffic lights, poles and signs; and poles and town fields).

Figure 1. MMBTU Used in Baseline Year by Facility Type (FY 2016)

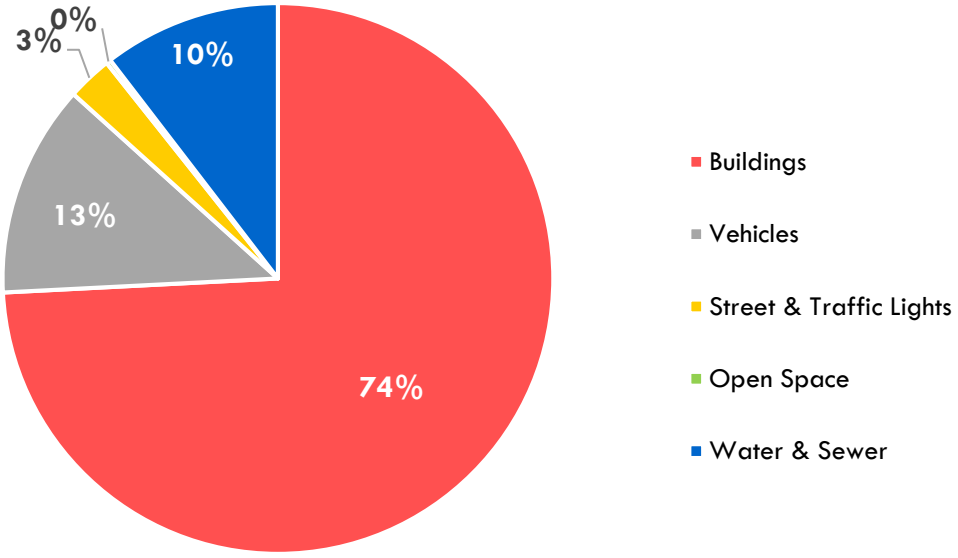
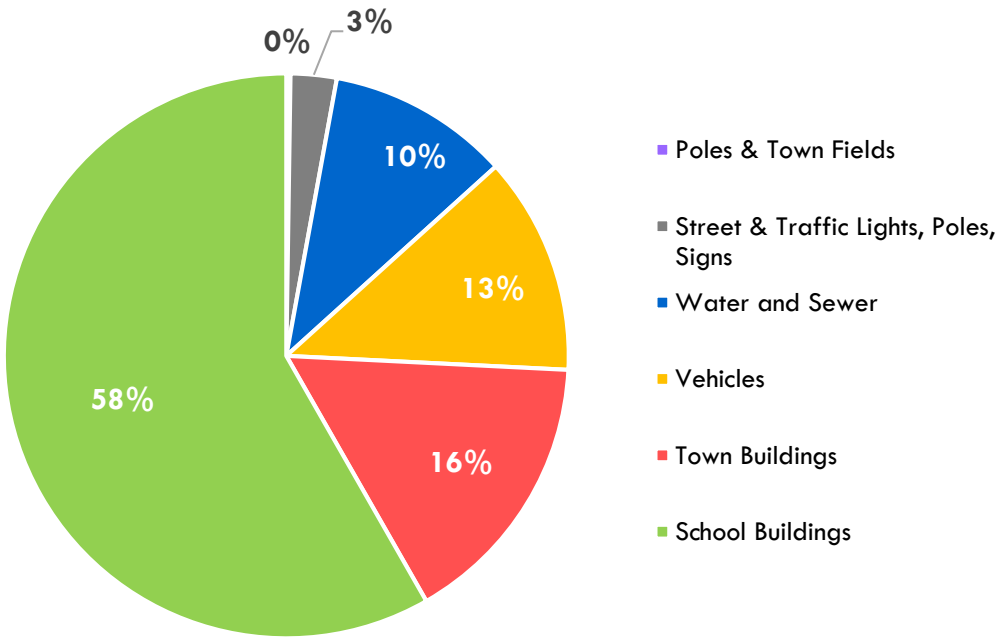


Figure 2. MMBTU Used in Baseline Year by Department Category (FY 2016)



Franklin has identified energy savings measures for buildings, vehicles, and streetlights to reduce energy use 19.6 percent based on the non-weather normalized usage, as illustrated in **Table 2.**

Table 2: Summary of Municipal Energy Use: Baseline Year FY 2016

Category	MMBTU Used in Baseline Year	% of Total MMBTU Baseline Energy Consumption	Projected Planned MMBTU Savings	Savings as % of Total MMBTU Baseline Energy Consumption
Non-Weather Normalized				
Buildings	79,453	74.2%	16,758	15.6%
Vehicles	13,375	12.5%	2,620	2.4%
Street & Traffic Lights	2,823	2.6%	1,423	1.3%
Open Space	285	0.3%	0	0.0%
Water & Sewer	11,161	10.4%	238	0.2%
Total Non-Weather Normalized	**107,097**	**100%**	**21,039**	**19.6%**
Weather Normalized	**112,027**	**100%**	**--***	**--***

**Savings are not weather normalized and can only be compared against other data that is not weather normalized.*

III. Energy Use Baseline Inventory

Identification of the Inventory Tool Used

The Town of Franklin used the Department of Energy Resources (DOER) MassEnergyInsight (MEI) web-based energy inventory and analysis tool.

Identification of the Baseline Year

Fiscal Year (FY) 2016 will serve as the baseline year. FY 2016 ran from July 1, 2015 to June 30, 2016. This will give the Town the maximum amount of time (FY 2017 – FY 2021) to reach its 20% energy reduction goal.

Energy Baseline

In the baseline year, the Town used 107,097 MMBTUs of energy. In order to reach the Green Communities goal of reducing energy consumption by 20%, Franklin will need to reduce its energy consumption by 21,419 MMBTU. **Table 3** on pages 11-12 presents energy use for each municipal facility in native units and MMBTU.

Table 3: Franklin Municipal Energy Use Baseline (FY2016)

	Electric		Gas		Propane		Gasoline		Diesel		Total MMBTU
	MMBTU	kWh	MMBTU	therms	MMBTU	Gallons	MMBTU	Gallons	MMBTU	Gallons	
Null usage	8	2,220	0	0							**8**
Old Franklin High School*	182	53,237	0	0							**182**
Recycle Center*	18	5,231	0	0							**18**
Municipal Building	1,206	353,520	1,966	19,655							**3,172**
New Historical Museum	109	31,876	214	2,144							**323**
Davis Thayer School	615	180,200	1,670	16,700							**2,285**
Fire Station - West Central St	834	244,440	1,425	14,250							**2,259**
John F Kennedy School	916	268,373	1,972	19,723							**2,888**
DPW Administration Building	259	75,960	233	2,328							**492**
Old Town Hall*	221	64,633	0	0							**221**
Senior Center	689	201,960	1,411	14,106							**2,100**
Parmenter School	933	273,360	2,404	24,043							**3,337**
Old Historic Museum	0	65									**-**
Remington Jefferson School	3,596	1,054,000	6,010	60,096							**9,606**
Keller Sullivan School	3,941	1,155,000	8,973	89,731							**12,914**
Library	628	184,160	1,311	13,112							**1,940**
Police Station	972	284,806	493	4,934							**1,465**
Horace Mann/Oak/ECDC School	4,192	1,228,500	6,801	68,012							**10,993**
Dog Pound	36	10,651	0	0	132	1,456					**168**
DPW Garage	631	184,971	2,888	28,880							**3,519**
Brick House School	1	403	0	0							**1**
Fire Station - King Street	339	99,279	823	8,232							**1,162**
Franklin High School - New	11,418	3,346,500	8,766	87,663							**20,185**
DPW Storage Building	1	171	0	0							**1**
Rec Center	56	16,274	159	1,589							**214**
Subtotal for Buildings	**31,801**	**9,319,790**	**47,519**	**475,198**	**132**	**1,456**					**79,453**
Poles and Town Fields - Public Facilities	253	74,128									**253**
Gazebo	32	9,422									**32**
Subtotal for Open Space	**285**	**83,550**									**285**
Subtotals for Street Lights & Traffic Lights	**2,823**	**827,402**									**2,823**
Subtotal for Vehicles							**8,971**	**72,347**	**4,404**	**31,687**	**13,375**
Well No 1 & 2	432	126,523			44	489					**476**
Water Treatment Plant	1,808	529,900			231	2,541					**2,039**
Well No. 3	504	147,760			66	722					**570**
Well No. 4	1,007	295,280			101	1,112					**1,108**
Well No. 5	476	139,437			122	1,345					**598**
Well No. 6	529	155,082			210	2,308					**739**
Well No. 7	554	162,409			151	1,658					**705**
Well No. 8	583	170,863			103	1,135					**686**
Well No. 9	594	173,984			42	467					**636**
Well No. 10	399	116,848			33	364					**432**
Pleasant St. Booster/Tank	473	138,649	43	430							**516**
Bright Hill Booster	72	21,216	106	1,060							**178**
Tanglewood Booster	27	7,913	17	169							**44**
Susans Way Booster			12	116							**12**
Jefferson Booster	109	32,016									**109**
FIP Booster	140	41,119	2	20							**142**
Washington Street Booster	103	30,051									**103**

Table 3: Franklin Municipal Energy Use Baseline (FY2016)

	Electric		Gas		Propane		Gasoline		Diesel		Total MMBTU
	MMBTU	kWh	MMBTU	therms	MMBTU	Gallons	MMBTU	Gallons	MMBTU	Gallons	
Hillside Tanks	19	5,594									**19**
Forge Hill Tank	52	15,368									**52**
FIP Tank	18	5,418									**18**
Milliken Sewer Pump Station	290	84,938	88	883							**378**
Jefferson Sewer Pump Station	62	18,113	1	14							**63**
Ainsley Drive Sewer Pump Station	53	15,670									**53**
Bridle Path Sewer Pump Station	33	9,776	2	20							**35**
Charles River Drive Sewer Pump Station	49	14,246	50	495							**98**
Dawn Marie Circle Sewer Pump Station	27	8,008	64	644							**92**
Anthony Road Sewer Pump Station	11	3,174	0	3							**11**
East Central Street Sewer Pump Station	18	5,227	2	21							**20**
Grove Street No. 1 Sewer Pump Station	14	3,995									**14**
Grove Street No. 2 Sewer Pump Station	10	2,965	125	1,249							**135**
Jackson Circle Sewer Pump Station	15	4,309	46	463							**61**
Kenwood Circle Sewer Pump Station	35	10,309	112	1,119							**147**
Monterey Drive Sewer Pump Station	52	15,229									**52**
Longhill Road Sewer Pump Station	33	9,627	48	484							**81**
Oxford Drive Sewer Pump Station	78	22,906	7	66							**85**
Palomino Drive Sewer Pump Station	37	10,978	76	764							**114**
Red Gate Lane Sewer Pump Station	38	11,236	111	1,108							**149**
Sahlin Circle Sewer Pump Station	54	15,924									**54**
Squibnocket Road Sewer Pump Station	69	20,139									**69**
Washington Street Sewer Pump Station	113	33,080									**113**
Populatic Street Sewer Pump Station	35	10,394									**35**
Beth Road Stormwater Pump Station	30	8,751									**30**
FIP Sewer Pump Station	87	25,473	0	0							**87**
Bald Hill Tank	1	386									**1**
Subtotal for Water, Sewer, and Pumps	**9,143**	**2,680,283**	**912**	**9,128**	**1,105**	**12,141**					**11,161**
TOTAL ENERGY USE	**44,052**	**12,911,025**	**48,433**	**484,326**	**1,237**	**13,597**	**8,971**	**72,347**	**4,404**	**31,687**	**107,097**

*The Old Franklin High School and Old Town Hall were put out of use and demolished during FY16, which is why there is no natural gas usage associated with these buildings for FY16. The Recycle Center is an outdoor facility with no heat.

IV. Energy Reduction Plan

Narrative Summary

Table 4 in **Appendix A** illustrates the identified energy savings measures to reduce non-weatherized usage from FY16 by 21,039 MMBTUs or 19.6% in five years.

Overview of Goals for Years 1-3:

- Retrofit lighting fixtures with consistent, energy efficient LED fixtures and bulbs in the Senior Center, Davis Thayer School, DPW Admin. Building, Franklin High School, Horace Mann School, Keller Sullivan School, Remington Jefferson School, Dog Pound, Fire Station Headquarters & Substation, Municipal Building, Museum, and Police Station.
- Retrofit all streetlights with LED technology.
- Adopt a city-wide "No Idling" policy for all municipal vehicles.
- Incorporate a switch to 100% synthetic oil for all municipal vehicles' oil replacement.
- Closely monitor vehicle tire air pressure to maintain vehicle fuel efficiency.
- Replace twelve non-exempt vehicles with fuel-efficient full battery electric vehicles.
- Retrofit four pickup trucks to run as plug-in hybrid electric vehicles using aftermarket conversion technology.
- Carry out interior caulking and door weather stripping at the King Street Fire Station.
- Install a condensing boiler, transformers, and VFDs on the distribution pumps at Keller Sullivan School.
- Install a condensing boiler and VFDs on the distribution pumps at Parmenter School
- Install transformers, VFDs on the distribution pumps, and MeLink Controls at Remington Jefferson School.
- Carry out roof-wall intersection air sealing, overhang air sealing, door weather stripping at the Keller Sullivan School.
- Install pipe insulation, valve and fitting insulation and tank insulation at the Keller Sullivan School

Overview of Goal for Years 4-5:

- Install high efficiency motors at Well Water Station #1/#2, #4, #5, #7, #9, and the Pleasant Street Booster Pump Station, and Bright Hill Booster Pump Station
- Install a condensing boiler and transformers at the Horace Mann School.
- Carry out roof-wall intersection air sealing, overhang air sealing, door weather stripping at the Municipal Building.
- Install pipe insulation, valve and fitting insulation and tank insulation at the Municipal Building and Fire Station Headquarters.
- Carry out interior caulking and door weather stripping at the Franklin Fire Headquarters.
- Carry out air sealing and weather stripping at the Police Station

- Pilot behavior-based energy savings programs at all Franklin schools.
    - Programs should include initial documentation of appropriate set points and a quarterly documentation that those set points are being followed.
- Achieve Building Operator Certification for Facilities Manager and additional staffer.

Areas of Least Efficiency/Greatest Waste:

Table 4b shows that the top 10 largest energy users in Town account for roughly 66 percent of all usage.

Table 4b. Top 10 Energy Consuming Facilities in Franklin

Facility	MMBTUs	Percent of FY2016 Baseline
#1 Franklin High School - New	20,185	18.8%
#2 Keller Sullivan School	12,914	12.1%
#3 Horace Mann School	10,993	10.3%
#4 Remington Jefferson School	9,606	9.0%
#5 DPW Garage	3,519	3.3%
#6 Parmenter School	3,337	3.1%
#7 Municipal Building	3,172	3.0%
#8 John F Kennedy School	2,888	2.7%
#9 Davis Thayer School	2,285	2.1%
#10 Fire Station - West Central St	2,259	2.1%
Total FY 2016 Usage for Top Ten	**71,158**	**66.4%**
Total FY 2016 Usage Baseline	**107,097**	**100.0%**

However, the largest users are not always indicative of the most inefficient users of energy. **Table 3** on the following page shows buildings from MEI's "Buildings to Target" tool that identifies underperforming and/or wasteful buildings. The top five most inefficient municipal buildings in Franklin are the Fire Station at West Central Street, the Fire Station at King Street, Police Station, Senior Center, and Municipal Building.

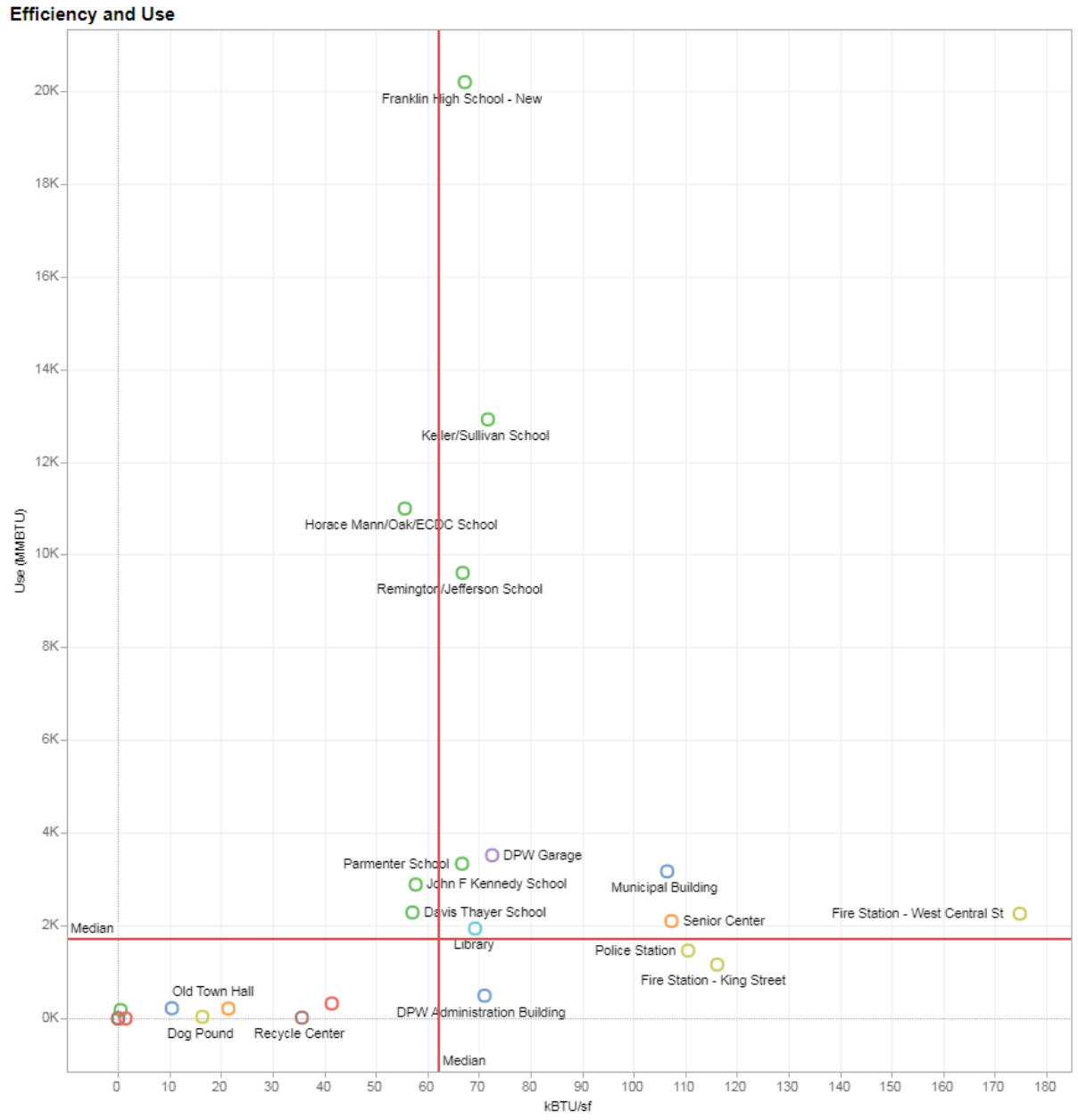


Figure 3. Energy Use Intensity (kBTU/sf) and Total Energy Use (MMBTU) for Buildings.

Points further to the right have a higher energy use per square foot (i.e. less energy efficient). Points higher up use more total energy. The Fire Station on West Central Street, for example, uses the most energy per square foot of any building but has relatively low useage overall.

Red lines show the medians for the Town's buildings.

Path to 20% Energy Use Reduction by the end of Fiscal Year 2021

Program Management Plan for Implementation, Monitoring, and Oversight

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

In support of DOER's requirements for Green Communities, MAPC recommends the following best practices:

- Present a summary of completed annual Green Communities reports to Town Council for review and progress tracking.
- Revisit the energy reduction plan to select potential projects for consequent competitive grant application rounds.
- Upon completion of selected measures, compare consequent usage to the estimate highlighted in this energy reduction plan to identify discrepancies, if any.

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

Buildings/Water & Sewer

Energy Source performed preliminary energy audits for the Town's buildings and water and sewer mechanical systems in 2017. The audit identifies measures that provide 11.6 in energy savings (12,354 MMBTUs) from energy conservation in the Town's buildings and 0.2 percent in energy savings (238 MMBTUs) from energy conservation in the Town's water and sewer mechanical systems. The Energy Source Audit is included in **Appendix B**.

Streetlights Calculations

An LED streetlight retrofit analysis, prepared by MAPC, predicts that the Town can reduce its streetlight electricity consumption by 1.3% (1,423 MMBTU). The full Streetlight Retrofit Analysis is included in **Appendix C**.

Municipal Vehicle Measures

MAPC prepared additional calculations for several measures to reduce energy consumption from the Town's vehicle fleet. The Fleet Management strategies contribute to reducing Franklin's overall energy consumption by 2.4% (2,620 MMBTU). The calculations and details supporting the vehicle measures are included in **Appendix D**.

Getting to 20% Reduction – Additional Strategies

In supplement of the strategies that bring Franklin's energy use reduction to 15.5%, **Appendix E** outlines behavioral change strategies that Franklin can explore, such as behavior-based school programs and Building Operator Certification (BOC) training for facility staff that can further

result in a 4.1 percent reduction in energy consumption (4,404 MMBTU), bringing the overall energy reduction to 19.6%.

The Town anticipates several major changes to the municipal building stock in the next five years. A renovation of 3,000 square feet on the second level of the Senior Center was completed in December 2016 – bringing full community programming to both levels of the building. The Senior Center addition did not come online until FY17, so this new usage is not reflected in the Town's FY16 baseline. The existing Library Building is currently undergoing significant renovation to its existing space as well as an addition of 8,000 square feet in total on two levels of the building. The Town conservatively estimates a 0.5-1.0% additional reduction from the FY16 Baseline as a result of the renovations and energy efficiency improvements made to existing structures.

Additionally, in the next year and a half, the Town plans to construct a new Water Treatment Plant to replace the current Water Treatment Plant building. The Town also has plans to build a new Police Station in three to four years, and intends to commission an architectural study as early as January 2017.

Energy Conservation Measures

Table 4 in **Appendix A** lists recommended energy conservation measures. References for each measure is included in the table and these references are included as appendices to the Energy Reduction Plan. Projected annual MMBTU savings for each category (buildings, vehicles, street and traffic lights, and water and sewer) are subtotaled to arrive at a municipal grand total of 21,039 MMBTU energy savings over five years.

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

Municipal Buildings (including schools)

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

Vehicles (including schools)

The Fuel-Efficient Vehicle policy will have become engrained within municipal purchasing practices after 5 years, and the Town will seek to explore even more efficient policies and tracking systems to enable more efficiency.

Street and Traffic Lighting

As the Town expects to have all streetlights retrofitted with LED bulbs within the 5 year period, the Town will next look to retrofit traffic lighting with LEDs as well as other lighting opportunities into the future.

Perpetuating Energy Efficiency

An annual municipal audit by Town and Schools staff can tap into the knowledge of the employees who use and maintain the building 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. Web-based application systems such as See Click Fix can be considered to create additional real-time opportunities for efficiencies in operation and maintenance.

The Town of Franklin 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 further engrained in the culture of the Town and will provide opportunities to instill the ethos into additional policies and programs for more dedicated long-term funding streams and strategies.

V. Appendix A: Table 4 – Franklin Energy Conservation Measures Data

Table 4.0: Energy Conservation Measures for Franklin Municipal Energy Use

Measure		Status	Energy Data				Financial Data						Reference	
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/year)	Projected Annual Energy Savings				Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (therms)	Vehicle Gasoline (gallons)	Diesel Savings (Gallons)								
		TOTALS:	4,109,029	43,988	19,577	1,901	728,185	$ 6,408,845		$ 836,190	$ 5,558,255	7.6		
Senior Center	LED Lighting	Completed on Sept. 2017	**88,031**	**0**	-	-	**$12,764**	**$103,298**		**$25,231**	**$78,067**	**6.1**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Remington Jefferson School	LED Lighting - Ph2	Completed on March 2017	**100,733**	**0**	-	-	**$14,606**	**$121,845**		**$27,869**	**$93,976**	**6.4**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	LED Lighting - Ph2	Completed on July 2017	**86,510**	**0**	-	-	**$12,544**	**$125,373**		**$26,207**	**$99,166**	**7.9**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Davis Thayer School	LED Lighting	Completed on Dec. 2016	**65,465**	**0**	-	-	**$9,492**	**$81,734**		**$16,771**	**$64,963**	**6.8**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Parmenter School	LED Lighting	Completed on Dec. 2016	**82,258**	**0**	-	-	**$11,927**	**$119,458**		**$19,864**	**$99,594**	**8.4**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	LED Lighting - Ph1	Completed on Dec. 2016	**100,419**	**0**	-	-	**$14,561**	**$128,998**		**$31,025**	**$97,973**	**6.7**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
DPW	LED Lighting	Completed on Dec. 2016	**122,799**	**0**	-	-	**$17,806**	**$126,597**		**$32,485**	**$94,112**	**5.3**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Municipal Building	LED Lighting - Ph1	Completed on Sept. 2016	**79,196**	**0**	-	-	**$11,483**	**$118,731**		**$52,130**	**$66,601**	**5.8**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Kennedy School	LED Lighting	Completed on July 2016	**69,354**	**0**	-	-	**$13,871**	**$88,648**		**$11,090**	**$77,558**	**5.6**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Dog Pound	LED Lighting	Proposed Q1 - 2018	**4,364**	**0**	-	-	**$860**	**$2,404**		**$325**	**$2,079**	**2.4**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Fire Headquarters	LED Lighting	Proposed Q1 - 2018	**93,733**	**0**	-	-	**$16,203**	**$61,760**		**$11,305**	**$50,455**	**3.1**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Fire Substation	LED Lighting	Proposed Q1 - 2018	**46,632**	**0**	-	-	**$7,930**	**$39,531**		**$10,660**	**$28,871**	**3.6**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	LED Lighting - Ph3	Proposed Q1 - 2018	**283,526**	**0**	-	-	**$51,502**	**$312,018**		**$96,860**	**$215,158**	**4.2**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Franklin High School	LED Lighting	Proposed Q1 - 2018	**427,733**	**0**	-	-	**$88,212**	**$448,906**		**$106,933**	**$341,973**	**3.9**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Horace Mann School	LED Lighting - Ph2	Proposed Q1 - 2018	**161,863**	**0**	-	-	**$34,333**	**$296,287**		**$40,466**	**$255,821**	**7.5**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Municipal Building	LED Lighting - Ph2	Proposed Q1 - 2018	**459**	**0**	-	-	**$67**	**$714**		**$50**	**$664**	**9.9**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Museum	LED Lighting	Proposed Q1 - 2018	**5,073**	**0**	-	-	**$1,794**	**$9,814**		**$2,080**	**$7,734**	**4.3**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Police Station	LED Lighting	Proposed Q1 - 2018	**47,919**	**0**	-	-	**$9,040**	**$47,868**		**$14,455**	**$33,413**	**3.7**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Remington Jefferson School	LED Lighting - Ph2	Proposed Q1 - 2018	**88,749**	**0**	-	-	**$19,530**	**$141,755**		**$22,187**	**$119,568**	**6.1**	Capital funds	Energy Source Audit Report, 2017, see Appendix B
Horace Mann School	Mechanical - Condensing Boiler Install	Proposed Q4 - 2020	**0**	**7,540**	-	-	**$14,670**	**$713,000**		**$30,000**	**$683,000**	**46.6**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Horace Mann School	Mechanical - Transformers	Proposed Q4 - 2020	**50,342**	**0**	-	-	**$7,300**	**$69,857**		**$7,551**	**$62,306**	**8.5**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechanical - Condensing Boiler Install	Proposed Q4 - 2018	**0**	**8,778**	-	-	**$14,758**	**$598,000**		**$30,000**	**$568,000**	**38.5**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechancial - VFD on Distribution Pumps	Proposed Q4 - 2018	**65,806**	**0**	-	-	**$9,542**	**$29,900**		**$5,500**	**$24,400**	**2.6**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechancial - Transformers	Proposed Q4 - 2018	**78,395**	**0**	-	-	**$11,367**	**$105,299**		**$11,759**	**$93,540**	**8.2**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechancial - Kitchen Controls	Proposed Q4 - 2018	**9,527**	**4,550**	-	-	**$5,931**	**$20,250**		**$5,460**	**$14,790**	**2.5**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechancial - Weatherization	Proposed Q4 - 2018	**4,921**	**3,254**	-	-	**$3,968**	**$35,117**		**$0**	**$35,117**	**8.9**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Keller Sullivan School	Mechancial - Pipe Insulation	Proposed Q4 - 2018	**0**	**294**	-	-	**$294**	**$1,825**		**$0**	**$1,825**	**6.2**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Parmenter School	Mechanical - Condensing Boiler Install	Proposed Q4 - 2019	**0**	**2,736**	-	-	**$11,074**	**$333,500**		**$15,000**	**$318,500**	**28.8**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Parmenter School	Mechanical - VFD on Distribution Pumps	Proposed Q4 - 2019	**44,444**	**0**	-	-	**$6,444**	**$18,200**		**$4,500**	**$13,700**	**2.1**	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B

Table 4.0: Energy Conservation Measures for Franklin Municipal Energy Use

Measure		Status	Energy Data				Financial Data						Reference	
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/year)	Projected Annual Energy Savings				Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (therms)	Vehicle Gasoline (gallons)	Diesel Savings (Gallons)								
		TOTALS:	4,109,029	43,988	19,577	1,901	728,185	$ 6,408,845		$ 836,190	$ 5,558,255	7.6		
Remington Jefferson School	Mechanical - Condensing Boiler Install	Proposed Q4 - 2019	0	7,592	-	-	$12,767	$517,500		$20,000	$497,500	39.0	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Remington Jefferson School	Mechanical - VFD on Distribution Pumps	Proposed Q4 - 2019	131,357	0	-	-	$19,047	$59,346		$12,850	$46,496	2.4	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Remington Jefferson School	Mechanical - Transformers	Proposed Q4 - 2019	23,975	0	-	-	$3,476	$27,847		$3,596	$24,251	7.0	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Remington Jefferson School	Mechanical - Kitchen Controls	Proposed Q4 - 2019	6,805	3,585	-	-	$4,857	$17,550		$4,302	$13,248	2.7	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Davis Thayer School	Mechanical - Condensing Boiler Install	Proposed Q4 - 2018	0	1,960	-	-	$13,690	$391,000		$20,000	$371,000	27.1	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Fire Headquarters	Mechanical - Weatherization	Proposed Q4 - 2021	209	190	-	-	$220	$2,282		$0	$2,282	10.4	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Fire Headquarters	Mechanical - Pipe Insulation	Proposed Q4 - 2021	0	385	-	-	$385	$4,888		$0	$4,888	12.7	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Municipal Building	Mechanical - Weatherization	Proposed Q4 - 2021	964	637	-	-	$777	$8,130		$0	$8,130	10.5	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Municipal Building	Mechanical - Pipe Insulation	Proposed Q4 - 2021	0	320	-	-	$320	$5,789		$0	$5,789	18.1	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Police Station	Mechanical - Weatherization	Proposed Q4 - 2021	807	626	-	-	$743	$6,557		$0	$6,557	8.8	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
King Street Fire Station	Mechanical - Weatherization	Proposed Q4 - 2018	145	141	-	-	$162	$1,725		$0	$1,725	10.6	Green Communities grant	Energy Source Audit Report, 2017, see Appendix B
Franklin High School	Behavior-based energy efficiency program	Proposed FY20 - FY21	5,334	0	-	-	$747	$5,000		$0	$5,000	6.7	Green Communities grant	MAPC and Power Down Report, see Appendix E
Davis Thayer School	Behavior-based energy efficiency program	Proposed FY20 - FY21	18,025	0	-	-	$2,523	$5,000		$0	$5,000	2.0	Green Communities grant	MAPC and Power Down Report, see Appendix E
John F Kennedy School	Behavior-based energy efficiency program	Proposed FY20 - FY21	26,846	0	-	-	$3,758	$5,000		$0	$5,000	1.3	Green Communities grant	MAPC and Power Down Report, see Appendix E
Parmenter School	Behavior-based energy efficiency program	Proposed FY20 - FY21	27,345	0	-	-	$3,828	$5,000		$0	$5,000	1.3	Green Communities grant	MAPC and Power Down Report, see Appendix E
Remington/Jefferson School	Behavior-based energy efficiency program	Proposed FY20 - FY21	105,393	0	-	-	$14,755	$5,000		$0	$5,000	0.3	Green Communities grant	MAPC and Power Down Report, see Appendix E
Keller/Sullivan School	Behavior-based energy efficiency program	Proposed FY20 - FY21	115,504	0	-	-	$16,171	$5,000		$0	$5,000	0.3	Green Communities grant	MAPC and Power Down Report, see Appendix E
Horace Mann/Oak/ECDC School	Behavior-based energy efficiency program	Proposed FY20 - FY21	122,860	0	-	-	$17,200	$5,000		$0	$5,000	0.3	Green Communities grant	MAPC and Power Down Report, see Appendix E
Franklin High School	Behavior-based energy efficiency program	Proposed FY20 - FY21	334,642	0	-	-	$46,850	$5,000		$0	$5,000	0.1	Green Communities grant	MAPC and Power Down Report, see Appendix E
Town-wide	Building Operator Certification	Proposed FY20 - FY21	493,680	1,400	-	-	$10,500	$1,695		$0	$1,695	0.2	Green Communities grant	The Building Operator Certification Program, see Appendix E
Buildings Subtotal	MMBTU Saved:	16,758	3,622,143	43,988	-	-	$ 606,650	$ 5,384,996		$ 718,511	$ 4,666,485	7.69		
Street Lights	LED Retrofit	Proposed Q1 - 2018	417,025	-	-	-	$ 78,041	$ 560,752		$ 104,256	$456,496	5.8	Bonds	MAPC LED Retrofit Analysis, see Appendix C
Street Lights Subtotal	MMBTU Saved:	1,423	417,025		-	-	$ 78,041	$ 560,752	$ -	$ 104,256	$ 456,496	5.85		
Vehicle Maintenance	Switch to 100% synthetic oil	Proposed Q4 - 2018	0	0	1,447	634	$3,299	$0		$0	$0	0.0	n/a	MAPC Vehicle Measures Calculations, see Appendix D
Vehicle Policy	Installation of anti-idling technology in police cruisers	Proposed Q4 - 2018	0	0	10,950	-	$16,878	$14,400		$0	$0	0.9	Green Communities grant	MAPC Vehicle Measures Calculations, see Appendix D
Vehicle Maintenance	Tire air pressure maintenance toolkit	Proposed Q4 - 2018	0	0	2,894	1,267	$6,597	$0		$0	$0	0.0	n/a	MAPC Vehicle Measures Calculations, see Appendix D
Vehicle Replacement Strategy	Replacement of 12 non-exempt vehicles in the fleet with full battery electric vehicles	Proposed Q4 - 2018	0	0	3,498	-	$6,591	$360,000		$0	$360,000	54.6	Green Communities grant	MAPC Vehicle Measures Calculations, see Appendix D
Vehicle Replacement Strategy	Retrofit 4 Ford F150 Pickups to plug-in hybrid electric vehicles	Proposed Q4 - 2018	0	0	788	-	$1,876	$96,000		$0	$96,000	51.2	Green Communities grant	MAPC Vehicle Measures Calculations, see Appendix D
Vehicle Subtotal	MMBTU Saved:	2,620	-	-	19,577	1,901	$ 33,365	$ 374,400	$ -	$ -	$ 360,000	0.85		
Well Station #1/#2	Mechanical - high efficiency motors	Proposed Q4 - 2020	2,848	0	-	-	$413	$4,892		$570	$4,322	10.5	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Well Station #4	Mechanical - high efficiency motors	Proposed Q4 - 2020	6,242	0	-	-	$905	$9,880		$1,248	$8,632	9.5	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B

Table 4.0: Energy Conservation Measures for Franklin Municipal Energy Use

Measure		Status	Energy Data				Financial Data						Reference	
Category/Building	Energy Conservation Measure	Status (Completed with month/year or Planned Quarter/year)	Projected Annual Energy Savings				Projected Annual Cost Savings ($)	Estimated Total Project Cost ($)	Green Communities Grant* ($)	Estimated Utility Incentives ($)	Estimated Cost After Utility Incentives ($)	Estimated Payback After Incentives (years)	Funding Source	Source for Energy Savings
			Electricity Savings (kWh)	Natural Gas Savings (therms)	Vehicle Gasoline (gallons)	Diesel Savings (Gallons)								
		TOTALS:	4,109,029	43,988	19,577	1,901	728,185	$ 6,408,845		$ 836,190	$ 5,558,255	7.6		
Well Station #5	Mechanical - high efficiency motors	Proposed Q4 - 2020	2,063	0	-	-	$299	$6,864		$413	$6,451	21.6	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Well Station #7	Mechanical - high efficiency motors	Proposed Q4 - 2020	1,738	0	-	-	$252	$7,007		$348	$6,659	26.4	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Well Station #8	Mechanical - high efficiency motors	Proposed Q4 - 2020	31,996	0	-	-	$4,639	$31,675		$5,850	$25,825	5.6	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Well Station #9	Mechanical - high efficiency motors	Proposed Q4 - 2020	5,643	0	-	-	$818	$6,054		$1,129	$4,925	6.0	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Pleasant Street Booster Station	Mechanical - high efficiency motors	Proposed Q4 - 2020	6,206	0	-	-	$900	$9,785		$1,241	$8,544	9.5	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Bright Hill Booster Station	Mechanical - high efficiency motors	Proposed Q4 - 2020	13,125	0	-	-	$1,903	$12,540		$2,625	$9,915	5.2	Enterprise funds	Energy Source Audit Report, 2017, see Appendix B
Water & Sewer Subtotal	MMBTU Saved:	238	69,861	-	-	-	10,130	88,697		13,423	75,274	7		
	Total MMBTU Saved	21,039	4,109,029	43,988	19,577	1,901								

VI. Appendix B: Town of Franklin Energy Audit – Energy Source

Energy Efficiency Comprehensive Project

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energysource

September 5th, 2017

Dear Michael D'Angelo,

Energy Source is pleased to present you with this energy conservation analysis. We trust you will find this a cost effective means to reduce your energy costs, and also improve the controls on your HVAC equipment. 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 installation of new Condensing Boilers, LED fixtures, Variable Frequency Drives (VFDs), Motors, High Efficiency Transformers, Building Weatherization, Kitchen Exhaust System, and Pipe Insulation.

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

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

Sincerely,

Gabriel Andreson

Energy Source

Disclaimer

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

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

For any questions regarding this report, please contact Gabriel Andreson, Energy Efficiency Consultant for Energy Source, Inc. at 401-490-7555. Any additional use of this report is prohibited unless permission is given in writing from Energy Source, Inc.

Executive Summary

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

- Franklin Dog Pound
- Franklin Fire Headquarters
- Franklin Substation
- Franklin High School
- Franklin Municipal Building
- Franklin Museum
- Franklin Police Station
- Horace Mann Middle/ Oak Street Elementary Schools
- Keller Elementary/ Annie Sullivan School
- Parmenter Elementary School
- Remington Middle/ Jefferson Elementary School
- Davis Thayer Elementary School
- Franklin Well/Booster Stations

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

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

Energy Cosnervation Measures	Total Project Cost	Estimated Incentives	Estimated Customer Cost	Electricity Savings		Heating Savings		O & M Savings	Total Cost Savings	Payback Period (years)
				kWh	Cost	Therms	Cost			
Install Condensing Boilers	$2,553,000	$115,000	$2,438,000	0	$0	28,606	$28,606	$38,353	$66,959	36.4
Install LED Lighting	$1,361,057	$305,321	$1,055,736	1,160,051	$168,207	0	$0	$61,263	$229,470	4.6
Install High Efficiency Transformers	$200,929	$22,906	$178,023	152,712	$22,143	0	$0	$0	$22,143	8
VFDs/Motors on Distribution Pumps	$139,121	$28,700	$110,421	273,603	$39,672	0	$0	$0	$39,672	2.8
Motors on Well Distribution Pumps	$57,022	$7,573	$49,449	37,865	$5,490	0	$0	$2,193	$7,683	6.4
Building Weatherization	$53,811	$0	$53,811	7,046	$1,022	4,848	$4,848	$0	$5,870	9.2
Install Kitchen Exhaust System	$37,800	$9,761	$28,039	16,332	$2,368	8,134	$8,134	$0	$10,503	2.7
Pipe Insulation	$12,502	$0	$12,502	0	$0	999	$999	$0	$999	12.5
Total	**$4,415,242**	**$489,262**	**$3,925,980**	**1,647,609**	**$238,903**	**42,588**	**$42,588**	**$101,809**	**$383,299**	**10.2**

ECM #1-Install New Condensing Boilers

Existing Conditions

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

Energy Conservation Measure Details

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

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

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

Building	Heat Savings		Total O & M Savings	Total Cost Savings
	Therms	Cost		
Horace Mann Middle/Oak Street Elementary School	7,540	$7,540	$7,130	$14,670
Keller Elementary/Annie Sullivan School	8,778	$8,778	$5,980	$14,758
Parmenter Elementary School	2,736	$2,736	$8,338	$11,074
Remington/Jefferson School	7,592	$7,592	$5,175	$12,767
Davis Thayer Elementary School	1,960	$1,960	$11,730	$13,690
Total	**28,606**	**$28,606**	**$38,353**	**$66,959**

Implementation

The implementation of this measure requires the purchase and installation of condensing boilers. The total material and installation cost breakdown along with incentives are shown on the table below,

Building	Make	Model Type	Model #	Quantity	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Horace Mann Middle/Oak Street Elementary School	Lochinvar	Crest	FB-4000	3	$713,000	$30,000	$683,000	46.6
Keller Elementary/Annie Sullivan School	Lochinvar	Crest	FB-3500	3	$598,000	$30,000	$568,000	38.5
Parmenter Elementary School	Lochinvar	FTXL	FTX850	2	$333,500	$15,000	$318,500	28.8
Remington/Jefferson School	Lochinvar	Crest	FB-4500	2	$517,500	$20,000	$497,500	39.0
Davis Thayer Elementary School	Lochinvar	Crest	FBN2001	2	$391,000	$20,000	$371,000	27.1
Total				**12**	**$2,553,000**	**$115,000**	**$2,438,000**	**36.4**

Approximately $115,000 can be obtained from utility rebates; therefore, the adjusted Customer Cost is $2,438,000. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$2{,}438{,}000}{\$66{,}959} = 36.4\ years$$

ECM #2- Install New LED Lighting Fixtures

Existing Conditions

This measure involves the installation of LED fixtures. Currently, ten town/school buildings have 28 Watt or 32 Watt T-8 flourescent and compact flourescent fixtures.

Energy Conservation Measure Details

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

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

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

Building	Electricity Savings		Total O & M Savings	Total Cost Savings
	kWh	Cost		
Franklin High School	427,733	$62,021	$26,191	$88,212
Horace Mann Middle/Oak Street Elementary School	161,863	$23,470	$10,863	$34,333
Keller Elementary/Annie Sullivan School	283,526	$41,111	$10,391	$51,502
Remington/Jefferson School	88,749	$12,869	$6,661	$19,530
Franklin Dogg Pound	4,364	$633	$227	$860
Franklin Fire Headquarters	93,733	$13,591	$2,612	$16,203
Franklin Substation	46,632	$6,762	$1,168	$7,930
Franklin Muncipal Building	459	$67	$0	$67
Franklin Museum	5,073	$736	$1,058	$1,794
Franklin Police Station	47,919	$6,948	$2,092	$9,040
Total	**1,160,051**	**$168,207**	**$61,263**	**$229,470**

Annual energy savings of 1,160,051 kWh can be realized from this measure which will lead to an annual total cost savings of $229,470.

Implementation

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

Building	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Franklin High School	$448,906	$106,933	$341,973	3.9
Horace Mann Middle/Oak Street Elementary School	$296,287	$40,466	$255,821	7.5
Keller Elementary/Annie Sullivan School	$312,018	$96,860	$215,158	4.2
Remington/Jefferson School	$141,755	$22,187	$119,568	6.1
Franklin Dogg Pound	$2,404	$325	$2,079	2.4
Franklin Fire Headquarters	$61,760	$11,305	$50,455	3.1
Franklin Substation	$39,531	$10,660	$28,871	3.6
Franklin Muncipal Building	$714	$50	$664	10.0
Franklin Museum	$9,814	$2,080	$7,734	4.3
Franklin Police Station	$47,868	$14,455	$33,413	3.7
Total	**$1,361,057**	**$305,321**	**$1,055,736**	**4.6**

It was estimated approximately $305,321 can be obtained from the utility program; therefore, the adjusted customer cost is $1,055,736. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$1{,}055{,}736}{\$229{,}470} = 4.6\ years$$

ECM #3- Install High Efficiency Transformers

Existing Condition

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

Energy Conservation Measure Details

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

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

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

Building	Quantity	Capacity (kVA)	Electricity Savings	
			kWh	Cost
Horace Mann Middle/Oak Street Elementary School	8	335	50,342	$7,300
Keller Elementary/Annie Sullivan School	12	545	78,395	$11,367
Remington/Jefferson School	2	180	23,975	$3,476
Total	**22**	**1,060**	**152,712**	**$22,143**

Annual energy savings of 152,712 kWh can be realized from this measure; therefore, Total Cost Savings of $22,143 can be obtained.

Implementation

The implementation of this measure requires the purchase and the installation of twenty-two Rex Transformers. The total material and installation cost of the transformers for this measure is approximately $200,929. Utility incentives of $22,906 are estimated to be obtained as well; therefore, the adjusted customer cost is $178,023. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$178{,}023}{\$22{,}143} = 8\ years$$

ECM #4 -Install VFD's/Motors on Distribution Pumps

Existing Conditions

This measure involves the installation of nine Variable Frequency Drives at four of the Franklin buildings. Currently, the hot water is being supplied from boilers and delivered to baseboards, unit ventilators, Air Handler Units (AHUs), and Make up Air Units (MUAUs) throughout the buildings. At Remington/Jefferson School, a chiller is being used to provide chilled water to their supply fans. These buildings use a differential pressure sensor to control the water flow to allow sufficient amount of water to be supplied throughout the entire building. When adequate flow is met, the remaining water runs through a bypass loop which recirculates the water; therefore, the circulating pumps operate at a constant speed regardless of the load conditions needed for each hot/chilled water coil.

Energy Conservation Measure Details

It is recommended Variable Frequency Drives (VFDs) and high efficiency motors are installed on each pump and controlled via differential pressure and the current three way valve will be closed off entirely. This setting will reduce the pump power consumption because the flow that is being bypassed back into the boiler will be conserved and this will result in electricity savings. The specifications for each pumping system is shown below:

Building	VFD Application	Quantity
Keller/ Sullivan School	Hot Water Pumps	2
Parmenter Elementary School	Hot Water Pumps	2
Remington/ Jefferson School	Hot Water Pumps	2
	Hot Water Pump	1
	Chilled Water Pumps	2
Franklin Well Water Station #8	Well Water Pump	1
Total		**10**

The scope of this work includes the following:

- Supply and install Variable Frequency Drives (VFDs) in place of the existing motor starters

- Remove and replace ten existing pump motors with new NEMA Premium Motors
- Integrate into existing Energy Management System (if applicable)
- Start-up and testing of the new VFDs
- Warranty for one year

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

Building	VFD Application	Quantity	Size (hp)	kWh/HP	Motor Efficiency	Annual Energy Savings	
						kWh	Cost
Keller/ Sullivan School	Hot Water Pumps	2	15	2040	93.0%	65,806	$9,542
Parmenter Elementary School	Hot Water Pumps	2	10	2040	91.8%	44,444	$6,444
Remington/ Jefferson School	Hot Water Pumps	2	20	2040	93.1%	87,648	$12,709
	Hot Water Pump	1	15	2040	93.0%	32,903	$4,771
	Chilled Water Pumps	2	7.5	657	91.2%	10,806	$1,567
Franklin Well Water Station #8	Well Water Pump	1	40	799.9	94.5%	31,996	$4,639
Total		**10**				**273,603**	**$39,672**

Annual energy savings of 273,603 kWh can be realized from this measure. An electricity marginal cost of $0.145/kWh based on utility billing data was used to determine the annual cost savings of $39,672.

Implementation

The implementation of this measure requires the purchase and installation of ten VFDs and motors controlled by differential pressures. The implementation also requires a controller, pressure sensors (if necessary), and electrical wiring. The VFDs will also need to be programmed and integrated into the current building Energy Management System (EMS). The total material and installation cost of the drives and control system for this measure is $139,121. Approximately $28,700 can be obtained from rebates by the utility company; therefore the adjusted customer cost is $110,421. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$110{,}421}{\$39{,}672} = 2.8\ years$$

ECM #5 -Install New Motors on Distribution Pumps

Existing Conditions

This measure involves the replacement/installation of ten motors at seven of the Franklin stations. Currently, the motors at these Franklin Well Stations are inefficient and old.

Energy Conservation Measure Details

It is recommended that high efficiency motors are installed on each pump. By installing new motors, the power consumption will reduce and this will result in electrical savings. The specifications for each motor is shown below:

Building	Quantity	Size (hp)	Current Motor Efficiency
Franklin Well Water Station #1/#2	1	15	90.4%
Franklin Well Water Station #4	1	75	93.1%
Franklin Well Water Station #5	1	60	94.0%
Franklin Well Water Station #7	1	50	93.5%
Franklin Well Water Station #9	1	40	91.2%
Pleasant Street Booster Pump Station	1	40	91.0%
	1	40	89.4%
Bright Hill Booster Pump Station	2	5	85.5%
	1	15	89.7%
Total	**10**		

The scope of this work includes the following:

- Remove and replace ten existing pump motors with new NEMA Premium Motors
- Warranty for one year

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

Building	Quantity	Size (hp)	Current Motor Efficiency	Proposed Motor Efficiency	Annual Energy Savings		O & M Cost Savings	Total Cost Savings
					kWh	Cost		
Franklin Well Water Station #1/#2	1	15	90.4%	93.0%	2,848	$413	$188	$601
Franklin Well Water Station #4	1	75	93.1%	95.1%	6,242	$905	$380	$1,285
Franklin Well Water Station #5	1	60	94.0%	95.0%	2,063	$299	$264	$563
Franklin Well Water Station #7	1	50	93.5%	94.5%	1,738	$252	$269	$522
Franklin Well Water Station #9	1	40	91.2%	94.5%	5,643	$818	$233	$1,051
Pleasant Street Booster Pump Station	1	40	91.0%	94.5%	2,499	$362	$188	$551
	1	40	89.4%	94.5%	3,707	$538	$188	$726
Bright Hill Booster Pump Station	2	5	85.5%	89.6%	12,519	$1,815	$321	$2,137
	1	15	89.7%	93.0%	606	$88	$161	$249
Total	**10**				**37,865**	**$5,490**	**$2,193**	**$7,684**

Annual energy savings of 37,865 kWh can be realized from this measure. An electricity marginal cost of $0.145/kWh, was used to determine the annual electricity cost savings of $5,490. With operations and maintenance savings of $2,193, the total cost savings for this measure is approximately $7,683.

Implementation

The implementation of this measure requires the purchase and installation of ten motors. The total material and installation cost for this measure is $57,022. Approximately $7,573 can be obtained from rebates by the utility company; therefore the adjusted customer cost is $49,449. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$49{,}449}{\$7{,}683} = 6.4\ years$$

ECM #6- Building Weatherization

Existing Condition

This measure involves weatherizing each campus building. Below is a description of each weatherization measure that is being proposed,

- **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.
- **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.
- **Caulking** – the weather stripping of the overhead doors in both fire stations in town has been installed without sealant or caulking. Nails and compression fitting alone leaves gaps between the weather stripping material and exterior wall structure. Caulking will ensure the gap between the weather stripping carrier and walls will no longer allow cold air to infiltrate the building.
- **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.
- **Overhead Door Weather Stripping** - remove existing weather stripping and replace with new commercial grade weather stripping to create a full air seal around the door. 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-Wall Intersection Air Sealing – the exterior flashing and finishes at the roof-wall intersection are not constructed to stop air leakage (Police Station).

Roof-Wall Intersection Air Sealing – gaps between the roof deck and the wall framing are pathways for unwanted infiltration/ exfiltration (Police Station).

Roof-Wall Intersection Air Sealing – the exterior flashing and finishes at the roof-wall intersection are not constructed to stop air leakage (Municipal Building).

Roof-Wall Intersection Air Sealing – gaps at the interior of the roof-wall intersection combine with the unsealed exterior flashing and finish details to allow unwanted infiltration/ exfiltration (Municipal Building).

Roof-Wall Intersection Air Sealing – the exterior flashing and finishes at the roof-wall intersection are not constructed to stop air leakage (Keller/ Sullivan School).

Roof-Wall Intersection Air Sealing – fiberglass was used to fill gaps between the roof and wall framing components. Fiberglass is an air permeable material that needs to be covered with an air barrier to avoid further air leakage at the roof-wall intersection (Keller Sullivan School).

Energy Conservation Measure Details

By implementing this measure, the reduction is heat loss/heat gain will occur which will lead to energy savings. The scope of work includes the following:

- Roof-Wall Intersection Air Sealing
- Overhang Air Sealing
- Caulking
- Door Weather Stripping
- Overhead Door Weather Stripping

A overall work summary is shown below,

Weatherization Measure	Keller/Sullivan School	King Street Fire Station	Municipal Building	Police Station	Franklin Fire Headquarters	Total Quantity	
Roof-Wall Intersection Air Sealing (LF)	1647		366	246		2,259	LF
Overhang Air Sealing (SF)	100			212		312	SF
Overhang Air Sealing (LF)	54					54	SF
Caulking- Interior (LF)		196			308	504	LF
Single Door Weather Stripping (Units)	7	5	3	6	6	27	Units
Double Door Weather Stripping (Units)	1	10			1	12	Units
Overhead Door Weather Stripping (LF)	1	10			1	12	LF

Building	Electricity Savings		Heating Savings		Total Cost Savings
	kWh	Cost	Therms	Cost	
Keller/Sullivan School	4,921	$714	3,254	$3,254	$3,968
King Street Fire Station	145	$21	141	$141	$162
Municipal Building	964	$140	637	$637	$777
Police Station	807	$117	626	$626	$743
Franklin Fire Headquarters	209	$30	190	$190	$220
Total	**7,046**	**$1,022**	**4,848**	**$4,848**	**$5,870**

By implementing this measure approximately 7,046 kWh and 4,848 Therms can be realized; therefore, a total annual cost savings of $5,870 was estimated.

Implementation

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

Building	Total Project Cost	Payback Period (years)
Keller/Sullivan School	$35,117	8.9
King Street Fire Station	$1,725	10.6
Municipal Building	$8,130	10.5
Police Station	$6,557	8.8
Franklin Fire Headquarters	$2,282	10.4
Total	**$53,811**	**9.2**

The estimated customer cost is $53,811. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$53{,}811}{\$5{,}870} = 9.2\ years$$

ECM #7- Install Kitchen Hood Controls

Existing Conditions

This measure involves the install of kitchen hood systems to automatically control the kitchen ventilation and exhaust at two of the schools. Currently, the kitchen exhaust and the make-up air units stay on for 3,600 annual hours.

Energy Conservation Measure Details

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

- Supply and install Variable Frequency Drives (VFDs) in place of the existing motor starters for kitchen exhaust and ventilation fans
- Supply and install two CaptiveAire controllers
- Install infrared and temperature sensors in the kitchen exhaust ductwork
- Integrate into existing Energy Management System
- Start-up and testing of the new VFDs
- Warranty for one year

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

Building	Fan Type	Size (hp)	Electricity Annual Savings		Natual Gas Annual Savings		Total Cost Savings
			kWh	Cost	Therms	Cost	
Keller/ Sullivan School	MAU	2	9,527	$1,381	4,550	$4,550	$5,931
	Exhaust	5					
Remington/ Jefferson School	Exhaust	5	6,805	$987	3,585	$3,585	$4,571
Total		**12**	**16,332**	**$2,368**	**8,134**	**$8,134**	**$10,503**

Annual energy savings of 16,332 kWh and 8,134 Therms can be realized from this measure; therefore, the total cost savings is $10,503.

Implementation

The implementation of this measure requires the purchase and installation of three VFDs controlled by differential temperature. The implementation also requires a controller, temperature/ infrared sensors and electrical wiring. The VFDs will also need to be programmed and integrated into the current building Energy Management System (EMS). The total material and installation cost of the drives and control system for this measure is shown below along with estimated utility company:

Building	Fan Type	Size (hp)	Total Project Cost	Estimated Utility Incentives	Customer Cost	Payback Period (years)
Keller/ Sullivan School	MAU	2	$20,250	$5,460	$14,790	2.5
	Exhaust	5				
Remington/ Jefferson School	Exhaust	5	$17,550	$4,302	$13,248	2.9
Total		**12**	**$37,800**	**$9,761**	**$28,039**	**2.7**

Approximately $9,761 can be obtained from rebates by the utility company; therefore the adjusted customer cost is $28,039. The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$28{,}039}{\$10{,}503} = 2.7\ years$$

ECM #8- Pipe Insulation

This measure involves the insulation of bare pipes, tanks, and valve & fittings at four buildings. Below is a description of each weatherization measure that is being proposed,

- **Pipe Insulation** – un-insulated pipes in the heating system 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.

Pipe Insulation – Victaulic pipe insulation was removed. Exposing pipe to unconditioned boiler room is leading to unnecessary distribution losses (Keller/Sullivan School).

Valve & Fitting Insulation – the 3-Way valve in the distribution system is a tricky component to insulate. The large uninsulated surface needs to be wrapped in order to reduce distribution losses (Keller Sullivan School).

Valve & Fitting Insulation – the suction diffuser (yellow) and strainer (blue) are not insulated which is leading to unnecessary distribution losses (Keller Sullivan School).

Tank Insulation – the air separator tank represents a large surface are in the heating distribution which if continued to left uninsulated will result in distribution losses (Municipal Building).

Valve & Fitting Insulation – the strainer is uninsulated which is leading to unnecessary distribution losses (Municipal Building).

Valve & Fitting Insulation – the butterfly valve at the pumps needs to be insulated in order to reduce distribution losses (West Central St Fire Station).

Energy Conservation Measure Details

It is recommended that the bare pipes, tanks, and valve & fittings is insulated with cellular insulation. By implementing this measure, the reduction is heat loss will accrue, which will lead to energy savings. The scope of work includes the following:

- Install pipe insulation to meet the insulation requirements of the fluid temperature in the pipe

- Utilize/install pipe covering/jacket to protect the insulation material as required in the work area.

A summary of the uninsulated components are shown below,

Building	Uninsulated Pipe Length (ft)	Uninsulated Valves & Fittings (Units)	Uninsulated Tanks (Units)	Heat Savings	
				Therms	Cost
Keller/ Sullivan School	5	14	0	294	$294
Muncipal Building	77	47	1	320	$320
Franklin Fire Headquarters	2	21	1	385	$385
Total	**84**	**82**	**2**	**999**	**$999**

By implementing this measure approximately 999 Therms can be realized and annual total cost savings of $999.

Implementation

The implementation of this measure requires the insulation on bare hot water/valves, fittings, and one tank. The total material and installation cost of this measure is broken down below,

Building	Project Cost	Payback Period (years)
Keller/ Sullivan School	$1,825	6.2
Muncipal Building	$5,789	18.1
Franklin Fire Headquarters	$4,888	12.7
Total	**$12,502**	**12.5**

The simple payback is calculated as follows:

$$Payback\ Period = \frac{Customer\ Cost}{Cost\ Savings} = \frac{\$12{,}502}{\$999} = 12.5\ years$$

energysource

Installation and Warranty Information

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

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

Installation

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

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

Warranty

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

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

VII. Appendix C: Town of Franklin LED Streetlight Retrofit Savings Calculator – MAPC

National Grid Franklin

LED Retrofit Costs & Incentive

Existing Type	Nominal Wattage	Quantity	Replacement LED Wattage	Materials Cost per Unit (photocell + fuse + light)	Total Material Cost	Labor Cost per Unit	Total Labor Cost	Audit Cost per Unit	Total Audit Cost	Design/PM Cost per Unit	Total Design/PM Cost	Total Cost to Retrofit
Roadway												
HPS Rdw	50	1363	25	$ 204	$ 278,052		$ 109,040		20,445		40,890	448,427
HPS Rdw	70	0	25	$ 204	$ -		$ -		-		-	-
HPS Rdw	100	63	42	$ 204	$ 12,852		$ 5,040		945		1,890	20,727
HPS Rdw	150	16	53	$ 284	$ 4,544		$ 1,280		240		480	6,544
HPS Rdw	250	190	101	$ 284	$ 53,960		$ 15,200		2,850		5,700	77,710
HPS Rdw	400	16	130	$ 334	$ 5,344		$ 1,280		240		480	7,344
MV Rdw	100	0	25	$ 204	$ -	$80	$ -	$15	-	$30	-	-
Incandescent I	105	0	42	$ 204	$ -		$ -		-		-	-
Post-Top							$ -		-		-	-
HPS Post	50	0	25	434	-		$ -		-		-	-
HPS Post	100	0	42	434	-		$ -		-		-	-
Flood							$ -		-		-	-
HPS Fld	250	0	101	420	-		$ -		-		-	-
HPS Fld	400	0	130	420	-		$ -		-		-	-
					$ 354,752		**$ 131,840**		**$ 24,720**		**$ 49,440**	**$ 560,752**

Annual Energy & Maintenance Costs **after** Retrofit

Annual kWh Billed Per Light	Total Billed kWH	Actual kWh	Deliver Rate per kWh	Delivery Cost (S-5)	Cost per Light for Annual Third Party Routine Maintenance	Annual Third-Party Maintenance Charge*	Annual maintenance Contingency*	Supply Rate per kWh	Supply Charge	Total Annual Costs
104	142,263	142,263		$ 12,707		$ 8,178			$ 11,452	$ 32,337
104	-	-		$ -		$ -			$ -	$ -
104	6,576	11,047		$ 587		$ 378			$ 529	$ 1,495
313	5,010	3,540		$ 447		$ 96			$ 403	$ 947
522	99,156	80,118		$ 8,857		$ 1,140			$ 7,982	$ 17,979
522	8,350	8,684		$ 746		$ 96			$ 672	$ 1,514
104	-	-	$ 0.08932	$ -	$ 6	$ -	**$ 16,480**	$ 0.08050	$ -	$ -
104	-	-		$ -		$ -			$ -	$ -
104	-	-		$ -		$ -			$ -	$ -
104	-	-		$ -		$ -			$ -	$ -
313	-	-		$ -		$ -			$ -	$ -
522	-	-		$ -		$ -			$ -	$ -
	261,355	**245,653**		**$ 23,344**		**$ 9,888**	**$ 16,480**		**$ 21,039**	**$ 70,751**

*Annual maintenance costs decrease for LEDs due to their longer life. See "Back Up" tab for maintenance cost figures.

*Recommend keeping same reserve for contingency as pre-retrofit

Annual Savings from an LED Retrofit

Billed Savings ($)	Billed Savings (kWh)	Actual Savings (kWh)	Initial Payback	Incentive from Utility	Net Cost After Utility	Payback with Utility Incentive	Grant from DOER (30% materials and labor)	Net Cost After Utility & DOER Grant
$ 43,042	205,302	205,302		$ 51,325.47			$ 100,729.96	
$ -	-	-		$ -			$ -	
$ 4,536	24,483	20,012		$ 5,002.99			$ 3,866.70	
$ 1,207	6,542	8,012		$ 2,002.90			$ 1,146.33	
$ 25,247	141,954	160,992		$ 40,247.94			$ 8,673.62	
$ 4,009	23,042	22,708		$ 5,677.00			$ 284.10	
$ -	-	-		$ -			$ -	
$ -	-	-		$ -			$ -	
				$ -				
$ -	-	-		$ -				
$ -	-	-		$ -				
$ -	-	-		$ -				
$ -	-	-		$ -				
$ 78,041	**401,323**	**417,025**	**7.19**	**$ 104,256**	**$ 456,496**	**5.85**	**$ 114,701**	**$ 341,795**

IX. Appendix D: Town of Franklin Vehicle Measures Calculations – MAPC

Anti-Idling Technology in Police Cruisers

MAPC used the Havis IdleRight system to scope out this Energy Conservation Measure. The system is an example of one of many anti-idling technologies available to the Town. This particularly system monitors battery conditions and can turn the engine on and off when needed to minimize gasoline use while preserving battery life.

Item	Unit	Data Source
FY16 PD gasoline usage in gallons	33,367	Town/MEI
Hours per shift idling	8	Police Chief
Hours per day idling (3 shifts)	24	Calculation
Days per week on duty	7	Police Chief
Gallons saved per hour of idling	0.625	Havis IdleRight (http://idleright.havis.com/fuel-mgmt.html)
Gallons saved per vehicle per year	5,475	Calculation
# Police Cruisers	32	Town Vehicle Inventory
# Cruisers per shift	2	Police Chief
Total gallons saved per year	10,950	Calculation
MMBTUs saved per year	**1,357.8**	Calculation
Conservative $/gallon of gas	1.5	Approx. 70% of current gas prices (http://www.massachusettsgasprices.com)
Annual cost savings	**$16,425.00**	Calculation
Cost per Vehicle	$450	Source: Ashurnham and Truro ERPs
Total Cost for all Cruisers	$14,400	Calculation
Payback (Years)	0.88	Calculation
Additional Calculations		
Gallons saved per hour*	0.625	
% energy saved over vehicle baseline	10.2%	
% energy saved over total baseline	1.3%	

**Source: http://idleright.havis.com/fuel-mgmt.html*

A typical vehicle that idles for 6 hours at an emergency or construction scene uses as much as 4 gallons of gas. That same vehicle, equipped with the Havis IdleRight system, uses less than one-quarter of a gallon of gas.

Policies that Affect Fleet Gas and Diesel Usage

As municipalities across the commonwealth track their energy use, government officials have been surprised to learn what a large part of total energy consumption goes towards fueling municipal vehicles; municipal fleets often account for over one third of the city or town's total energy consumption. This information points to vehicles as important targets in the reduction of energy consumption and greenhouse gas emissions.

The Town of Franklin already uses FuelMaster to manage and monitor fuel usage for its municipal fleet. FuelMaster is a fuel economizer and pollution reduction device which utilizes magnetic hydrodynamic technology to improve the combustion of hydrocarbon fuels.[1] Additional elements to add to such a vehicle program may include: a preventative maintenance schedule that tracks use, repairs and preventative maintenance and the close monitoring of tire air pressure.

The use of 100% synthetic oil can reduce fuel consumption up to 2% according to national studies.[2] Synthetic oil also reduces the number of oil changes needed each year, leading to a corresponding reduction in associated oil expense and labor. Synthetic oil is safe to use as a substitute to conventional petroleum-based oils and does not result in ill-effects to engines including older engines.

Closely Monitor Tire Air Pressure and Use Fuel Efficient Tires		
All FY 2016 Gasoline Usage (Gallons)	72,347	
All FY 2016 Diesel Usage (Gallons)	31,687	
Percent Savings	4%	Maintaining appropriate air pressure in vehicle tires can decrease that vehicles fuel consumption by as much as 4%.*
Gallons Gasoline Saved per Year	2,894	
Gallons Diesel Saved per Year	1,267	
MMBTUs Saved per Year	**261**	
Use 100% Synthetic Oil		
All FY 2016 Gasoline Usage (Gallons)	72,347	
All FY 2016 Diesel Usage (Gallons)	31,687	
Percent Savings	2%	The use of 100% synthetic oils reduces fuel consumption, the number of annual oil change and labor costs.*

[1] http://fuelmaster.com/How_It_Works.htm
[2] http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf

Gallons Gasoline Saved per Year	1,447	
Gallons Diesel Saved per Year	634	
MMBTUs Saved per Year	**523**	
Total MMBTUs	**784**	
*http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf		

Vehicle Replacement & Retrofit Calculations

In accordance with the Town's fuel efficient vehicle policy, the Town plans to replace twelve non-exempt gasoline internal combustion engine vehicles with full battery electric vehicles within the next five years. Additionally, the Town plans to retrofit four of its pickup trucks with XL Hybrids plug-in hybrid electric conversion technology. Calculations for both of these strategies are on Page 55. Switching from a fossil fuel burning vehicles to vehicles that run on electricity will provide the Town with cost and energy savings within its vehicle fleet.

		Current Annual Use			Replacement and Retrofit		Calculated Annual Use					Estimated Annual	
Make/Model	**Replacement/Retrofit Type**	Gasoline (CY16)	VMT (CY16)	Cost	Annual Gasoline Gallons*	Annual Gasoline Gallons**	Annual Gasoline Use (gal)	Cost	Electricity Use (kWh)***	Cost ($0.18/kWh)	Annual Savings (gal)	Annual Savings (MMBTU)	Annual Cost Savings
CHEVROLET COBALT	**EV Replacement**	109.4	1,786	$260.37		15.9			537.39	$96.73	93.45	11.26	$163.64
CHEVROLET MALIBU	**EV Replacement**	130.5	2,762	$310.59		24.7			831.07	$149.59	105.84	12.75	$161.00
CHEVROLET MALIBU	**EV Replacement**	132.1	2,796	$314.40		25.0			841.30	$151.43	107.14	12.91	$162.96
CROWN VICTORIA	**EV Replacement**	391.6	7,490	$932.01		66.9			2,253.69	$405.66	324.73	39.12	$526.34
CROWN VICTORIA	**EV Replacement**	391.6	7,490	$932.01		66.9			2,253.69	$405.66	324.73	39.12	$526.34
FORD EXPEDITION	**EV Replacement**	873.7	8,672	$2,079.41		77.4			2,609.34	$469.68	796.27	95.93	$1,609.72
CHEVROLET COBALT	**EV Replacement**	350.3	8,852	$833.71		79.0			2,663.50	$479.43	271.26	32.68	$354.28
CHEVROLET COBALT	**EV Replacement**	57.6	1,112	$137.09		9.9			334.59	$60.23	47.67	5.74	$76.86
FORD FOCUS	**EV Replacement**	137	2,145	$326.06		19.2			645.42	$116.17	117.85	14.20	$209.89
CHEVROLET SONIC	**EV Replacement**	114	2,445	$271.32		21.8			735.68	$132.42	92.17	11.10	$138.90
CHEVROLET SONIC	**EV Replacement**	114	2,445	$271.32		21.8			735.68	$132.42	92.17	11.10	$138.90
CROWN VICTORIA	**EV Replacement**	1166.3	4,682	$2,775.79		41.8			1,408.78	$253.58	1124.50	135.47	$2,522.21
FORD F150 PICKUP	**Plug-In Hybrid Retrofit**	243.3	3,260	$579.05	162.2		162.2	$ 386.04			81.10	9.77	$193.02
FORD F150 PICKUP	**Plug-In Hybrid Retrofit**	564.2	5,344	$1,342.80	376.1		376.1	$ 895.20			188.07	22.66	$447.60
FORD F150 PICKUP	**Plug-In Hybrid Retrofit**	586.4	7,585	$1,395.63	390.9		390.9	$ 930.42			195.47	23.55	$465.21
FORD F150 PICKUP	**Plug-In Hybrid Retrofit**	970.6	12,884	$2,310.03	647.1		647.1	$ 1,540.02			323.53	38.98	$770.01
										TOTALS	**4,285.94**	**516.35**	**$8,466.89**

*XL Hybrids reports that the aftermarket conversion technology for Ford F150s increases vehicle fuel economy be 50%. Calculated by dividing annual vehicle mileage by the vehicle's existing MPG increased by a factor of 1.5.
Source: http://www.xlhybrids.com/content/assets/Uploads/XLH-PHEV-Flyer-8.5x11-4C-NTEA-0817-LR.pdf
**Assuming replacement with a 2017 Nissan Chevy Bolt or equivalent vehicle with an MPGe rating of 112. Calculated by dividing annual vehicle mileage by new electric vehicle MPGe.
Source: http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=38428
***Used average EV consumption of 33.7 kWh per gallon.
Source: https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=3&year1=2017&year2=2018&vtype=Electric&srchtyp=newAfv&pageno=2&sortBy=Comb&tabView=0&rowLimit=10

Cost calculations are based on the national average cost for gasoline of $2.38 and ISO NE reported average cost for electricity of $0.18/kWh.

X. Appendix E: Behavior-Based Energy Savings

School Behavior-Based Savings Program

A School Behavior-Based Energy Use Reduction Program will allow Franklin to not only better understand the inefficiencies in their school building operations, but will also help them implement programs that will work synergistically with their existing investments in energy infrastructure in school buildings. Further, this program can support or expand school curriculum by using "buildings as a teaching tool" for students.

While behavior-based energy reduction strategies have been difficult to measure or evaluate in the past, this is no longer the case. The Acton-Boxborough School District has been recognized by both DOER and the U.S. Department of Education as a national leader in implementing behavior-based energy programs that result in significant and measured energy savings. Moreover, schools with established behavior-based energy programs have reduced their energy use by 20% to 37% as a direct result to the behavior-based initiatives.

More information can be found in the Powering Down report the US Green Building Council's Center for Green Schools at http://centerforgreenschools.org/sites/default/files/resource-files/Behavior-based-Efficiency.pdf.

In 2016, four MAPC communities (Hamilton, Wenham, Salem and Swampscott), hired a consultant to oversee the implementation of a behavior-based energy reduction program in one school in each school district. The programs used a faculty lead to work with students that developed programs to ensure everyday energy savings – such as lights being turned off – as well as larger weekly savings, such as powering down all applicable electronics by end of day Friday. The programs also connected students to the facilities staff. In this way, students became an extension of the facilities staff to help monitor issues and check up on set points, etc.

Hiring a consultant is not necessary, but is highly recommended for the first year of implementation. Based on MAPC's program with the four schools, MAPC would recommend budgeting about $15,000 to $20,000 for a consultant. Also, each school would want to set aside about $500 to $1000 per year to pay for materials the students may need to implement their behavioral awareness programs.

For Franklin, MAPC assumed a conservative 10% savings per year for electricity in six schools.

School	MMBTU Electricity FY 2016	Reduction from Program	MMBTU Saved Electricity (Annual)	kWh Saved Electricity (Annual)	Cost Savings Electricity (Annual)
Franklin High School - Old	182	10%	18.2	5,334	$747
Davis Thayer School	615	10%	61.5	18,025	$2,523
John F Kennedy School	916	10%	91.6	26,846	$3,758
Parmenter School	933	10%	93.3	27,345	$3,828
Remington/Jefferson School	3,596	10%	359.6	105,393	$14,755
Keller/Sullivan School	3,941	10%	394.1	115,504	$16,171
Horace Mann/Oak/ECDC School	4,192	10%	419.2	122,860	$17,200
Brick House School	1	10%	0.1	29	$4
Franklin High School - New	11,418	10%	1141.8	334,642	$46,850
Total	**25,794**		**2,579**	**755,979**	**105,837**

Building Operator Certification

The Building Operator Certification suggests that based on evaluated programs, the certification will have an average savings of:

- 493,680 kWh per year[3]
- 1,400 therms per year

This translates to **1,824 MMBTUs** per year.

Source: http://www.theboc.info/wp-content/uploads/2017/02/BOC-Energy-Savings-FAQ-2.0-web.pdf

[3] 0.3 kWh saved per square foot for approximately 1,645,000 square feet.

XI. Appendix F: MMBTU Conversion Chart – DOER

MMBTU Conversion Chart[4]

Fuel Energy Content of Common Fossil Fuels per DOE/EIA

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

- 1 kilowatt hour of electricity = 0.003412 MMBTU
- 1 therm = 0.1 MMBTU
- 1 ccf (100 cubic foot) of natural gas = 0.1028 MMBTU (based on U.S. consumption, 2007)
- 1 gallon of heating oil = 0.139 MMBTU
- 1 gallon of propane = 0.091 MMBTU
- 1 cord of wood = 20 MMBTU
- 1 gallon of gasoline = 0.124 MMBTU (based on U.S. consumption, 2007)
- 1 gallon of E100 ethanol = 0.084 MMBTU
- 1 gallon of E85 ethanol = 0.095 MMBTU
- 1 gallon of diesel fuel = 0.139 MMBTU
- 1 gallon of B100 biodiesel = 0.129 MMBTU
- 1 gallon of B20 biodiesel = 0.136 MMBTU[5]
- 1 gallon of B10 biodiesel = 0.137 MMBTU[7]
- 1 gallon of B5 biodiesel = 0.138 MMBTU[7]
- 1 barrel of residual fuel oil = 6.287 MMBTU

[4] If a conversion factor for a fuel you use is not provided, please contact DOER.

[5] Calculated Values from those of diesel and B100 biodiesel