
Town of Hingham Energy Reduction Plan

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



In fulfillment of the
Massachusetts Green Communities Grant Program Criterion 3

October 2018

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I. Purpose and Acknowledgements

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

B. List of Contributors:

The collaborative efforts of the Town Administrator Tom Mayo, Assistant Town Administrator Michelle Monsegur, Energy Action Committee Chair Brad Moyer, Hingham Municipal Light Plant Director Paul Heanue, and MA Department of Energy Resources' Green Communities Regional Coordinator Seth Pickering were vital to produce this plan.

Much of the information in this plan was derived from energy audits performed by Energy Source. Additional technical assistance was provided by the Metropolitan Area Planning Council (MAPC), the author of this plan.

II. Executive Summary

A. Narrative Summary of the Town

The Town of Hingham is a Plymouth County community situated on the South Shore of Massachusetts. Hingham was settled by the English in 1633, under the name “Bare Cove.” With an area of 26.3 square miles, Hingham has a population of 22,157 according to the 2010 Census. The Town is governed by a Selectmen-Administrator plan with an open Town Meeting. Hingham’s school district includes a High School, Middle School, and four Elementary Schools.

B. Summary of Municipal Energy Uses

- Total Number of Municipal Buildings - 25

See Appendix A for a list of all buildings. The largest users are the High School, Middle School, and Town Hall, respectively.

- Open Space: 4 facilities

The scoreboards for Haley Field and Ward Street Field, The Otis Street Band Stand, and the Bathing Beach comprise this category.

- Total Number of Municipal Vehicles: - 112

10 of these vehicles are subject to Hingham’s Fuel Efficient Vehicle Policy, and the current average miles per gallon for these is 19.2 mpg, with the highest 27 mpg and the lowest 17 mpg.

- Total Number of Street Lights and Traffic Lights: 2,331 cobrahead streetlights; 2 school zone speed limit signs, and 7 accounts for traffic lights.

- Water and Sewer: 12 sewer pumping stations.

The Broad Cove Pumping Station, consumes (37%) of the energy use for the water and sewer sector.

Table 1: Municipal Energy Use Summary	
	Number
Buildings	

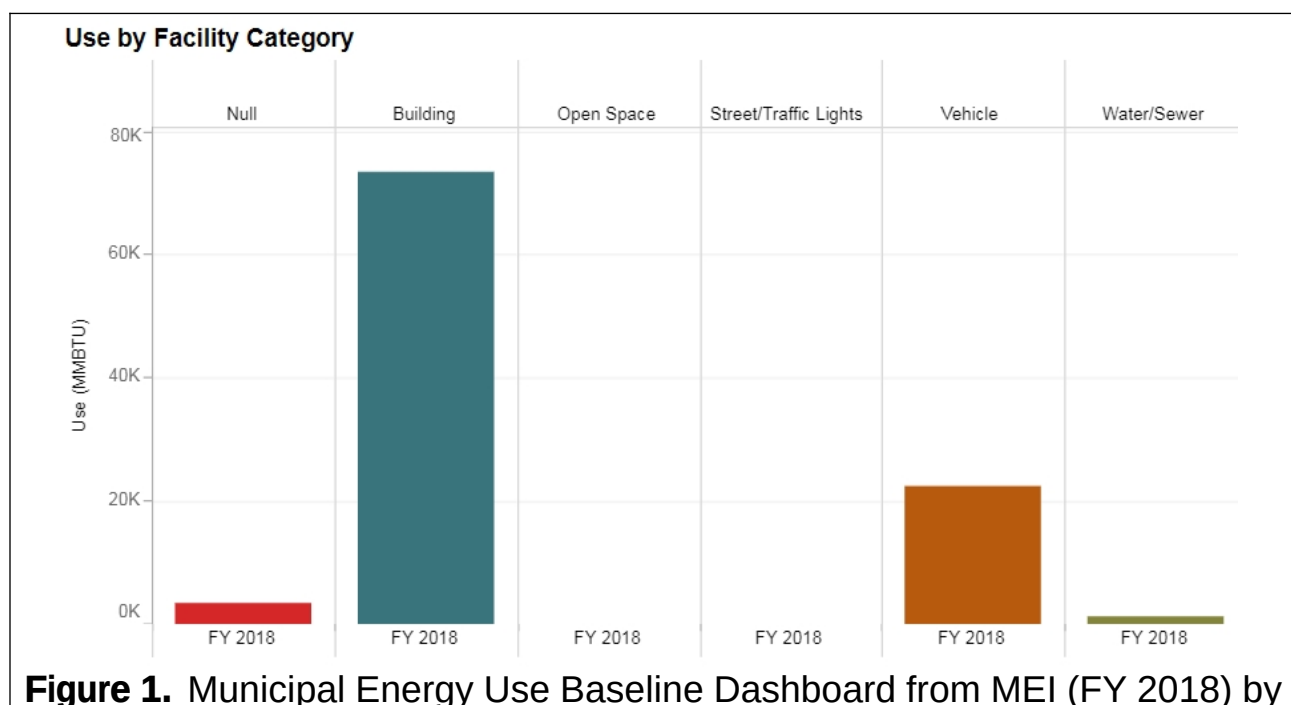
Oil Heat	8
Natural Gas Heat	20
Propane Heat	1
Biomass Heat	0
Other Heat Type	0
Electric or No heat	0
Open Space	
Properties	4
Vehicles	
Gasoline or Diesel	111
Hybrid	1
Electric	0
Street Lights	
Cobraheads	2,331
Decoratives	0
Traffic Lights	9
Water and Sewer	
Drinking Water Treatment Plant	0
Drinking Water Pumping Station	2
Wastewater Treatment Plant	0
Wastewater Lift Station (Pumping Station)	12

C. Summary of Energy Use Baseline and Plans for Reduction

This Energy Reduction Plan commits Hingham to reduce energy use in municipal facilities by at least 20% compared to Fiscal Year (FY) 2018 over five years. In the baseline year, the Town used 100,991 MMBTUs of energy¹. A process called weather normalization can be used to adjust this 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. The MassEnergyInsight tool is currently being modified to perform weather normalization, and such data will be available in future years. Currently, all data in this energy reduction plan (ERP) is non-weather normalized unless indicated otherwise.

Hingham’s 20% energy reduction goal will be measured against the non-weather normalized baseline of 100,991 MMBTUs. This means the Town must reduce usage by at least 20,198 MMBTUs.

As shown in **Figure 1**, buildings made up the vast majority (72%) of the usage by facility type (i.e. building, street/traffic light, open space, vehicles, and water/sewer).



¹ From Mass Energy Insight, *Energy Reduction Plan Guidance Table 3 (MMBTU)* tab, for FY 2018

Facility Category.

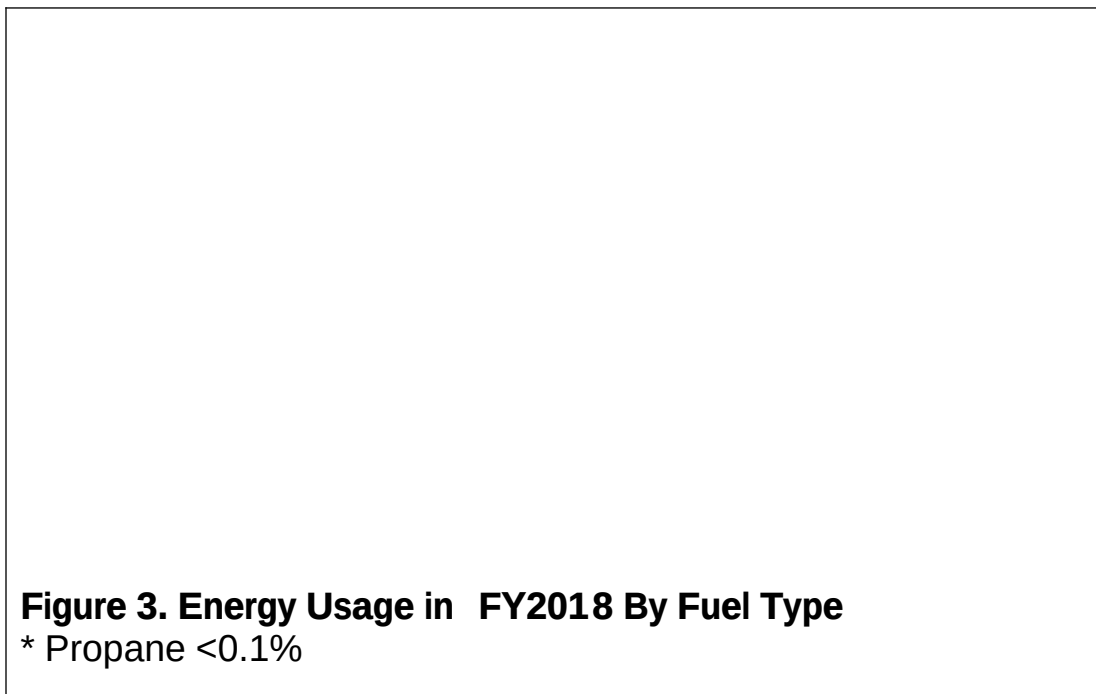
Hingham has identified energy savings measures in each facility category to reduce energy use 23% based on the total **non-weather normalized** usage, as illustrated in **Table 2a**.

Table 2a: Summary of Municipal Energy Use & 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
Non-Weather Normalized				
<i>Buildings</i>	73,503	72.78%	17,977	17.80%
<i>Open Space</i>	7	0.01%	14	0.01%
<i>Street/Traffic Lights</i>	3,521	3.49%	2,044	2.02%
<i>Vehicles</i>	22,558	22.34%	3,566	3.53%
<i>Water/Sewer/Pumping</i>	1,402	1.39%	241	0.24%
Total Non-Weather Normalized	100,991	100%	19,814	23.61%

III. Energy Use Baseline Inventory

- A. Identification of the Inventory Tool Used** - The Town of Hingham used the Department of Energy Resources' (DOER) MassEnergyInsight (MEI) web-based energy inventory and analysis tool. This tool automatically inputs energy use from natural gas. The Hingham Municipal Light Plant must enter energy use from electricity. Oil, gasoline, diesel, and propane must be entered manually by the Town. Energy use is measured in British thermal units (MMBTUs), which allows all fuel types (e.g. electricity, natural gas, diesel, etc.) to be converted to a common unit.
- B. Identification of the Baseline Year** -FY 2018 will serve as the baseline year. FY 2018 ran from July 1, 2017 to June 30, 2018. This will give the Town until June 30, 2024 (FY 2019 - FY 2024) to reach its 20% energy reduction goal.
- C. Municipal Energy Consumption for the Baseline Year (FY 201 8)** - In the baseline year, the Town used 100,991 MMBTUs of energy. As shown in Figure 3, energy use from electricity and natural gas is roughly equal and together they account for 70% of total energy use.



Of the top ten energy users in Hingham, all are buildings and all six schools are represented.

Table 2b . Top 10 Energy Users in Hingham		
User	Annual Energy Use (MMBTU)	Annual Energy Use (% of Baseline)
Hingham High School	20,614	20.41%
Hingham Middle School	10,762	10.66%
Hingham Town Hall	7,673	7.60%
South Elementary School	6,208	6.15%
Foster Elementary School	5,302	5.25%
South Shore Country Club	4,650	4.60%
Plymouth River Elementary School	3,816	3.78%
Hingham Public Library	3,717	3.68%
East Elementary School	2,709	2.68%
Central Fire Station	1,883	1.86%

Appendix A presents **Table 3a and 3b** showing energy use for each municipal facility in native units and MMBTUs in the baseline year. Note that Appendix A shows non-weather normalized data.

D. Energy Reduction Goal - Hingham's 20% energy reduction goal will be measured against the non-weather normalized baseline of 100,991 MMTBUs. Hingham will need to reduce its non-weather normalized energy consumption by at least 20,198 MMBTUs.

Figure 4. 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. Red lines show the medians for the Town's buildings.

IV. Energy Reduction Plan

A. Narrative Summary

Table 4 (see page 19) shows all identified energy reduction measures in each facility to reduce **non-weather normalized** usage from FY 2018 by 20,198 MMBTUs or 20%. The following section outlines the goals for energy efficiency implementation by year, and discusses management and oversight strategies for effective implementation.

As shown in Table 5, just over half of the energy reductions needed to meet the Town's 20% reduction goal can likely be found in just five facilities: Hingham High School, Foster Elementary School, Town Hall, South Elementary School, and East Elementary School. Cumulatively, these have a payback of just over eight years.

Table 5. Top Energy Reduction Facilities			
Facility	MMBTU Savings	Percent of Energy Reduction Goal	Cumulative Percent of Energy Reduction Goal
Hingham High School	6,314	31.26%	31.26%
Foster Elementary School	2,255	11.16%	42.42%
Town Hall	927	4.59%	47.01%
South Elementary School	1,248	6.18%	53.19%
East Elementary School	1,087	5.38%	58.57%

Funding for these measures will come from a variety of sources. Typically, utility incentives will be available for each project. Additionally, the Green Communities program from DOER offers the Town a designation grant (expected to be about \$150,000) and the chance to apply for up to \$250,000 of annual grant funding in each of the five years of its plan. It is recommended that the Town actively seek additional grants from DOER as well as other potential sources to complement these funds.

1. Overview of Goals for Years 1-3:

Buildings:

Retrofit Measures

- In year 1, perform lighting retrofits in Hingham High School and School Building 12, as well as condensing boilers and controls at Hingham High School. Town will use its Green Communities Designation Grant funding, along with utility incentives, to fund 100% of these measures. This will allow the Town to start immediately and will provide 5% of the energy savings needed.
- After the year 1 measures are planned, Town Administration will meet with project stakeholders and determine if and how plan for implementation measures should change for years 2-3. This should likely include targeting the largest energy users and sources of largest savings. Currently, most building energy savings measures are slated to be completed within years 2 and 3 or very early in year 4.

Behavioral Measures

- In year 1, achieve Building Operator Certification for DPW Director and School Facilities Directors, or their designees.
- Pilot behavior-based energy savings programs in High School, Middle School, and elementary schools. Programs should include initial documentation of appropriate set points and a quarterly documentation that those set points are being followed.

Water & Sewer:

- Perform variable frequency drive retrofits in the Broad Cove sewer pumping station.

Streetlights & Open Space Lighting:

- *Audits:* Arrange for audits of all decorative street lighting and outdoor field lighting to get an accurate count and develop a plan for retrofitting.

Vehicles:

Retrofit Measures

- Explore opportunity to retrofit applicable vans with hybrid conversion technology (e.g. XL Hybrids).
- For any replacement vehicle, explore viability of replacing with electric or hybrid electric vehicle.

Behavioral Measures

- Adopt a city-wide “No Idling” policy for all municipal vehicles and closely monitor vehicle tire air pressure to maintain vehicle fuel efficiency.
 - o For this policy to be effective, the Town should include some level of documentation and reporting on its effectiveness.

2. Overview of Goal for Years 4-5:

- Implement any building retrofit measures that have not been done in years 1-3:
 - o Installation of energy management systems in Town buildings and lighting retrofits in schools are slated to finish early in year 4.
 - o New motors for the sewer pump stations, RTU Optimizers, Refrigeration Controls, Infrared Heaters, and other measures are slated for years 4 and 5.
- Retrofit all decorative street lighting.
- Build on pilot behavior-based energy reduction programs to create a permanent program in schools.
- Explore opportunity to retrofit police cruisers with anti-idling technology (e.g. StealthPower or IdleRight).

3. Energy Efficiency Identification Measures:

- As noted previously, the Town should schedule audits for decorative street lighting, then reassess their reduction plan.
- The Town should continue to utilize MEI to review data and identify if year-over-year trends are occurring as expected. Unexpected increases or the failure of some categories to decrease despite known interventions/retrofits should prompt further inquiry.
- Use MEI's building "Buildings to Target" tab to identify underperforming and/or wasteful buildings based on Energy Use Intensity (see Figure 4 above).
- Conduct research and talk with experts such as energy auditors, DOER, MAPC, Massachusetts Clean Energy Center, and others to find out if new technologies have come to market that could provide new savings in existing facilities. MAPC recommends exploring Massachusetts Clean Energy Center's Commercially Ready Technology's list. See <http://www.masscec.com/>.

B. Path to 20% Energy Use Reduction by the end of Fiscal Year 2024

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

- Town Administration, in collaboration with the School Department, will be responsible both for oversight of the Energy Reduction Plan and for implementation of energy conservation measures within the Town. The Assistant Town Administrator, in coordination with the School Business Manager, will be responsible for the annual reporting requirements to DOER to maintain designation and eligibility for annual competitive grant funding.

- Town Administration should establish set point and setback schedules for at least the top three largest energy users in town: Hingham High School, Hingham Middle School, and Hingham Town Hall. The desired set points and schedules may differ by season and should be documented in writing. The Town Administrator and facility managers should then agree to a schedule for updates, at which the facility managers will provide written confirmation that the buildings are operating with the agreed upon set points and set-backs. **This process is intended to minimize the chance that set points and setbacks get overridden or forgotten. In some communities, this type of set point change has gone unnoticed for months, causing excessive spikes in energy use.**

The set point reporting could be included as part of a behavior-based energy reduction program, recommend for Hingham's schools.

- The Town Administrator's office should provide an annual update to the Board of Selectmen by the end of January following the submission of the Annual Report to DOER. The presentation should include:
 - o The trend for town-wide **weather-normalized** energy usage.
 - Should show the baseline, current year, and any years in between
 - o The trend for energy usage in at least the top three energy using buildings - Hingham High School, Hingham Middle School, and Hingham Town Hall - which together comprise just under 40% of the Town's energy use.
 - Should show the baseline, current year, and any years in between
 - o A summary of the major efficiency measures implemented over the past year.
 - o An explanation or hypothesis of the cause(s) of the trends town-wide and in at least each of the top three buildings.

- o Update on Green Communities competitive grant applications.

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

- Building audits were provided by Energy Source, Inc. in September-October 2018, which identified opportunities for 15.2% in energy savings. Energy Source provided Level 1 audits in all Town buildings. The Energy Source Energy audits are included in Appendix B.

MAPC developed estimates for energy savings through behavior-based energy programs in schools and Building Operator Certification may be found in Appendix F. These measures provide another 2.8% in energy savings.

- Street light measures are available in Appendix C.
- Vehicle measures are available in Appendix D.
- Water and Sewer measures were provided through an audit by Energy Source. It identifies 0.24% energy savings. The audit is available in Appendix B.

3. Energy Conservation Measures

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

Table 4: Energy Conservation Measures

Please see attached spreadsheet for the full table.

Building/Site Name	Energy Conservation Measure Name	Projected Annual Electricity Savings (kWh)	Projected Annual Natural Gas Savings (therms)	Projected Annual Oil Savings (gallons)	Total MMBTU Savings	Projected Annual Cost Savings (\$)	Total Installed Cost (\$)	Utility Incentives (\$)	Net Cost (\$)	Payback
Hingham High School	LED Lighting	367,517	0	0	1,254	\$66,153	\$437,913	\$0	\$437,913	6.6
Hingham High School	Condensing Boilers	0	19,688	0	1,969	\$23,626	\$611,874	\$20,000	\$591,874	25.1
Hingham High School	Refrigeration Controls	16,113	0	0	55	\$2,900	\$19,044	\$0	\$19,044	6.6
Hingham High School	Kitchen Fan Controls	6,562	1,719	0	194	\$3,244	\$29,089	\$1,719	\$27,370	8.4
Hingham High School	Demand Control Ventilation	0	11,994	0	1,199	\$14,393	\$106,470	\$9,600	\$96,870	6.7
Hingham High School	Demand Control Ventilation	30,063	4,463	0	549	\$10,767	\$30,940	\$3,900	\$27,040	2.5
Hingham High School	Variable Frequency Drives/ Motors	8,533	0	0	29	\$1,536	\$19,680	\$0	\$19,680	12.8
Hingham High School	Building Weatherization	6,560	4,421	0	464	\$6,486	\$58,734	\$2,211	\$56,524	8.7
Hingham High School	Mechanical Insulation	0	1,323	0	132	\$1,588	\$9,946	\$662	\$9,285	5.8
Hingham High School	Replace Transformers	137,152	0	0	468	\$24,687	\$180,651	\$0	\$180,651	7.3
Hingham Middle School	LED Lighting	159,199	0	0	543	\$28,656	\$195,629	\$0	\$195,629	6.8
Hingham Middle School	Building Weatherization	1,091	736	0	77	\$1,080	\$11,574	\$368	\$11,206	10.4
Hingham Middle School	Mechanical Insulation	0	772	0	77	\$926	\$4,754	\$386	\$4,368	4.7
Foster Elementary School	LED Lighting	204,161	0	0	697	\$36,749	\$208,881	\$0	\$208,881	5.7
Foster Elementary School	Refrigeration Controls	7,825	0	0	27	\$1,409	\$12,588	\$0	\$12,588	8.9
Foster Elementary School	Kitchen Fan Controls	932	0	737	106	\$2,084	\$15,744	\$0	\$15,744	7.6
Foster Elementary School	Energy Management System	11,602	0	5,608	819	\$16,668	\$204,100	\$0	\$204,100	12.2
Foster Elementary School	RTU Optimizer	3,153	0	29	15	\$644	\$7,194	\$0	\$7,194	11.2
Foster Elementary School	Building Weatherization	2,532	0	1,228	179	\$3,649	\$22,760	\$0	\$22,760	6.2
Foster Elementary School	Mechanical Insulation	0	0	1,225	170	\$3,185	\$20,632	\$0	\$20,632	6.5
Foster Elementary School	Steam Boiler Controls (Oil-to-Gas)	8,557	-38,893	29,513	242	\$31,603	\$144,000	\$2,927	\$141,073	4.5
Plymouth River School	LED Lighting	114,104	0	0	389	\$20,539	\$178,624	\$0	\$178,624	8.7
Plymouth River School	Refrigeration Controls	8,605	0	0	29	\$1,549	\$12,975	\$0	\$12,975	8.4
Plymouth River School	Kitchen Fan Controls	24,974	0	0	85	\$4,495	\$23,277	\$0	\$23,277	5.2
Plymouth River School	Building Weatherization	43,385	0	0	148	\$7,809	\$20,107	\$0	\$20,107	2.6
Plymouth River School	RTU Optimizer	9,219	0	0	31	\$1,659	\$16,951	\$0	\$16,951	10.2
South Elementary School	Condensing Boilers	0	6,668	0	667	\$8,002	\$181,200	\$15,000	\$166,200	20.8
South Elementary School	Energy Management System	4,983	56	0	23	\$964	\$6,500	\$900	\$5,600	5.8
South Elementary School	Refrigeration Controls	7,925	0	0	27	\$1,427	\$11,813	\$0	\$11,813	8.3
South Elementary School	Kitchen Fan Controls	5,145	955	0	113	\$2,072	\$24,289	\$955	\$23,334	11.3
South Elementary School	Building Weatherization	1,829	1,233	0	130	\$1,809	\$13,940	\$617	\$13,323	7.4
South Elementary School	Mechanical Insulation	0	1,986	0	199	\$2,383	\$12,658	\$993	\$11,665	4.9
South Elementary School	Variable Frequency Drives/ Motors	26,494	0	0	90	\$4,769	\$14,040	\$0	\$14,040	2.9
East Elementary School	LED Lighting	260,685	0	0	889	\$46,923	\$163,367	\$0	\$163,367	3.5
East Elementary School	Building Weatherization	2,084	1,404	0	148	\$2,060	\$21,535	\$702	\$20,833	10.1
East Elementary School	Mechanical Insulation	0	505	0	51	\$606	\$4,731	\$253	\$4,478	7.4

Hingham Library	LED Lighting	122,255	0	0	417	\$22,006	\$98,484	\$0	\$98,484	4.5
Hingham Library	Variable Frequency Drives/ Motors	13,830	0	0	47	\$2,489	\$19,968	\$0	\$19,968	8.0
Town Hall	LED Lighting	211,897	0	0	723	\$38,141	\$197,155	\$0	\$197,155	5.2
Town Hall	Condensing Boilers	0	2,038	0	204	\$2,446	\$195,000	\$12,000	\$183,000	74.8
Central Fire Station	LED Lighting	67,490	0	0	230	\$12,148	\$46,514	\$0	\$46,514	3.8
Central Fire Station	Condensing Boiler (Oil-to-Gas)	0	-6,011	5,068	103	\$5,965	\$66,000	\$4,000	\$62,000	10.4
Central Fire Station	Infrared Heaters	0	240	0	24	\$288	\$28,000	\$1,500	\$26,500	92.0
North Fire Station	LED Lighting	9,240	0	0	32	\$1,663	\$12,793	\$0	\$12,793	7.7
North Fire Station	Condensing Boiler (Oil-to-Gas)	0	-2,950	2,487	51	\$2,927	\$24,000	\$2,000	\$22,000	7.5
North Fire Station	Wi-Fi Programmable T-Stats	1,617	0	48	12	\$416	\$1,823	\$0	\$1,823	4.4
South Fire Station	LED Lighting	12,637	0	0	43	\$2,275	\$13,873	\$0	\$13,873	6.1
South Fire Station	Condensing Boiler (Oil-to-Gas)	0	-3,116	2,628	54	\$3,093	\$24,000	\$2,000	\$22,000	7.1
South Fire Station	Wi-Fi Programmable T-Stats	0	0	59	8	\$152	\$1,823	\$0	\$1,823	12.0
DPW Headquarters	LED Lighting	53,834	0	0	184	\$9,690	\$66,768	\$0	\$66,768	6.9
DPW Headquarters	Infrared Heaters	0	480	0	48	\$576	\$37,800	\$3,000	\$34,800	60.4
DPW Headquarters	Building Weatherization	1,214	818	0	86	\$1,200	\$17,866	\$409	\$17,457	14.5
DPW Headquarters	Wi-Fi Programmable T-Stats	3,557	208	0	33	\$890	\$4,860	\$800	\$4,060	4.6
Transfer Station	LED Lighting	1,876	0	0	6	\$338	\$3,408	\$0	\$3,408	10.1
South Shore Country Club	Kitchen Fan Controls	4,751	2,654	0	282	\$4,040	\$18,965	\$2,654	\$16,311	4.0
South Shore Country Club	Refrigeration Controls	11,534	0	0	39	\$2,076	\$19,135	\$0	\$19,135	9.2
South Shore Country Club	RTU Optimizer	4,961	0	0	17	\$893	\$7,150	\$0	\$7,150	8.0
Old HMLP	LED Lighting	4,052	0	0	14	\$729	\$11,635	\$0	\$11,635	16.0
School Depot	LED Lighting	10,889	0	0	37	\$1,960	\$12,548	\$0	\$12,548	6.4
Old Tree & Park Barn	Condensing Boiler (Oil-to-Gas)	0	-803	677	14	\$797	\$18,500	\$1,000	\$17,500	22.0
GAR Hall	LED Lighting	2,242	0	0	8	\$404	\$3,923	\$0	\$3,923	9.7
Old DPW Barn	LED Lighting	3,099	0	0	11	\$558	\$5,400	\$0	\$5,400	9.7
Building 12	LED Lighting	19,693	0	0	67	\$3,545	\$11,846	\$0	\$11,846	3.3
Building 179	LED Lighting	13,727	0	0	47	\$2,471	\$13,680	\$0	\$13,680	5.5
Broad Cove Station	Variable Frequency Drives/ Motors	51,679	0	0	176	\$9,302	\$59,540	\$0	\$59,540	6.4
Walton Cove Station	Variable Frequency Drives/ Motors	12,823	0	0	44	\$2,308	\$30,132	\$0	\$30,132	13.1
South Street Station	Variable Frequency Drives/ Motors	6,100	0	0	21	\$1,098	\$33,807	\$0	\$33,807	30.8
To insert additional rows, select this row, right-click, and select "Insert."										
		2,125,981	12,588	49,307		525,982	4,164,598	90,554	4,074,044	
TOTAL MMBtu SAVINGS		7253.847115	1258.831304	6853.742457	15,366					

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, Hingham will work with School and Town staff as well as outside consultants, when necessary, to assess and document the condition of major municipal buildings. 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 become ingrained within municipal purchasing practices after five years, and the Town will seek to explore even more energy efficient policies and tracking systems to enable more fuel efficiency.

3. Street and Traffic Lighting

As the Town expects to have all streetlights retrofitted with LED bulbs within the five-year period, the Town will next look to include wireless controls that can dim lights to drive further savings.

4. Perpetuating Energy Efficiency

An annual municipal audit by Town and School staff can tap into the knowledge of the employees who use and maintain Hingham's facilities 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 Hingham will grow its capacity to retrofit and build more efficient facilities, purchase more fuel efficient vehicles, and illuminate the Town through more efficient lighting throughout the five-year period. These

practices will provide opportunities to instill the energy saving ethos into additional policies and programs for more dedicated long-term funding streams and strategies.

V. Appendix A : Municipal Energy Consumption for FY 2018 - MMBTUs and Native Units

Table 3a. Baseline in MMBTUs:

		2018					
		Diesel	Electric	Gas	Gasoline	Oil	Total
Null	Null		1,356				1,356
	Boat Fuel				194		194
	Streetlights		1,921				1,921
	Total		3,277		194		3,472
Building	Hingham Middle School		4,976	5,787			10,762
	Hingham High School		5,875	14,739			20,614
	Plymouth River Elementary S..		3,816				3,816
	South Elementary School		1,903	4,305			6,208
	Foster Elementary School		1,262	285		3,756	5,302
	Hingham DPW HQ		380	698			1,078
	Hingham Transfer Station		262				262
	Bldg #179 - 28 Bare Cove Par..		25			942	967
	Old DPW Barn - 101 Hersey S..		34	0			34
	Hingham Town Hall		4,855	2,818			7,673
	Old HMLP Plant (308 Cushing..		403				403
	Memorial Bell Tower		14				14
	South Fire Station		119			299	417
	North Fire Station		122			523	645
	Central Fire Station		509			1,374	1,883
	South Shore Country Club		1,693	2,957			4,650
	East School		2,709				2,709
	GAR Hall		61	343			404
	School Depot - 19 Fort Hill Str..		182			42	224
	Bldg #12 - 33 Bare Cove Road					485	485
	Old Tree and Park Barn					110	110
	Hingham Public Library		1,701	2,016			3,717
	Harbormaster Shed		13				13
	Recreation Barn		47	122			169
	New HMLP Plant			943			943
	Total		30,962	35,011		7,530	73,503

		2018					Total
		Diesel	Electric	Gas	Gasoline	Oil	
Open Space	Haley Field Scoreboard		2				2
	0 Otis Street Band Stand		0				0
	Bathing Beach		1				1
	Ward Street Field Scoreboard		4				4
	Total		7				7
Street/Traffic Lights	William Terry Drive Traffic Lig..		5				5
	175 Derby Street Traffic Lights		6				6
	0 Hersey at South Street Traffi..		11				11
	0 High Free at Main Street Lig..		5				5
	3 Summer Street Traffic Lights		9				9
	Cushing Street Blinking Light		2				2
	0 West Street Traffic Lights		7				7
	School light at 847 Main Street		4				4
	School light at 1099 Main Stre..		0				0
	Total		49				49
Vehicle	Vehicles	10,495			12,064		22,558
	Total	10,495			12,064		22,558
Water/Sewer	Sewer Pumping Station - Bay..		5				5
	Sewer Pumping Station - Bel ..		64				64
	Sewer Pumping Station - Brad..		50				50
	Sewer Pumping Station - Broa..		546				546
	Sewer Pumping Station - Gre..		165				165
	Sewer Pumping Station - 106 ..		125	2			127
	Sewer Pumping Station - 62 H..		91				91
	Sewer Pumping Station - Linc..		19				19
	Sewer Pumping Station - Mill ..		53				53
	Sewer Pumping Station - 340..		81	4			85
	Sewer Pumping Station - Sout..		138				138
	Sewer Pumping Station - 176 ..		59				59
	Total		1,395	7			1,402
Grand Total		10,495	35,690	35,018	12,258	7,530	100,990

Table 3b. Baseline in Native Units

		Electric (kWh)	Gas (therms)	2018 Oil (gallons)	Gasoline (gallons)	Diesel (gallons)
Null	Null	397,478				
	Boat Fuel				1,566	
	Streetlights	563,073				
	Total	960,551			1,566	
Building	Hingham Middle School	1,458,256	57,868			
	Hingham High School	1,721,840	147,390			
	Plymouth River Elementary S..	1,118,280				
	South Elementary School	557,880	43,050			
	Foster Elementary School	369,760	2,847	27,018		
	Hingham DPW HQ	111,514	6,979			
	Hingham Transfer Station	76,655				
	Bldg #179 - 28 Bare Cove Par..	7,254		6,780		
	Old DPW Barn - 101 Hersey S..	10,031	0			
	Hingham Town Hall	1,422,880	28,177			
	Old HMLP Plant (308 Cushing..	118,143				
	Memorial Bell Tower	4,118				
	South Fire Station	34,844		2,148		
	North Fire Station	35,857		3,760		
	Central Fire Station	149,320		9,884		
	South Shore Country Club	496,262	29,566			
	East School	794,080				
	GAR Hall	17,886	3,425			
	School Depot - 19 Fort Hill Str..	53,393		301		
	Bldg #12 - 33 Bare Cove Road			3,491		
	Old Tree and Park Barn			790		
	Hingham Public Library	498,653	20,157			
	Harbormaster Shed	3,756				
	Recreation Barn	13,726	1,222			
	New HMLP Plant		9,427			
	Total	9,074,388	350,108	54,172		

		Electric (kWh)	Gas (therms)	2018 Oil (gallons)	Gasoline (gallons)	Diesel (gallons)
Open Space	Haley Field Scoreboard	627				
	0 Otis Street Band Stand	126				
	Bathing Beach	147				
	Ward Street Field Scoreboard	1,187				
	Total	2,087				
Street/Traffic Lights	William Terry Drive Traffic Lig..	1,411				
	175 Derby Street Traffic Lights	1,760				
	0 Hersey at South Street Traffi..	3,287				
	0 High Free at Main Street Lig..	1,406				
	3 Summer Street Traffic Lights	2,639				
	Cushing Street Blinking Light	678				
	0 West Street Traffic Lights	2,000				
	School light at 847 Main Street	1,142				
	School light at 1099 Main Stre..	6				
	Total	14,329				
Vehicle	Vehicles				97,287	75,501
	Total				97,287	75,501
Water/Sewer	Sewer Pumping Station - Bay..	1,368				
	Sewer Pumping Station - Bel ..	18,719				
	Sewer Pumping Station - Brad..	14,583				
	Sewer Pumping Station - Broa..	160,025				
	Sewer Pumping Station - Gre..	48,400				
	Sewer Pumping Station - 106 ..	36,498	24			
	Sewer Pumping Station - 62 H..	26,644				
	Sewer Pumping Station - Linc..	5,598				
	Sewer Pumping Station - Mill ..	15,574				
	Sewer Pumping Station - 340..	23,724	43			
	Sewer Pumping Station - Sout..	40,493				
	Sewer Pumping Station - 176 ..	17,301				
	Total	408,927	67			
Grand Total		10,460,282	350,175	54,172	98,853	75,501

VI. Appendix B: Building & Water/Sewer Energy Audits - Energy Source

Please see attached document.

VIII. Appendix C: Streetlight Calculations - MAPC

The Town of Hingham has already taken the initiative to complete a survey of all cobrahead streetlights in town, procure a vendor, and replace the streetlights with energy efficient LEDs. The installation of these new lights occurred between September 2017 and May 2018. We expect some of the savings from the LED streetlight conversion to be reflected in usage data for FY 2019. By comparing FY 2017 and FY 2018 streetlight usage, we can estimate that this measure will save the town of Hingham 2,044 MMBTU's in FY 2019, or 2% of the baseline usage.

Street Light Savings Calculation		
Street Light Use	Street Light Use Electricity (kWh)	Street Light Use (MMBTU)
FY 2017	1,162,356.0	3,966.0
FY 2018	563,073.3	1,921.2
Estimated Savings for FY 2019		2,044.8

IX. Appendix D: Vehicle Calculations - MAPC

Table 5: Policies that Affect Fleet Gasoline and Diesel Usage

Anti-Idling Policy**		
All FY 2018 Gasoline Usage (Gallons)	97,287	
All FY 2018 Diesel Usage (Gallons)	75,501	
Percent Savings	10%	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.*
Gallons Gasoline Saved per Year	9,729	
Gallons Diesel Saved per Year	7,550	
MMBTUs Saved per Year	2,210	
Closely Monitor Tire Air Pressure and Use Fuel Efficient Tires		
All FY 2018 Gasoline Usage (Gallons)	97,287	
All FY 2018 Diesel Usage (Gallons)	75,501	
Percent Savings	4%	Maintaining appropriate air pressure in vehicle tires can decrease that vehicle’s fuel consumption by as much as 4%.*
Gallons Gasoline Saved per Year	3,891	
Gallons Diesel Saved per Year	3,020	
MMBTUs Saved per Year	884	
Use 100% Synthetic Oil		
All FY 2018 Gasoline Usage (Gallons)	97,287	
All FY 2018 Diesel Usage (Gallons)	75,501	
Percent Savings	2%	The use of 100% synthetic oils reduces fuel consumption, the number of annual oil change, and labor costs.*
Gallons Gasoline Saved per Year	1,946	

Gallons Diesel Saved per Year	1,510	
MMBTUs Saved per Year	442	
Total MMBTUs	3,536	
* http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf		

Anti-Idling Technology in Police Cruisers

Systems such as the Havis IdleRight or StealthPower Idle Reduction system can be used to reduce fuel usage in police and other emergency response vehicles without compromising functionality. The systems can be used to run flashing lights and, in some cases, all electronics for the vehicles without the use of the engine. The systems also monitor the battery levels and will turn the engine on if and when needed.

Calculations have not been done at this time; however, some sample pricing is shown below. Paybacks are expected to be very short, given the high amount of usage and idle time seen in typical police vehicles.

Example of StealthPower Material & Installation Costs	
Basic (No HVAC running)	
Install	\$ 750.00
Unit - 1 battery system	\$ 4,999.00
Total	\$ 5,749.00
HVAC Running	
Install	\$ 1,200.00
Unit - 2 battery system	\$ 6,995.00
Separate HVA	\$ 3,000.00
Total	\$ 11,195.00
Pricing for 1-3 systems. Prices quoted by Bill Needles, Sales Director, StealthPower, October 2017	

X. Appendix E: Behavior-Based Energy Savings - MAPC

Building Operator Certification

The Building Operator Certification (BOC) program teaches facilities personnel to understand these systems and bring them collectively to peak efficiency. BOC suggests that based on evaluated programs, the certification will have an average savings of:

- 100,500 kWh per year
- 1,400 therms per year

This translates to **1837.57 MMBTUs** per year (See Table 1 for details).

TABLE 1. Summary of BOC Energy Saving Evaluation Results from 2000 – 2015**

RESULTS ACROSS ALL EVALUATION REPORTS	kWh	kW	Therms
Average Annual Savings Per Credentialed Operator	100,500	14.5	1,400
	Range 28,600 – 181,000	Range 9 – 37	Range 36 – 3,104
Average Savings Per Square Foot	0.30	*	–
	Range 0.02 – .50	Range –	Range –
Average % Energy Savings Per Credentialed Operator	2.5%	–	–

Excerpt from Building Operator Certification Program FAQ, available at <http://www.theboc.info/why-boc/energy-savings-evaluation-reports/>

The certification exam costs \$285 and the required preparatory course costs about \$1,695.

School Behavior-Based Savings Program

A School Behavior-Based Energy Use Reduction Program will allow Hingham to not only better understand the inefficiencies in its school building operations, but will also help the Town implement programs that will work synergistically with 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 of the behavior-based initiatives.

More information can be found in the Powering Down report the U.S. 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 the end of the day on Fridays. 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 it is highly recommended for the first year of implementation. Based on MAPC’s program with the four schools, MAPC would recommend budgeting a one-time investment of

\$15,000 to \$20,000 for a consultant. Also, each school would want to set aside about \$500 to \$1,000 per year to pay for materials the students may need to implement their behavioral awareness programs. While this may appear to be a lot of money, Table A shows that the costs could be fully recouped within a single year.

For Hingham, MAPC assumed a conservative 5% savings per year for electricity in its schools.

Table A. Behavior-Based Energy Reduction Programs					
School	MMBTU Electricity FY 2018	Reduction from Program	MMBTU Saved Electricity (Annual)	kWh Saved Electricity (Annual)	Cost Savings Electricity (Annual) *Assumes \$00.15/kWh
Hingham High School	5,875	5%	293.75	86,093	\$12,914
Hingham Middle School	4,976		248.8	72,919	\$10,938
Plymouth River Elementary School	2,709		135.45	39,698	\$5,955
East School	2,709		135.45	39,698	\$5,955
South Elementary School	1,903		95.15	27,887	\$4,183
Foster Elementary School	1,262		63.1	18,494	\$2,774
Total	19,434		971.7	284,789	\$42,718

XII. Appendix F: MMBTU Conversion Chart - DOER

MMBTU Conversion Chart²

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 MMBTU³
- 1 gallon of B10 biodiesel = 0.137 MMBTU⁷
- 1 gallon of B5 biodiesel = 0.138 MMBTU⁷
- 1 barrel of residual fuel oil = 6.287 MMBTU

² If a conversion factor for a fuel you use is not provided, please contact DOER.

³ Calculated Values from those of diesel and B100 biodiesel