

The Town of Burlington Energy Reduction Plan

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



In fulfillment of the
Massachusetts Green Communities Grant Program Criterion 3

October 2019

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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 Town Administrator Paul Sagarino, DPW Director John Sanchez, Facilities Superintendent Frank Anderson, Central Maintenance Superintendent Tommy Lee, Director of Operations for Public Schools Robert Cunha, Operations Analyst Rachel Caplan, and of the MA Department of Energy Resources' Green Communities Regional Coordinator Neal Duffy were vital to produce this plan.

Much of the information in this plan was derived from energy audits performed by Rise Engineering. 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 Burlington is a Middlesex County community situated on the watersheds of the Ipswich, Mystic, and Shawsheen rivers. Burlington was settled by English in 1641, and incorporated in 1799. The town’s industry was historically agricultural. With an area of 11.9 square miles, Burlington has a population of 24,498 according to the 2010 Census. The Town is governed by a Selectmen-Administrator plan with a Representative Town meeting. Burlington’s school district includes a High School, Middle School, and four Elementary Schools.

B. Summary of Municipal Energy Uses

- Total Number of Municipal Buildings: 24

See Appendix A for a list of all buildings. The largest users are the High School, Marshall Simonds Middle School, and Francis Wyman Elementary School, respectively.

- Open Space: 11

The Pine Haven and Chestnut Hill Cemeteries, the Concession Stand at Simonds Park, the Players Garage, and seven park light accounts comprise this category.

- Total Number of Municipal Vehicles: 108

22 of these vehicles are subject to Burlington’s Fuel Efficient Vehicle Policy, and the current average miles per gallon for these is 21.32 mpg, with the highest 30 mpg and the lowest 15 mpg.

- Total Number of Street Lights and Traffic Lights: 2,543 cobrahead streetlights; 35 traffic lights; 93 Decorative Lights.

- Water and Sewer: 14 sewer pumping stations and 4 drinking water pumping stations

Table 1: Municipal Energy Use Summary

	Number
Buildings	
Oil Heat	0
Natural Gas Heat	22
Propane Heat	0
Biomass Heat	0
Other Heat Type	0
Electric or No heat	2
Open Space	
Properties	4
Park Lights	7
Vehicles	
Gasoline or Diesel	108
Hybrid	0
Electric	0
Street Lights	
Cobraheads	2,543
Decoratives	93
Traffic Lights	35
Water and Sewer	
Drinking Water Treatment Plant	2
Drinking Water Pumping Station	4
Wastewater Treatment Plant	0
Wastewater Lift Station (Pumping Station)	14

C. Summary of Energy Use Baseline and Plans for Reduction

This Energy Reduction Plan commits Burlington to reduce energy use in municipal facilities by at least 20% compared to Fiscal Year 2019 over five years. In the baseline year, the town used 103,111 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 Mass Energy Insight tool is currently being modified to perform weather normalization, and such data will be available in future years. Currently, all data in this ERP is non-weather normalized unless indicated otherwise.

Burlington’s 20% energy reduction goal will be measured against the non-weather normalized baseline of 103,111 MMBTUs. This means the town must reduce usage by at least 20,622 MMBTUs.

As shown in **Figure 1**, buildings made up the vast majority (66%) of the usage by facility type (i.e. building, street/traffic light, open space, vehicles and water/sewer).

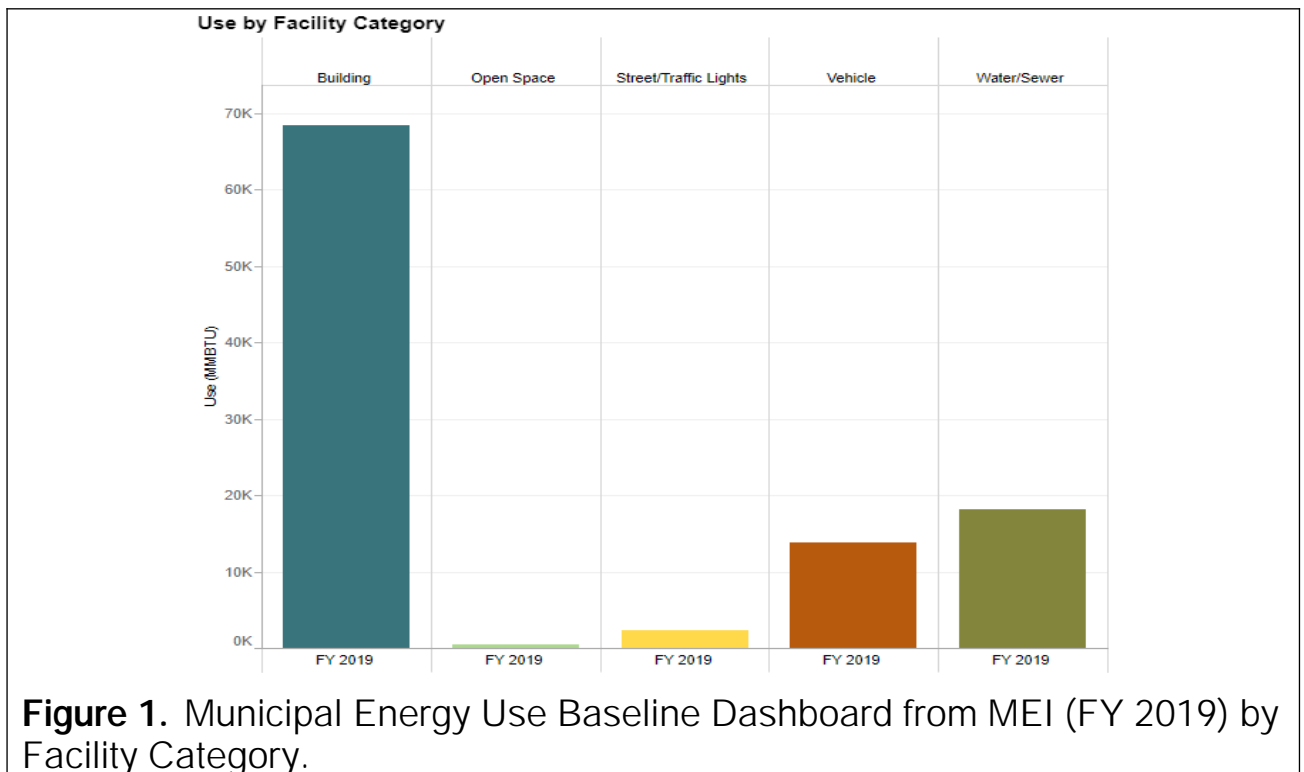


Figure 1. Municipal Energy Use Baseline Dashboard from MEI (FY 2019) by Facility Category.

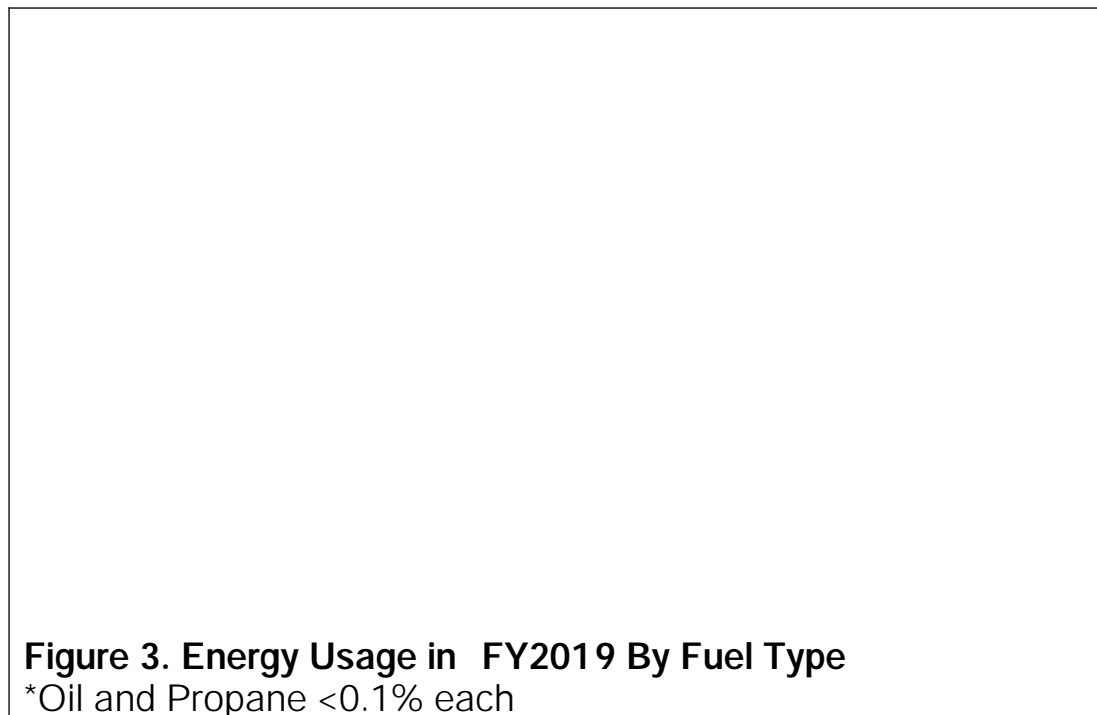
¹ From Mass Energy Insight, *Energy Reduction Plan Guidance Table 3 (MMBTU)* tab, for FY 2019

Burlington has identified energy savings measures in each facility category to reduce energy use 20% based on the total **non-weather normalized** usage, as illustrated in **Table 2 a**.

Table 2 a: 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				
Buildings	68,411	66.35%	21,499	20.85%
Open Space	389	0.38%	113	0.11%
Street/Traffic Lights	2,310	2.24%	0	0.00%
Vehicles	13,783	13.37%	3,291	3.19%
Water/Sewer/Pumping	18,217	17.67%	375	0.36%
Total Non-Weather Normalized	103,111	100%	25,278	24.52%

III. Energy Use Baseline Inventory

- A. Identification of the Inventory Tool Used** - The Town of Burlington 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 and electricity. Oil, gasoline, diesel, and propane must be entered manually. Energy use is measured in British thermal units (MMBTUs), which allow all fuel types (e.g. electricity, natural gas, diesel, etc.) to be converted to a common unit.
- B. Identification of the Baseline Year** - Fiscal Year (FY) 2019 will serve as the baseline year. FY 2019 ran from July 1, 2018 to June 30, 2019. This will give the Town until June 30, 2025 (FY 2020 - FY 2025) to reach its 20% energy reduction goal.
- C. Municipal Energy Consumption for the Baseline Year (FY 2019)** - In the baseline year, the town used 103,111 MMBTUs of energy. As shown in Figure 3, energy use from electricity and natural gas is roughly equal and together they account for 87% of total energy use.



Of the top ten energy users in Burlington, seven are buildings (See Table 3). Of the seven buildings, five schools are represented in the top ten energy users.

Table 2b. Top 10 Energy Users in Burlington		
User	Annual Energy Use (MMBTU)	Annual Energy Use (% of Baseline)
Burlington HS	23,331	22.63%
Marshall Simonds MS	11,642	11.29%
Francis Wyman ES	6,079	5.90%
Pine Glen ES	4,570	4.43%
Memorial ES	3,703	3.59%
Fox Hill ES	3,592	3.48%
61 Center St	2,365	2.29%
Police Station	2,263	2.19%
Library	1,923	1.86%
Town Hall Building	1,412	1.37%

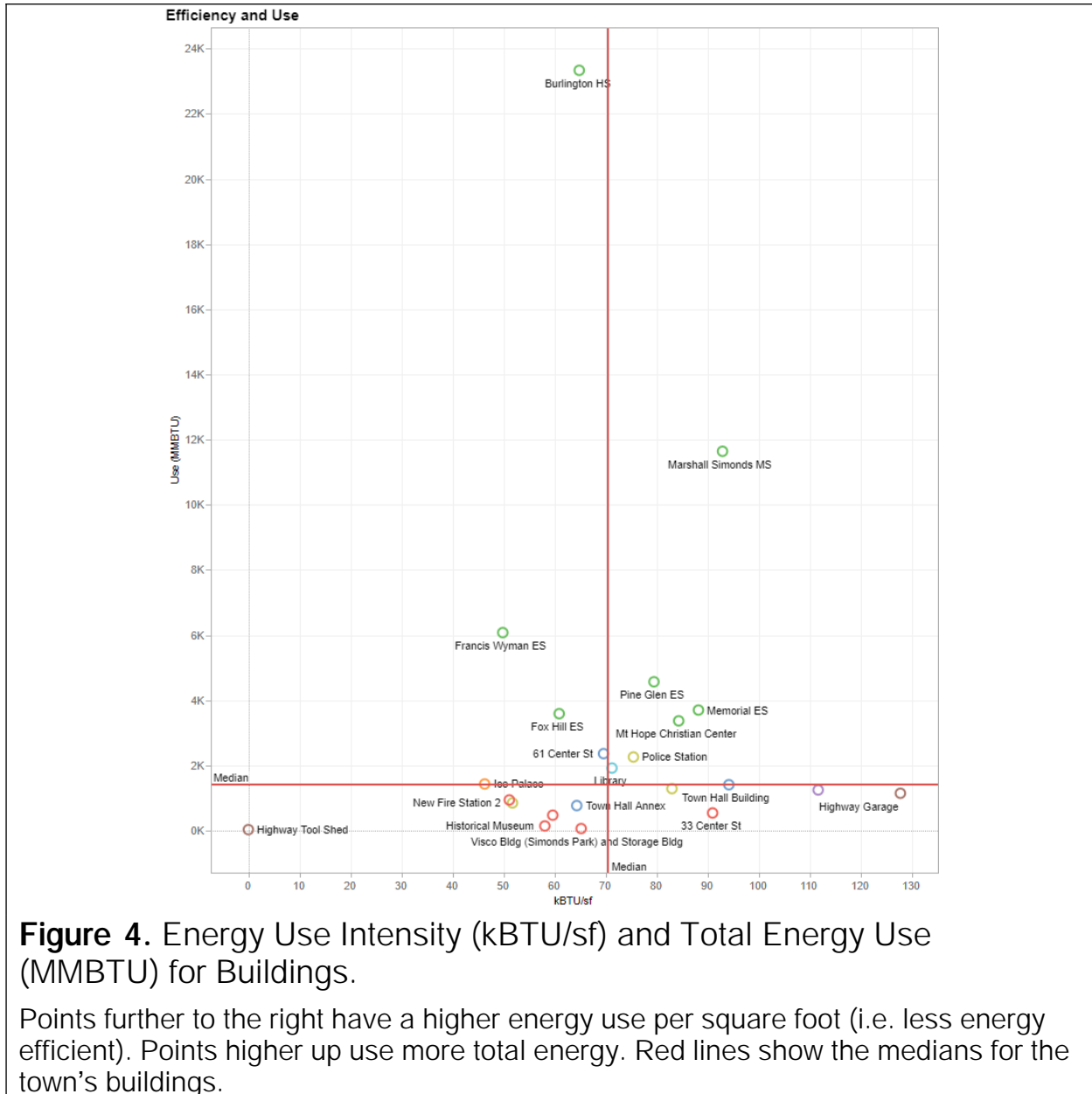
Energy Use Intensity is a measure of the energy used per square foot, with lower EUIs indicating more efficient buildings. Buildings with a higher EUI generally have more opportunities for cost-effective energy efficiency upgrades.

The median EUI of all buildings in Burlington is 70.39 kBtu per square foot². As shown in **Figure 4 (next page)**, the two largest users in town, the High School and Marshall Simonds Middle School, are relatively close to the median with EUIs of 48 and 91 kBtu per square foot respectively. The least efficient buildings are the Highway Garage with a EUI of 127.70 and the Maintenance / Recreation Building with an EUI of 111. Each of these two buildings are quite small and do not have a lot of use associated with them, so the town will see better results from targeting first buildings with high use and then those with high use and low efficiency.

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.

² All square footage data for buildings was taken from Burlington Assessors Office Property Record Card database for Fiscal Year 2019

D. Energy Reduction Goal - Burlington's 20% energy reduction goal will be measured against the non-weather normalized baseline of 103,111 MMTBUs. Burlington will reduce its non-weather normalized energy consumption by at least 20,622 MMTBUs.



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 2019 by 20,622 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 under half of the energy reductions needed to meet the town's 20% reduction goal can likely be found in just five facilities: The High School, Marshall Simonds Middle School, Pine Glen Elementary School, Francis Wyman Elementary School, and Fox Hill Elementary School.

Table 5. Top Energy Reduction Facilities			
Facility	MMBTU Savings	Percent of Energy Reduction Goal	Cumulative Percent of Energy Reduction Goal
Burlington High School	3,359	16.29%	16.29%
Marshall Simonds Middle School	2,270	11.01%	27.29%
Pine Glen Elementary School	1,668	8.09%	35.38%
Francis Wyman Elementary School	1,385	6.72%	42.10%
Fox Hill Elementary School	1,198	5.81%	47.91%

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 (likely \$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. The town will 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:

Audits

- Conduct additional audits in any buildings where measures were not identified in the initial energy audit by RISE. These audits should specifically focus on weatherization measures not previously assessed, such as ceiling insulation at the library.

Retrofit Measures

- In year 1, perform interior lighting retrofits in most buildings. The Town has already implemented interior lighting retrofits in many of the school buildings following a lighting audit from Eversource. The town will implement additional lighting measures identified by Commonwealth Electric this year.
- Also in year 1, implement upgrades at school buildings specifically Burlington High School and Marshall Simonds Middle School. The Town can see the largest impacts from their energy conservation measures by focusing on key buildings and pairing these retrofits with behavioral measures.

In years 2-3, complete upgrades in Pine Glen, Francis Wyman, and Fox Hill Elementary Schools. Together, these five buildings have the most energy savings identified.

- Based on the results of the additional audits, review findings with existing audit information 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.

Behavioral Measures

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

Water & Sewer:

- Audits: Conduct a Water and Sewer audit for all facilities. The pumping station accounts were not captured in the initial audit and since water and sewer makes up a significant portion of Burlington's energy use, this audit will identify energy conservation measures that the town can add to this energy reduction plan.

Streetlights & Open Space Lighting:

- Audits: Arrange for audits of all decorative street lighting and outdoor field lighting to get accurate count and develop plan for retrofitting. An audit of cobrahead streetlights is encouraged to get an accurate count as well - the utility inventory commonly has errors. The audit would allow the Town to plan for additional energy saving measures such as lighting controls and dimmers.

Vehicles:

Retrofit Measures

- Retrofit applicable vans with hybrid conversion technology (e.g. XL Hybrids).
- Replace Police, Buildings, and Fire vehicles identified with electric or hybrid vehicles.
- For any additional replacement vehicle, explore viability of replacing with electric or hybrid electric vehicle. To this end, continue to support electric vehicle infrastructure.

Behavioral Measures

- Ensure compliance to town-wide "Anti Idling" policy for all municipal vehicles and closely monitor vehicle tire air pressure to maintain vehicle fuel efficiency.
 - For this policy to be effective, the town will document and report 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:
 - Installation of EMS systems, lighting retrofits, and other measures in schools are slated to finish early in year 4.
 - EMS retro-commissioning for Town Hall and weatherization measures in the Town Hall, Library, and Human Services Building 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 will schedule audits for water and sewer pumping station uses, then reassess their reduction plan.
- The town will 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 2025

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

- The DPW, 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 DPW, in coordination with the School Facility Manager, will be responsible for the annual reporting requirements to DOER to maintain designation and eligibility for annual competitive grant funding.
- The Central Maintenance team, directed by Tommy Lee of the Department of Public Works, along with the Fire Department Fleet Manager, will implement the anti-idling policy in town vehicles. This team will also conduct vehicle maintenance in accordance with the updated town policies and the Green Communities energy reduction target. Additionally, the Central Maintenance team will advise and help to implement energy efficient vehicle replacements.
- The School Facility Manager, working with the Department of Public Works, will agree to set point and setback schedules for at least the top three largest energy users in town: Burlington High School, Marshall Simonds Middle School and Francis Wyman Elementary School. The desired set points and schedules may differ by season, and will be documented in writing. The DPW Director and School Facilities Manager should then agree to a schedule for updates, at which the School Facilities Manager 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 Burlington's schools.

- The Town Administrator's office should provide an annual update to the Board of Selectmen and School Committee by the end of January following the submission of the Annual Report to DOER. The presentation should include:
 - The trend for town-wide **weather-normalized** energy usage
 - Should show the baseline, current year and any years in between
 - The trend for energy usage in at least the top three energy using buildings - Burlington High School, Marshall Simmonds Middle School, and Francis Wyman Elementary School - which together comprise just under 40% of the town's energy use
 - Should show the baseline, current year and any years in between
 - A summary of the major efficiency measures implemented over the past year
 - An explanation or hypothesis the cause of the trends town-wide and in at least each of the top 3 buildings
 - 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 Rise Engineering in July 2019 and provide 12.5% energy savings. Rise Engineering provided

Level 1 audits in all town buildings. The Rise Engineering Energy audits are included in Appendix B.

- Commonwealth Electric conducted interior lighting audits this fall in several buildings including the town hall, library, Grandview farm, and youth & family services building. Where these interior lighting retrofits will be implemented by Commonwealth Electric, their savings estimates are used.
- Audits of interior lighting in six school buildings were conducted by Eversource in July 2019. The savings that these audits identified make up 2% savings from the baseline year. The lighting measures identified in this audit were implemented this summer and are excluded from the audits by Rise Engineering
- MAPC developed estimates for energy savings through behavior-based energy programs in schools and Building Operator Certification may be found in Appendix F. This provides another 4%
- Vehicle measures including vehicle replacements with electric vehicles and hybrids are available in Appendix D

3. Energy Conservation Measures

Table 4 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, water and sewer, and open space) are subtotaled to arrive at a municipal grand total

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, Burlington 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. In addition to exposing continuing opportunities for energy use reductions, this effort will provide the Town with a clear, long-term asset management strategy for the effective budgeting and maintenance of buildings.

2. Vehicles (including schools)

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

3. Street and Traffic Lighting

As the Town has already retrofitted all streetlights with LED bulbs, the Town will next include wireless controls that can dim to drive further savings.

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

V. Appendix A : Municipal Energy Consumption for FY 2019 - MMBTUs and Native Units

Table 3a. Baseline in MMBTUs:

Building		2019				Total
		Diesel	Electric	Gas	Gasoline	
Building	Fire Headquarters		598	694		1,291
	Police Station		1,040	1,222		2,263
	Burlington HS		9,653	13,678		23,331
	Town Hall Annex		352	420		772
	Francis Wyman ES		1,795	4,284		6,079
	New Fire Station 2		124	730		853
	Memorial ES		1,706	1,996		3,703
	Marshall Simonds MS		4,180	7,462		11,642
	Pine Glen ES		718	3,852		4,570
	Fox Hill ES		1,031	2,560		3,592
	Grandview		165	312		477
	Historical Museum		13	134		146
	Maintenance Bldg/ Players Bl.		165	1,085		1,251
	Highway Garage		185	964		1,149
	Visco Bldg (Simonds Park) an..		67			67
	61 Center St		873	1,492		2,365
	Clark and Reid		277	669		945
	Highway Tool Shed		34			34
	33 Center St		145	401		546
	Library		903	1,020		1,923
Town Hall Building		804	608		1,412	
	Total		24,827	43,583		68,411
Open Space	Pine Haven Cemetery		28	129		157
	Chestnut Hill Cemetery		17	192		209
	Concession Stand (Simonds ..		23			23
	Total		68	321		389
Street/Traffic Lights	Street Lights		1,812			1,812
	Traffic Lights		265			265
	Park Lights		233			233
	Total		2,310			2,310
Vehicle	Vehicle Usage	2,098			3,566	5,664
	Town Hall Vehicle Fleet	2,026			6,093	8,120
	Total	4,124			9,660	13,783

Table 3a. Baseline in MMBTUs Continued :

Water/Sewer	Mill Pond Water Treatment Fa..	5,207	899		6,106	
	Vine Brook Treatment Plant	3,202	1,418		4,620	
	Terrace Hall Station	2,268			2,268	
	Bedford Street Station	73			73	
	Francis Wyman Road Station	222			222	
	Douglas Ave Station	124	8		131	
	Wilmington Road Station	340			340	
	Brookside Lane Station	95	7		102	
	Westwood Street Station	78	5		83	
	Lucaya Circle Station	343			343	
	Townline Road Station	23	0		23	
	Grandview Ave Station	360			360	
	Keans Road Station	44			44	
	Lexington Street Station	20			20	
	Partridge Lane Station	37			37	
	Belmont Road Station	62			62	
	Main Office Water	203	280		483	
	Terrace Hall Pump Station	836	1		836	
	Sewer Metering Station	2			2	
	Lexington PWS Facility	643			643	
	Billerica Division Station	1,419			1,419	
	Total	15,600	2,617		18,217	
Grand Total		4,124	42,806	46,522	9,660	103,111

Table 3b. Baseline in Native Units

		2019			
		Electric (kWh)	Gas (therms)	Gasoline (gallons)	Diesel (gallons)
+					
Building	Fire Headquarters	175,200	6,935		
	Police Station	304,872	12,223		
	Burlington HS	2,829,164	136,783		
	Town Hall Annex	103,080	4,201		
	Francis Wyman ES	526,080	42,842		
	New Fire Station 2	36,280	7,297		
	Memorial ES	500,088	19,962		
	Marshall Simonds MS	1,225,220	74,616		
	Pine Glen ES	210,389	38,524		
	Fox Hill ES	302,280	25,604		
	Grandview	48,400	3,118		
	Historical Museum	3,733	1,336		
	Maintenance Bldg/ Players Bl..	48,500	10,853		
	Highway Garage	54,286	9,641		
	Visco Bldg (Simonds Park) an..	19,600			
	61 Center St	255,774	14,924		
	Clark and Reid	81,066	6,689		
	Highway Tool Shed	9,907			
	33 Center St	42,400	4,009		
	Library	264,576	10,199		
	Town Hall Building	235,600	6,078		
	Total	7,276,495	435,834		
Open Space	Pine Haven Cemetery	8,155	1,291		
	Chestnut Hill Cemetery	4,978	1,921		
	Concession Stand (Simonds ..	6,812			
	Total	19,945	3,212		
Street/Traffic Lights	Street Lights	531,052			
	Traffic Lights	77,776			
	Park Lights	68,314			
	Total	677,142			
Vehicle	Vehicle Usage			28,760	15,090
	Town Hall Vehicle Fleet			49,141	14,577
	Total			77,901	29,667

Table 3b. Baseline in Native Units Continued:

Water/Sewer	Mill Pond Water Treatment Fa..	1,526,020	8,990		
	Vine Brook Treatment Plant	938,455	14,179		
	Terrace Hall Station	664,620			
	Bedford Street Station	21,259			
	Francis Wyman Road Station	64,956			
	Douglas Ave Station	36,267	76		
	Wilmington Road Station	99,764			
	Brookside Lane Station	27,793	71		
	Westwood Street Station	22,995	48		
	Lucaya Circle Station	100,653			
	Townline Road Station	6,787	2		
	Grandview Ave Station	105,622			
	Keans Road Station	12,991			
	Lexington Street Station	5,751			
	Partridge Lane Station	10,773			
	Belmont Road Station	18,025			
	Main Office Water	59,597	2,799		
	Terrace Hall Pump Station	244,960	6		
	Sewer Metering Station	490			
	Lexington PWS Facility	188,480			
	Billerica Division Station	415,800			
	Total	4,572,058	26,171		
Grand Total		12,545,640	465,217	77,901	29,667

VI. Appendix D: Vehicle Calculations - MAPC

Table 5: Policies that Affect Fleet Gas and Diesel Usage

Anti-Idling Policy**		
All FY 2019 Gasoline Usage (Gallons)	77,901	
All FY 2019 Diesel Usage (Gallons)	29,667	
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	7,790	
Gallons Diesel Saved per Year	2,967	
MMBTUs Saved per Year	1,346	
Closely Monitor Tire Air Pressure and Use Fuel Efficient Tires		
All FY 2019 Gasoline Usage (Gallons)	77,901	
All FY 2019 Diesel Usage (Gallons)	29,667	
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	3,116	
Gallons Diesel Saved per Year	1,187	
MMBTUs Saved per Year	539	
Use 100% Synthetic Oil		
All FY 2019 Gasoline Usage (Gallons)	77,901	
All FY 2019 Diesel Usage (Gallons)	29,667	

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	1,558	
Gallons Diesel Saved per Year	593	
MMBTUs Saved per Year	269	
Total MMBTUs	2,154	
* http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf		

Table 6. Vehicle Replacements

Make/Model	Vehicle Function	Model Year	Replacement Vehicle	Current MPG	Replacement MPG	Vehicle Class	Average Annual VMT by vehicle class*	Annual Gasoline Savings (gal)	Annual MMBTU Savings	Annual \$ Savings
FORD ESCAPE	BUILDINGS	2012	2018 Ford Focus	23	107	Light Truck	11,712	400	48	\$ 1,024
FORD ESCAPE	BUILDINGS	2010	2018 Ford Focus	28	107	Light Truck	11,712	309	37	\$ 791
FORD ESCAPE	BUILDINGS	2010	2018 Ford Focus	28	107	Light Truck	11,712	309	37	\$ 791
FORD ESCAPE	FIRE	2009	2018 Ford Focus	21	107	Light Truck	11,712	448	54	\$ 1,148
FORD EXPLORER	FIRE	2015	2018 Ford Focus	20	107	Light Truck	11,712	476	57	\$ 1,219
FORD EXPLORER	FIRE	2017	2018 Ford Focus	20	107	Light Truck	11,712	476	57	\$ 1,219
CHEVROLET CAPRICE	POLICE	2011	2019 Chevrolet Bolt EV	21	119	Car	11,244	441	53	\$ 1,129
CHEVROLET CAPRICE	POLICE	2011	2019 Chevrolet Bolt EV	21	119	Car	11,244	441	53	\$ 1,129
CHEVROLET RANGER	POLICE	2013	Ford Police Responder Hybrid Sedan	21	38	Light Truck	11,712	250	30	\$ 639
CHEVROLET TRAVERSE	POLICE	2017	Ford Police Responder Hybrid Sedan	18	38	Light Truck	11,712	342	41	\$ 877
FORD CROWN VICTORIA	POLICE	2007	2019 Chevrolet Bolt EV	18	119	Car	11,244	530	64	\$ 1,358
FORD CROWN VICTORIA	POLICE	2008	2019 Chevrolet Bolt EV	19	119	Car	11,244	497	60	\$ 1,274
FORD CROWN VICTORIA	POLICE	2008	2019 Chevrolet Bolt EV	19	119	Car	11,244	497	60	\$ 1,274
FORD CROWN VICTORIA	POLICE	2009	2019 Chevrolet Bolt EV	19	119	Car	11,244	497	60	\$ 1,274
FORD CROWN VICTORIA	POLICE	2009	2020 Chevrolet Bolt EV	19	119	Car	11,244	497	60	\$ 1,274
FORD EXPEDITION	POLICE	2011	Ford Police Responder Hybrid Sedan	16	38	Light Truck	11,712	424	51	\$ 1,085
FORD EXPLORER	POLICE	2014	Ford Police Responder Hybrid Sedan	20	38	Light Truck	11,712	277	33	\$ 710
FORD EXPLORER	POLICE	2015	Ford Police Responder Hybrid Sedan	20	38	Light Truck	11,712	277	33	\$ 710
FORD EXPLORER	POLICE	2015	Ford Police Responder Hybrid Sedan	20	38	Light Truck	11,712	277	33	\$ 710
FORD TAURUS	POLICE	2008	2019 Chevrolet Bolt EV	20	119	Car	11,244	468	56	\$ 1,198
FORD TAURUS	POLICE	2011	2020 Chevrolet Bolt EV	20	119	Car	11,244	468	56	\$ 1,198
FORD TAURUS	POLICE	2013	2021 Chevrolet Bolt EV	20	119	Car	11,244	468	56	\$ 1,198
TOTAL								9,070	1,093	\$ 23,229

3

³ Sources: Alternative Fuels Data Center: <https://afdc.energy.gov/data/10309>; Fuel Economy: <http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=38428>; Ford Police Responder: <https://www.ford.com/police-vehicles/hybrid-police-responder/>; MA Average Gasoline Price: <https://gasprices.aaa.com/>

VII. 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 **683 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 Burlington 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 **a one-time investment of \$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. 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 Burlington, MAPC assumed a conservative 5% savings per year for electricity in its schools.

Table A. Behavior-Based Energy Reduction Programs					
School	MMBTU Electricity FY 2019	Reduction from Program	MMBTU Saved Electricity (Annual)	kWh Saved Electricity (Annual)	Cost Savings Electricity (Annual) *Assumes \$00.15/kWh
Burlington High School	23,331	5%	1166.55	341,896	\$51,284
Marshall Simonds Middle School	11,642		582.1	170,604	\$25,591
Francis Wyman Elementary School	6,079		303.95	89,083	\$13,362
Pine Glen Elementary School	4,570		228.5	66,970	\$10,045
Fox Hill Elementary School	3,591		179.55	52,623	\$7,893
Memorial Elementary School	1,709		85.45	25,044	\$3,757
Total	50,922			2,546.1	746,219

VIII. Retrocommissioning Measures in Schools

The energy audit from RISE engineering identified opportunities for retrocommissioning in the Town Hall, Town Hall Annex, and Fire Headquarters. Through these retrocommissions the town expects to identify and implement further efficiencies in the operation of building systems such as lighting, domestic hot water, air handling, heating and cooling.

In addition to the three facilities above, many of Burlington's school buildings make compelling cases for retrocommissioning. These buildings represent some of the largest energy users of town buildings, they have been in operation for long enough that new technologies and controls may be available, and each facility experiences consistent use and high occupancy throughout most of the year.

Using the methodologies outlined in the Energy Star Building Upgrade Manual Chapter on Retrocommissioning⁴, the town will conduct a procurement to find a project partner to complete the retrocommissioning in the six schools identified. This procurement will follow the guidelines included in "Advanced Retrocommissioning Workbook: A Guide for Building Owners"⁵.

In a study conducted by Lawrence Berkeley National Laboratory (LBNL), Portland Energy Conservation Inc., and the Energy Systems Laboratory at Texas A&M University the median building commissioned cost \$0.27 per square foot, demonstrated energy savings of 15% with a simple payback period of 0.7 years⁶. In the table below, we have used a more conservative estimate of 7.5% savings to show the energy savings expected from this measure in the six schools identified.

The total energy savings from this measure in the six schools would be **3,969 MMBTUs**.

⁴ Energy Star. Building Upgrade Manual. 2007.

https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH1_Intro.pdf

⁵ Portland Energy Conservation Inc. Advanced Retrocommissioning Workbook: A Guide for Building Owners.

⁶ Energy Star. Building Upgrade Manual. 2007.

https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH1_Intro.pdf Retrocommissioning Page

Table B Retrocommissioning Measures in School Buildings					
Building	kWh Electricity FY 2019	Therms Gas FY 2019	Energy Savings	kWh Saved Electricity	Therms Gas Saved
Memorial Elementary School	500,088	19,962	7.5%	37,507	1,497
Pine Glen Elementary School	210,389	38,524		15,779	2,889
Francis Wyman Elementary School	526,080	42,842		39,456	3,213
Fox Hill Elementary School	302,280	25,604		22,671	1,920
Marshall Simonds Elementary School	1,225,220	74,616		91,892	5,596
Burlington High School	2,829,164	136,783		212,187	10,259
Total	5,593,221	338,331		419,492	25,375

IX. Appendix F: MMBTU Conversion Chart - DOER

MMBTU Conversion Chart⁷

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 MMBTU⁸
- 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

⁷ If a conversion factor for a fuel you use is not provided, please contact DOER.

⁸ Calculated Values from those of diesel and B100 biodiesel