
The City of Somerville: Community Energy Profile

2016



Prepared by the Metropolitan Area Planning Council (MAPC)

for

The City of Somerville



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Executive Summary

In the wake of rising energy costs and increased frequency and severity of extreme weather, local governments in Massachusetts are beginning to understand the benefits of analyzing their energy consumption and identifying effective reduction measures.

The City of Somerville has taken significant steps over the past few years to advance energy efficiency, both in its internal municipal operations as well as for the community as a whole. Some of these steps include being designated by the state as a Green Community, retrofitting streetlights with energy-efficient LEDs, and developing a robust residential energy efficiency program. The City is keen to learn about the impact of its efforts so far and plan its next steps accordingly.

Somerville received technical assistance from the Metropolitan Area Planning Council (MAPC) to develop a Community Energy Profile. This document is designed to provide city officials with a clear understanding of Somerville's energy use along with regional context for municipal energy consumption. A detailed data and analysis of energy consumption across the municipal, residential, and commercial and industrial (C&I) sectors in the Somerville is provided. Additionally, the document also includes a regional comparison of municipal energy consumption with the neighboring cities of Cambridge and Medford.

The residential and C&I sectors in Somerville together account for 97% of the community's overall energy consumption. While residential electric consumption has experienced a downward trend between 2010 and 2014 – a result of effective energy efficiency programming – residential gas consumption has increased. Both electricity and gas use in the C&I sector experienced an increase over the same timeframe. It is critical that the City engage and collaborate with their residents and businesses to increase the adoption of energy efficiency and renewable energy for these two sectors. As far as the municipal sector is concerned, Somerville exhibits a much higher reliance on fuel oil when compared with Cambridge and Medford. Additionally, Somerville's municipal facilities have a significantly higher average energy use intensity compared to their counterparts in Cambridge and Medford. Addressing these issues will have a substantial impact on reducing the city's municipal energy consumption and carbon emissions.

The information and analysis presented in this Community Energy Baseline document is intended to give Somerville a more nuanced and granular understanding of energy consumption in the community, with preliminary recommendations on measures to investigate. MAPC is currently working with Somerville to develop a more robust strategy guide that will contain information to help prioritize the implementation of energy efficiency and renewable energy projects with the highest impact.

Somerville Energy Profile

INTRODUCTION

The Somerville Community Energy Baseline provides a snapshot of the city’s energy consumption trends across the municipal, residential, and commercial sectors. Due to concerns over increasing energy costs, municipal fiscal responsibilities, and environmental consequences due to climate change, communities across the country are pursuing cost-effective and innovative ways to reduce energy consumption and invest in cleaner energy sources. The baseline also provides a snapshot of the efforts that Somerville has engaged in so far to establish energy goals and implement energy initiatives and projects.

Somerville Energy Use At-A-Glance

Community Overview	
Electric Provider	Eversource
Natural Gas Provider	Eversource & National Grid
Population	78,804
Area	4.2 sq. miles
Density	19,220/sq. mile
Somerville’s 2014 Energy Profile	
Sector	Energy Consumption (MMBtus)
Municipal	159 thousand
Residential	2.5 million
Commercial & Industrial	2.2 million
Total	4.9 million

Source: MEI, Eversource, National Grid.

Figure 1: A snapshot of the City of Somerville’s energy usage.

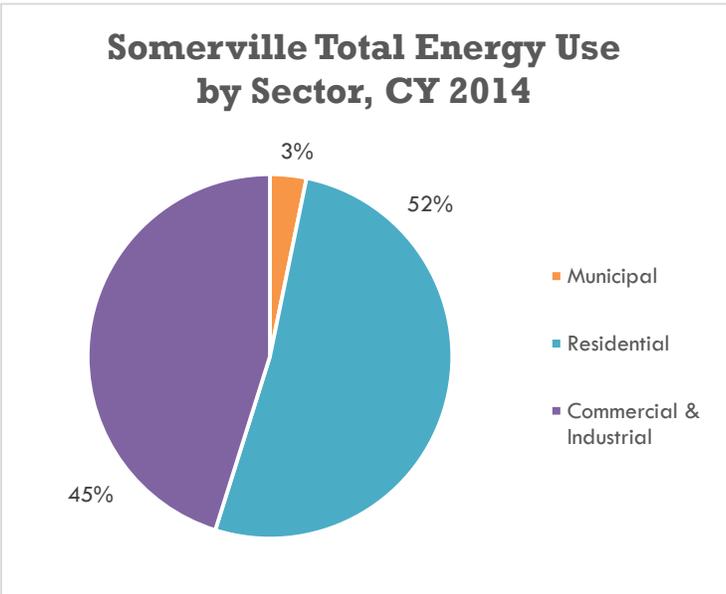


Figure 2: Somerville’s energy use by sector.

The City of Somerville is home to around 80,000 residents. These residents occupy over two-thirds of the city’s land area of 4.2 square miles, while commercial, industrial, and municipal uses account for the remainder. The city is served by Eversource for all its electricity needs, while both Eversource and National Grid are responsible for providing natural gas service. An analysis of Somerville’s 2014 energy use by sector (Figure 1) shows the residential (52%) and C&I (45%) sectors to be the two highest consumers of energy.

The city consumes almost 5 million MMBTUs of energy¹ on an annual basis, which amounts to over 761 million pounds of greenhouse gas emissions. Additionally, 53% of the emissions are caused from natural gas use, while electricity use accounts for 46%. Despite natural gas being a cleaner fuel source, its contribution to higher carbon emissions is primarily because Somerville consumed around 3.4 million MMBTUs of natural gas compared to just 1.4 million MMBTUs of electricity.

COMMUNITY EFFORTS

Goals, Plans, and Visions

Through the creation of the SomerVision Comprehensive Plan (2010 - 2030), the City of Somerville has demonstrated its commitment to viewing various aspects of the community's future through the lens of sustainability. The Plan, adopted by Somerville Planning Board in April 2012, serves as a guide for the city for future growth and development. Several of Somerville's goals relating to resources, transportation, and infrastructure identify energy efficiency as a sustainable and effective strategy for the community.

Green Communities Designation

Somerville's designation as a Green Community² in 2011 is further evidence of the City's long-term energy and environmental strategy commitments. The designation involved the satisfaction of five progressive energy-related criteria, such as streamlining the permitting process for renewable energy projects and creating an energy reduction plan to reduce municipal energy consumption by 20%. Somerville was also provided with significant funding to implement municipal energy efficiency projects across the city's portfolio of municipal properties. Since its designation in 2011, the City has received over \$360,000 in grant funding for projects including rooftop solar assessments, LED streetlight retrofits, Energy Management System upgrades, and EV charging stations.

Net-Zero Commitment and Greenhouse Gas Inventories

In 2014, Somerville's Mayor Curtatone announced a commitment to achieve net zero energy use in city buildings by 2050. The setting of such an ambitious carbon neutrality target was enabled thanks to the city's enduring efforts in measuring greenhouse gas emissions. In 2001, a municipal greenhouse gas inventory was completed, and led to the passage of a resolution to reduce city emissions 10 percent below 1990 levels by 2015. The city is currently in the process of developing a community-wide emissions inventory with the goal of supporting future energy and climate decisions.

¹ This number includes electricity and natural gas use from all sectors, but fuel oil use (diesel, gasoline, propane) from only the municipal sector.

² The Department of Energy Resources' Green Communities Designation and Grant Program, which is a result of the Green Communities Act signed by Governor Patrick in 2008, uses funding from auctions of carbon emissions permits under the Regional Greenhouse Gas Initiative to reward communities that win Green Communities designation by meeting five clean energy benchmarks.

Honeywell Energy Performance Contract

Somerville also entered into a \$7.8 million energy savings performance contract with Honeywell as a mechanism to fund deep energy retrofits in municipal facilities. In just three years, the City has already saved over \$476,000 through reduced utility bills, with annual savings guaranteed until 2029. Additionally, through Honeywell's 'Act!Earth' program, the city is able to take advantage of energy monitoring, data and education to effectively alter the way buildings are used and operated in order to reduce their energy use.

LED Streetlight Conversion

Somerville is currently in the process of converting every City-owned streetlight and other light fixtures to energy-efficient LED lightbulbs. The City is investing close to \$2.5 million in this technology, and will see that amount payed back in around five years. The LED fixtures will help Somerville reduce carbon dioxide emissions by approximately 600 metric tons annually.

Residential Energy Efficiency

Somerville's residential energy efficiency program was a joint initiative between Somerville's Housing Division, OSE, and Commission on Energy and Climate Change. Designed to address energy efficiency in multi-family and rental units, the program ran from November 2011 through December 2012 and resulted in 560 homes audited; \$96,000 in incentives delivered to 73 homes; and between 55 and 72 metric tons of CO₂ emissions reduced annually.

MUNICIPAL ENERGY PROFILE

Somerville monitors its municipal energy data using the MassEnergyInsight (MEI) tool. MEI is a free, web-based tool developed by Peregrine Energy Group and made available to cities and towns in Massachusetts through the Department of Energy Resources (DOER) as part of the Massachusetts Green Communities Program. Electricity and natural gas usage for Somerville's municipal accounts is pre-loaded by Eversource into the MEI program. Other fuel use data (such as heating oil and vehicle fuel) must be manually entered and kept up-to-date by Somerville municipal staff. Somerville's municipal sector accounts for approximately 3% of the City's total energy consumption.

MUNICIPAL FUEL MIX

The City of Somerville uses a variety of energy sources for its electricity, heating, cooling, and transportation needs. In calendar year 2014, over 161,000 MMBTUs were expended for municipal purposes. Figure 3 below illustrates that this energy demand was met primarily through electricity and natural gas, which accounted for 34% and 30% respectively of Somerville's energy mix.

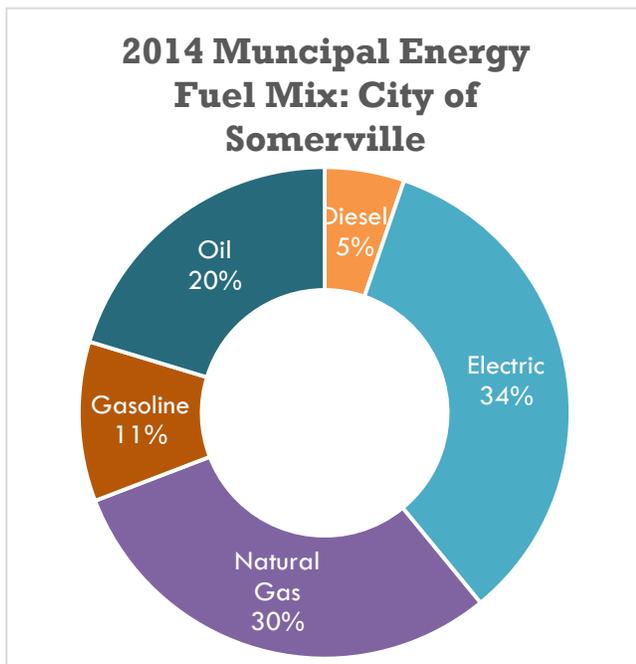


Figure 3: Electricity, natural gas, and oil accounted for 84% of the City's municipal energy mix in calendar year 2014.

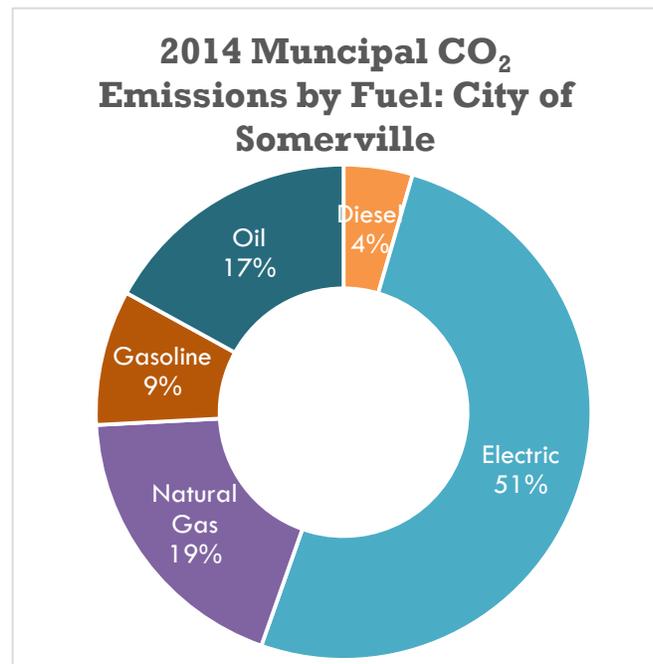


Figure 4: Electricity is the highest contributor municipal of carbon emissions.

Somerville also relied on oil to generate 32,000 MMBTUs of energy for heating its municipal facilities, which amounts to 20% of the city's fuel mix. Gasoline and diesel, primarily used as fuel for the municipal vehicle fleet, together accounted for around 16% of the city's energy mix. Comparing the carbon emissions from these fuel sources paints a slightly different picture (Figure 4). Natural gas is rich in methane, which has a higher energy content compared to other

fuel sources, and thus contributes to a lower CO₂-to-energy content. Despite accounting for 30% of municipal energy use, natural gas is responsible for just 19% of municipal carbon emissions. Electricity, on the other hand, is responsible for the majority (51%) of emissions from municipal energy use. Diesel and fuel oil also have comparatively high emissions levels per unit of energy generated, and together account for around 21% of carbon emissions. The municipal fuel and carbon emissions mix for Somerville implies that it will be highly beneficial for the City to focus its efforts on increasing energy efficiency for equipment that consumes large amounts electricity in its facilities, and explore the conversion of oil- and diesel-fueled equipment to more efficient natural-gas-powered equipment.

Table 1 and Figure 3 below show a breakdown of energy use by fuel type for each department in the City of Somerville. Most departments use an even split of electricity and natural gas for their energy needs. The Schools department consumes the highest amount of energy annually, around 82,134 MMBTUs. More than 25% of this consumption is through fuel oil. It is also worth noting that the Schools department accounts for almost 70% of the entire City’s annual oil consumption.

Table 1: Somerville’s municipal energy use by fuel type and department.

Municipal Department	Energy Use (MMBTU)					Grand Total
	Diesel	Electric	Gas	Gasoline	Oil	
Schools		30,124	29,219		22,791	82,134
Vehicles	8,453			16,936	53	25,442
Public Safety		5,372	7,841			13,213
Recreation		5,441	6,504		993	12,938
DPW		1,913	1,186		8,907	12,006
Street and Traffic Lights		7,592				7,592
Administration		2,236	815			3,051
Libraries		815	1,922			2,737
Parks		1,009	209			1,218
Other		12	825			837
Grand Total	8,453	54,514	48,521	16,936	32,744	161,168

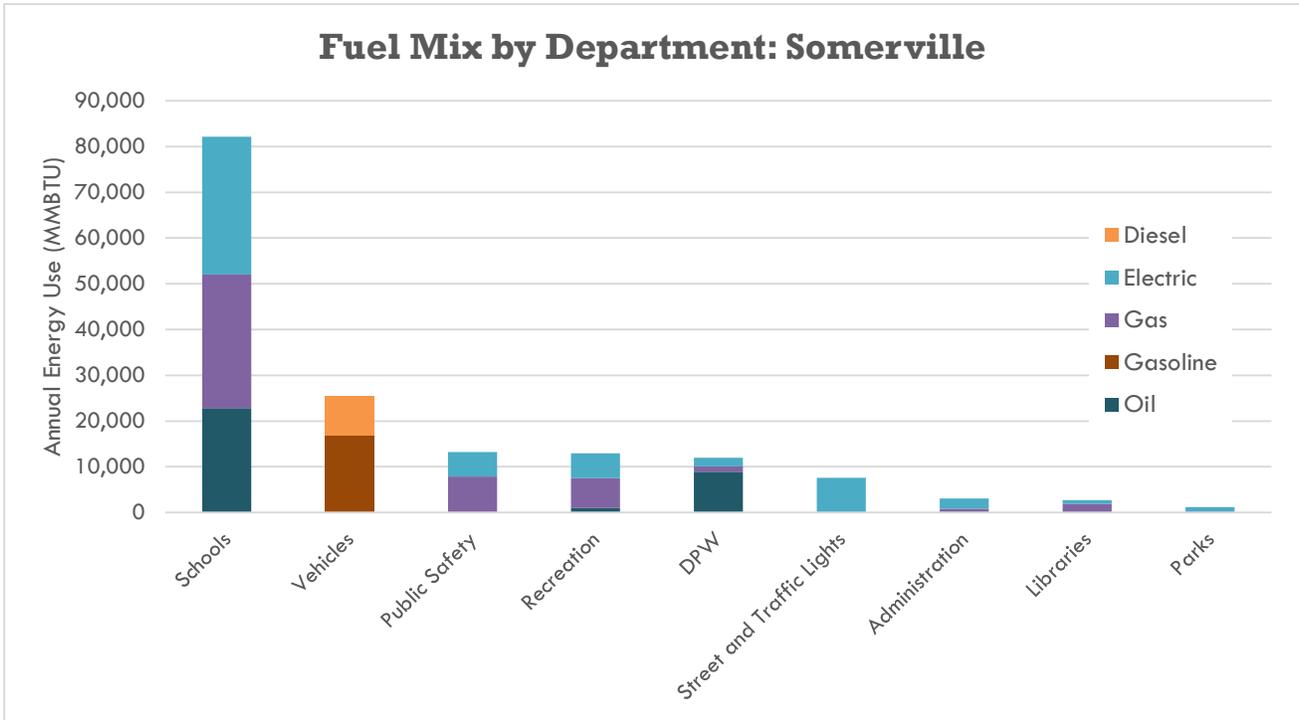


Figure 3: Somerville's Schools account for over 80,000 MMBTU of annual energy consumption in the municipality.

Based on this information, it is advisable for Somerville to prioritize the schools for energy efficiency upgrades. The City's school buildings account for more than half of overall municipal energy consumption. Combined with a reliance on fuel oil for heating purposes, the implication is that there exists significant potential for reducing energy usage through smarter fuel choices and energy-efficient equipment.

MUNICIPAL BUILDING ENERGY OVERVIEW

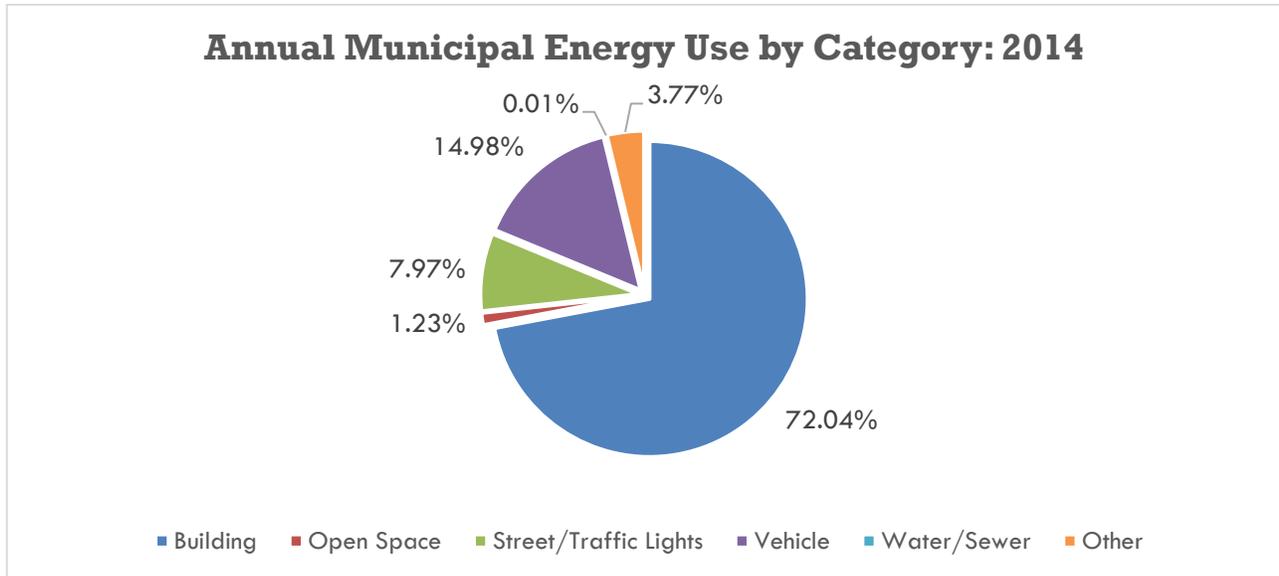


Figure 4: Buildings account for 72% of all municipal energy consumption in Somerville.

Municipal buildings make up approximately 72% of Somerville’s municipal energy use, as illustrated in Figure 4 above. Vehicle fuel in the form of diesel and gasoline accounts for almost 15% of annual energy use, while streetlights use almost 8%. The Somerville High School is the largest consumer of energy in the city, using over 31,000 MMBTUs on an annual basis. The High School is also the largest municipal facility in Somerville at over 415,000 square feet, resulting in an energy use intensity (EUI) of only 75 kBTU/sf. This places the facility as one of the more energy-efficient in the city’s portfolio.

The Union Square Fire Station is the second-largest user of energy, consuming 19,055 MMBTUs annually. With a gross floor area of just 87,500 square feet, however, this results in the second-highest EUI in the city of 218 kBTU/sf. A list of all municipal facilities and their respective Energy Use Intensities can be viewed in Table 2.

Table 2: Energy Use Intensity of Somerville's municipal facilities.

Facility	Department	Gross Floor Area (SF)	Use (MMBTU)	EUI (kBtu/sf)
City Hall Annex	Administration	12,196	989	81
Homan's Building	Administration	45,852	7	0
Somerville City Hall	Administration	37,960	3,911	103
Traffic & Parking	Administration	11,593	1,190	103
Administrative Building	DPW	89,448	10,914	122
Cross Street Elderly Center	DPW		1,111	-
Fire Station Headquarters	Public Safety	10,772	3,647	339
Highland Ave. Station	Public Safety	9,743	1,310	134
Lowell St. Station	Public Safety	6,925	1,367	197
Teele Sq. Station	Public Safety	13,385	2,001	149
Union Sq. Station	Public Safety	87,579	19,055	218
Central Library	Libraries	27,900	3,370	121
East Branch Library	Libraries	5,080	306	60
West Branch Library	Libraries	7,140	1,221	171
Inactive Accounts	Other		825	-
SCATV	Other	13,965	358	26
Skating Rink 1	Other		5,220	-
Skating Rink 2	Other		5,591	-
Park Lights or Parking Lots	Parks		103	-
Dilboy Pool	Recreation	7,776	114	15
Dilboy Stadium	Recreation		992	-
Walnut St Recreation Center	Recreation	13,464	952	71
Argenziano School	Schools	110,000	9,779	89
Arthur D Healey K-8	Schools	53,863	9,555	177
Benjamin G Brown ES	Schools	28,745	4,435	154
Capuano ECC	Schools	85,448	9,273	109
Cummings K-8	Schools	31,386	4,580	146
E Somerville Community K-8	Schools	92,544	11,675	126
Edgerly School Building	Schools	91,920	5,097	55
John F Kennedy K-8	Schools	151,986	18,600	122
Powder House Community School	Schools	87,599	17	0
Somerville HS	Schools	415,345	31,011	75
Somerville Public Schools Central Admin	Schools	3,781	200	53
West Somerville Neighborhood K-8	Schools	56,426	8,220	146
Winter Hill Community K-8	Schools	90,034	10,350	115

An analysis of energy use intensity by department reveals that there is a significant difference between the performances of facilities under various departments (Figure 5). Fire stations in Somerville have the highest average energy use intensity at around 207 kBtu per square foot. In comparison, administrative buildings have consumed about 71 kBtus per square foot. The

difference in energy use intensity is due to the primary use type of the facilities in Somerville’s portfolio. Fire stations and other public safety buildings typically operate on a 24 hour basis, and include garage spaces that may be air-conditioned yet exposed to outside weather conditions frequently. Administrative buildings are on shorter and more regular operational schedules, which could explain their lower energy use intensities.

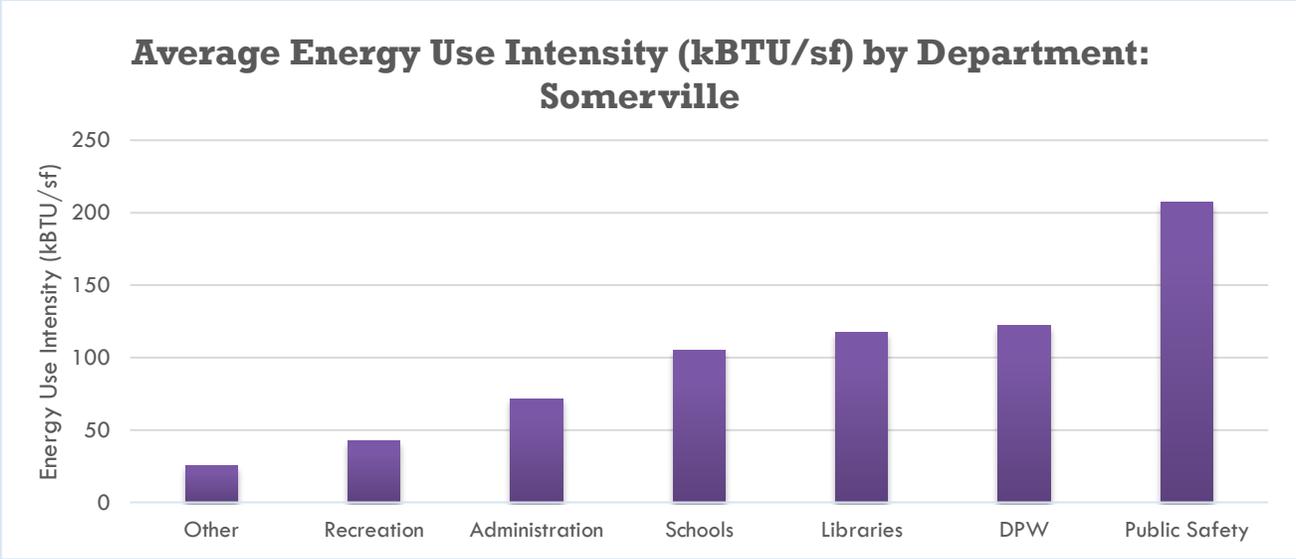


Figure 5: Average facility energy use intensity by department.

The majority of Somerville’s municipal facilities fall above the Massachusetts state average energy use intensity of 64 kBtu/sf for municipal buildings. This seems to indicate that there is potential for energy efficiency improvements across the entire portfolio of buildings. Moving away from inefficient fuel types such as oil and propane could also contribute towards reducing the energy use intensity of certain facilities.

RESIDENTIAL, COMMERCIAL, & INDUSTRIAL ENERGY PROFILE

Somerville’s residential, commercial, and industrial sectors account for approximately 97% of the City’s energy consumption. In 2014, the residential and C&I sectors together consumed over 4.7 million MMBTU. The best way to assess residential, commercial, and industrial consumption is to look at aggregated utility data for each sector. MAPC was able to collect aggregated electricity and gas consumption data for both the residential and C&I sectors in Somerville from the city’s utilities, Eversource and National Grid.

Fuel oil usage has not been included as part of this baseline.

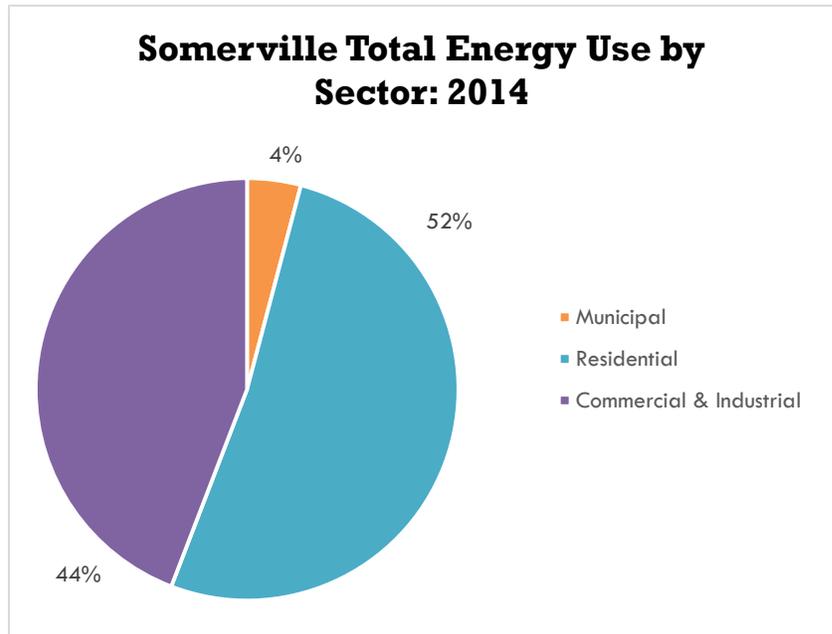


Figure 6: The residential sector accounts for the majority of the city’s energy consumption.

RESIDENTIAL SECTOR

Somerville’s population by race and ethnicity is fairly proportional to the state average, with a larger Hispanic/Latino population and a larger population of mixed race individuals. The city has a significantly higher percentage of persons over the age of 25 with a Bachelor’s degree or higher compared to the rest of the state (53% vs. 39%). Somerville’s median household income (\$67,118) is slightly higher than the state median (\$66,658).

Over 75% of Somerville’s housing stock comprises of multi-family units, with 2-4 multi-family units alone accounting for almost 60% of available housing. This profile is almost exactly an inverse of what is seen in the rest of the state, where single-family units make up

Somerville Residential Profile	
Median Household Income	\$67,118
Total # Housing Units	32,471
Owner-Occupied Units	32.38%
Renter-Occupied Units	67.62%
Housing Type	Percentage Mix
Single-Family Units	14.9%
Multi-Family, 2-4 Units	59.6%
Multi-Family, 5-9 Units	9.4%
Multi-Family, 10+ Units	10.5%
Total	100%

Source: 2008-2012 American Community Survey

around 76% of the housing stock. Additionally, over 67% of the available housing units in Somerville are occupied by renters, compared to a state average of 23%.

Residential Energy Consumption

The residential sector makes up approximately 52% of the energy consumption in Somerville. In the year 2014, Somerville residents consumed around 150 million kWh of electricity and over 20 million therms of natural gas. The resulting greenhouse gas emissions from these two energy sources amounted to over 363 million pounds of CO₂, with emissions from natural gas usage almost twice the amount from electricity usage.

Residential Energy Overview: 2014		
Annual Residential Energy Consumption in Somerville		
Fuel Type	Energy Consumption	Greenhouse Gas Emission
Electricity	150 million kWh	124 million lbs CO ₂
Natural Gas	20.4 million therms	239 million lbs CO ₂

Note that fuel oil usage was unavailable to include in this baseline.

GHG emissions were derived using the energy consumption by fuel type and the following conversion factors:

GHG Emissions Conversion Factors		
Fuel Type	Factor (lbs CO ₂ per Fuel Unit)	Fuel Unit
Electricity	0.828	kWh
Natural Gas	11.71	Therms

Source: MassEnergyInsight

Electricity use in Somerville has generally followed a downward trend. Between 2010 and 2014, annual electricity consumption was reduced by almost 8 million kWh. This reduction coincides with an increase of around in the number of residential electric accounts from 31,634 to 32,433. On average, residential electricity use on a per-customer basis dropped by 7.4% between 2010 and 2014, indicating that the City’s efforts to incentivize and promote energy efficiency improvements through state-level programs have made a positive impact so far.

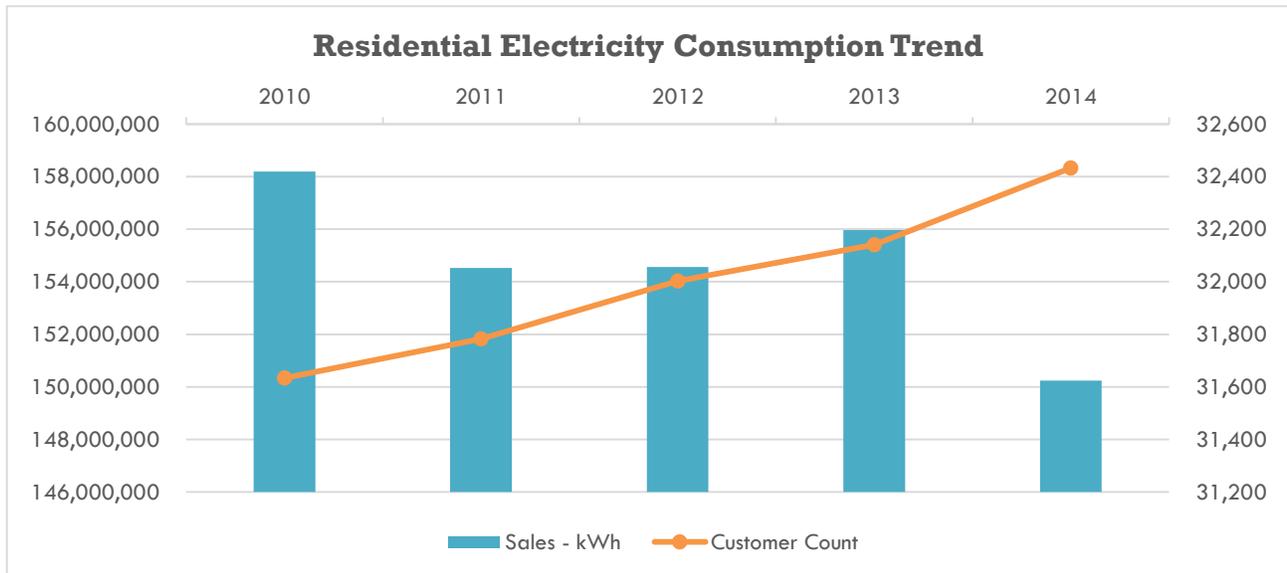


Figure 7: Residential electricity consumption reduced between 2010 and 2014 despite an increase in the number of customer accounts.

It is encouraging to observe that despite a high percentage of renters, Somerville residents have been steadily decreasing their consumption of electricity over the past few years. However, a low

percentage of owner-occupied housing units does imply that it may be challenging for the City to promote renewable energy adoption such as roof-top solar. It may be beneficial for Somerville to explore the development and promotion of community shared solar as an option for the renter-heavy residential population.

Natural gas usage, on the other hand, generally saw an increase over the past few years. Between 2012 and 2014³, annual natural gas consumption in the residential sector increased from around 15.5 million therms to over 20 million therms.

Converting both electric and natural gas usage from their native units to MMBTUs offered a more direct comparison between the two sources. In 2014, the average household in Somerville consumed 15.79 MMBTU of electricity and 77.30 MMBTU of natural gas. While the electricity usage represents a reduction of 4.1% compared to 2012, natural gas usage increased by 23.6% over the same period.

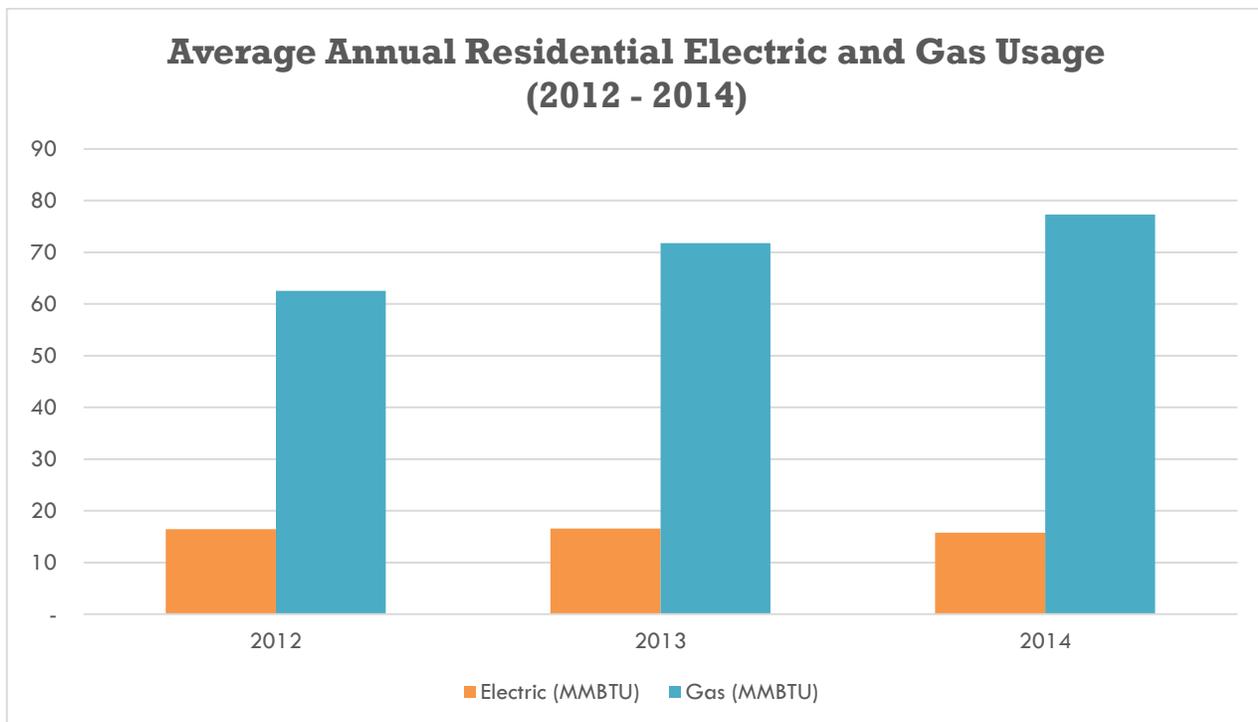


Figure 8: The average Somerville household receives almost five times as much energy from natural gas compared to electricity.

With natural gas accounting for more than 80% of the energy used on average in a Somerville household, the total average energy use increased by 17.8% between 2012 and 2014. While some of the increase for natural gas consumption could be attributed to weather-related circumstances, there still exists potential for implementing energy-efficiency programs to reduce residential natural gas consumption.

³ National Grid Gas data was unavailable for 2010 and 2011. In order to preserve consistency in analysis of trends, the three-year period of 2012 to 2014 was used.

COMMERCIAL AND INDUSTRIAL (C&I) SECTORS

Energy use in the C&I sectors accounts for approximately 44% of the city’s energy consumption. In 2014, electricity consumption amounted to around 240 million kWh, while 13.6 million therms of natural gas was expended based on data from Eversource and National Grid.

Somerville businesses have consistently been increasing their electricity consumption. In the five-year period between 2010 and 2014, C&I sector electricity usage went up by almost 40 million kWh. Accounting for the increase in customer accounts, this represented an 8.6% increase during that period.

C&I Sector Energy Overview: 2014

Annual C&I Energy Consumption in Somerville		
Fuel Type	Energy Consumption	Greenhouse Gas Emission
Electricity	240 million kWh	198 million lbs CO ₂
Natural Gas	13.6 million therms	160 million lbs CO ₂

GHG emissions were derived using the energy consumption by fuel type and the following conversion factors:

GHG Emissions Conversion Factors		
Fuel Type	Factor (lbs CO ₂ per Fuel Unit)	Fuel Unit
Electricity	0.828	kWh
Natural Gas	11.71	therms

Source: Environmental Protection Agency

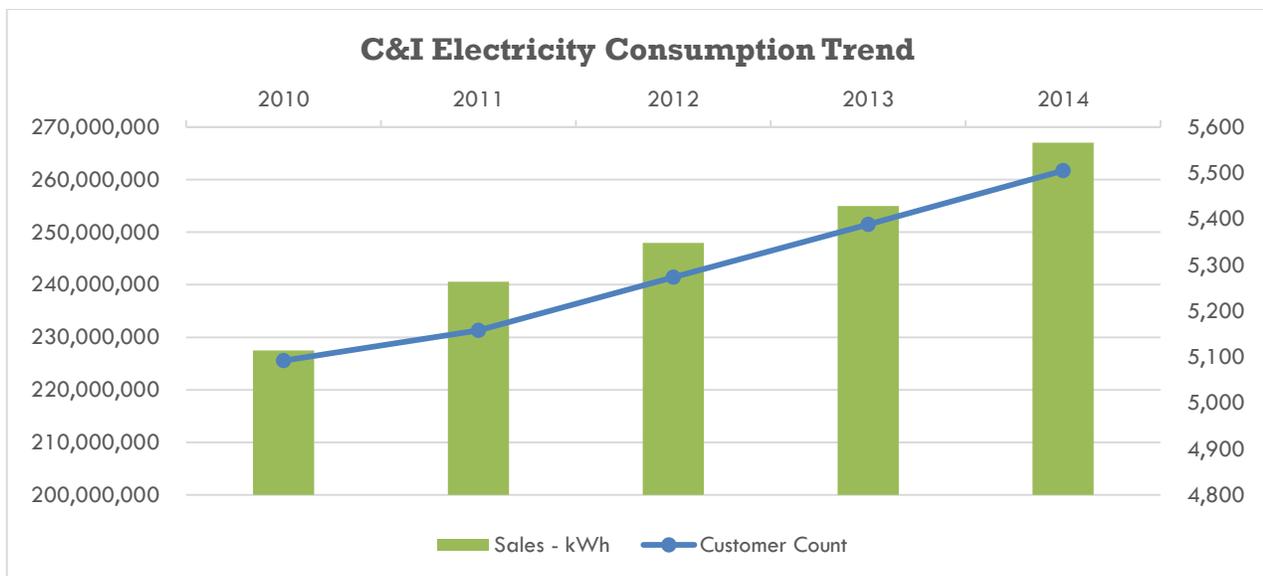


Figure 9: Somerville businesses continue to increase their electricity consumption.

Natural gas consumption was also analyzed for the three-year period between 2012 and 2014; Somerville businesses increased their annual usage from 11.6 million therms to 14.2 million therms during this time.

A comparison of electricity and natural gas consumption converted from their respective native units to MMBTUs reveals that the average Somerville business consumed 165 MMBTU of electricity and 894 MMBTU of natural gas in the year 2014 (Figure 11). This represents a 3.2% increase and a 23.4% increase respectively from 2012 usage.

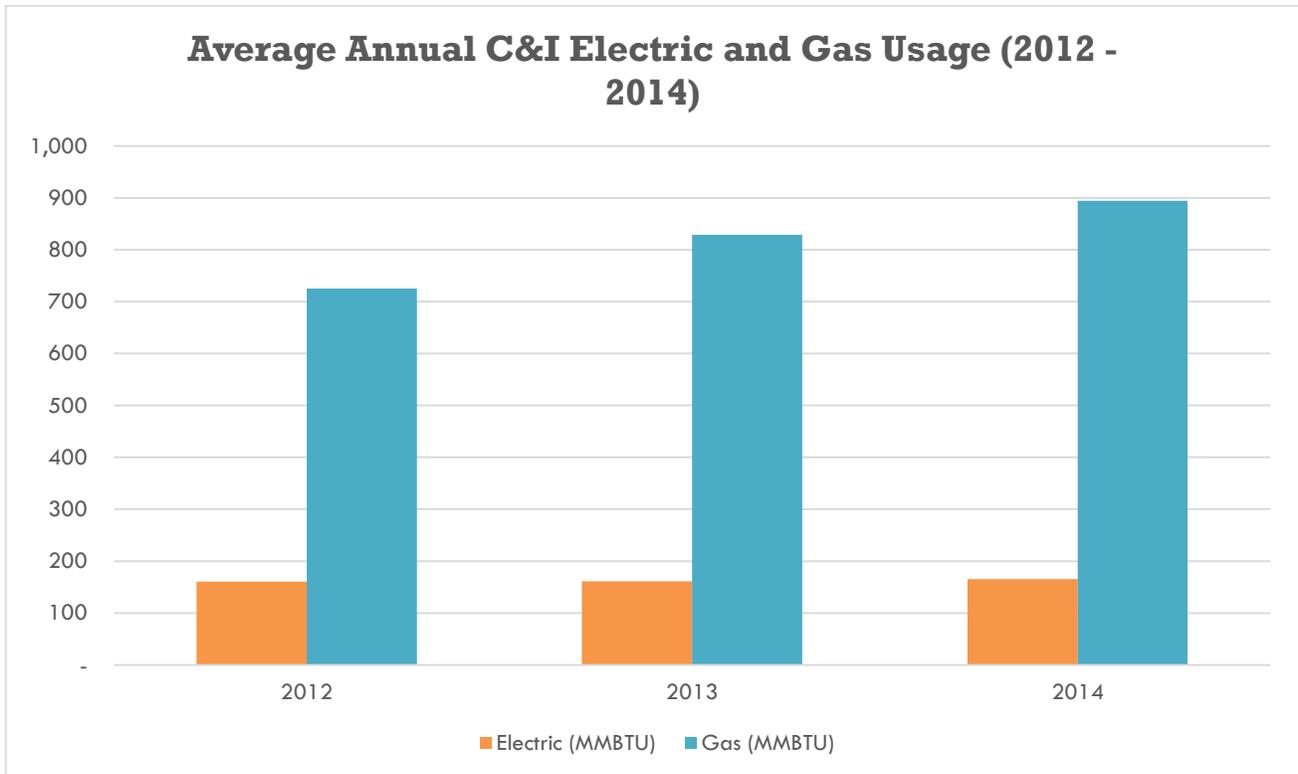


Figure 10: The average Somerville business increased overall energy consumption by almost 20% between 2012 and 2014.

Additionally, in keeping with the residential consumption profile, Somerville’s businesses used natural gas for over 84% of their overall energy needs. The reliance on natural gas, coupled with the general increase in overall energy use for the past three years, implies that the C&I sector could benefit significantly from structured energy programs – ideally as a collaboration between the City and the utilities – with incentives to reduce energy consumption and invest in energy efficiency upgrades.

Municipal Energy Profile: Regional Comparison

Somerville's community energy baseline is a valuable tool in understanding sectorial consumption trends and identifying opportunities for energy efficiency. A detailed analysis of municipal energy consumption can be especially useful as the community plans for operational tweaks and future capital improvement projects. However, it can sometimes be challenging for a municipality to interpret their energy profile effectively without a benchmark or comparison to similar communities.

This section presents a comparative analysis of the municipal energy profiles for three communities: Somerville, Cambridge, and Medford⁴. Information across four key categories – energy use, fuel mix, energy use intensity, and greenhouse gas emissions – has been compared to give the City of Somerville a regional context to better understand their municipal energy profile. Some key takeaways from this analysis are as follows:

- ▶ The Schools department is the largest consumer of energy in all three municipalities (between 40% and 58%).
- ▶ Electricity and natural gas are the two fuel sources that make up the majority of energy consumption in all three municipalities.
- ▶ Somerville has a significantly higher reliance on fuel oil (20%) compared to Cambridge and Medford (6% and 4% respectively).
- ▶ Fuel oil is responsible for 17% of all municipal greenhouse gas emissions in Somerville compared to under 5% in Cambridge and Medford.
- ▶ Somerville's facilities exhibit an average EUI of 112 kBtu/sf, which is significantly less energy-efficient than the EUI seen in Cambridge and Medford (both under 68 kBtu/sf).

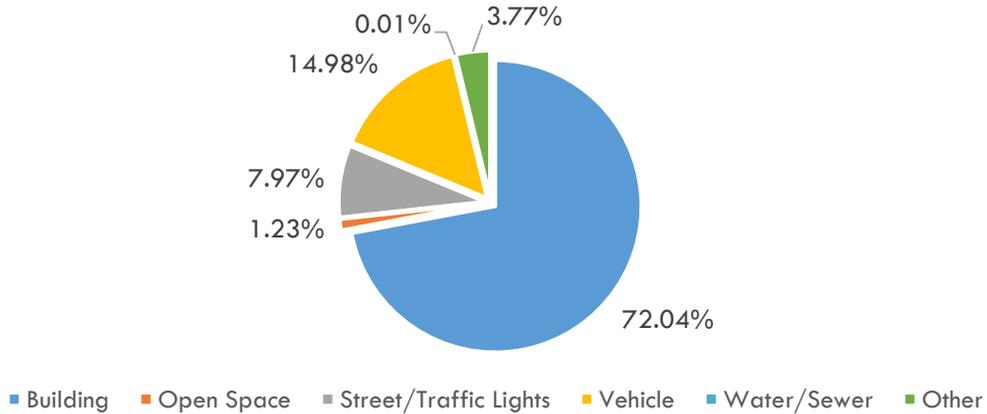
⁴ Energy use information for each community was accessed through MassEnergyInsight with the appropriate permissions. The following annual time-periods were used for the analysis:

- Somerville: Calendar Year 2014
- Cambridge: Fiscal Year 2014
- Medford: Fiscal Year 2014.

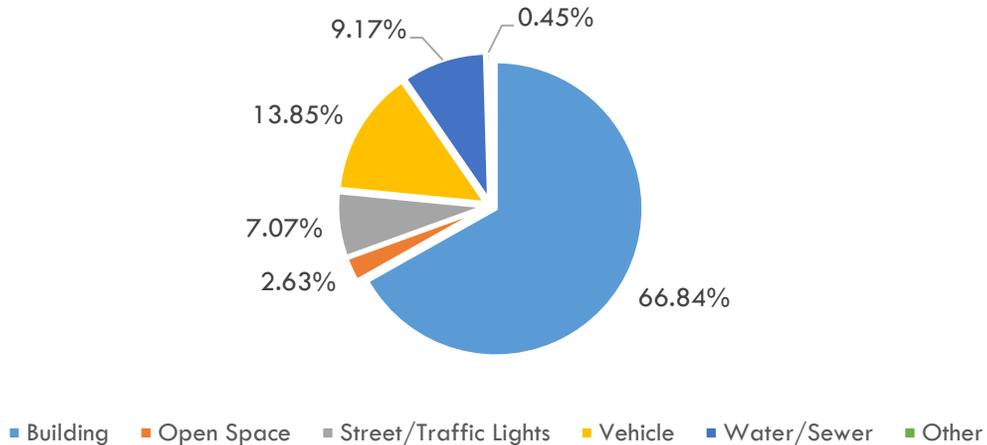
ENERGY USE

Municipal Energy Use by Category

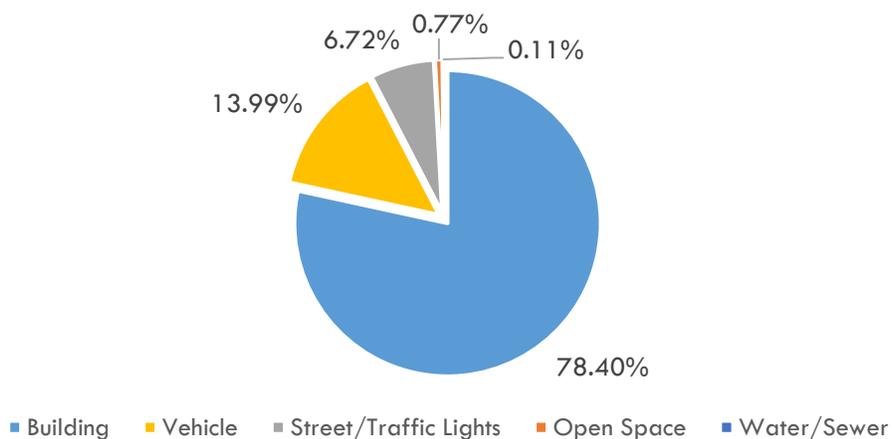
Municipal Energy Use by Category: Somerville



Municipal Energy Use by Category: Cambridge

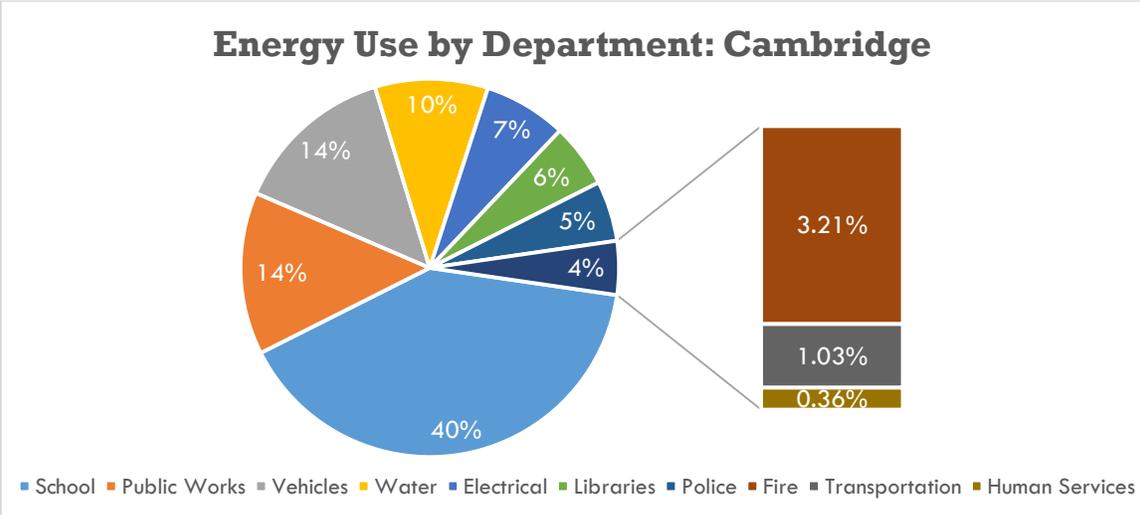
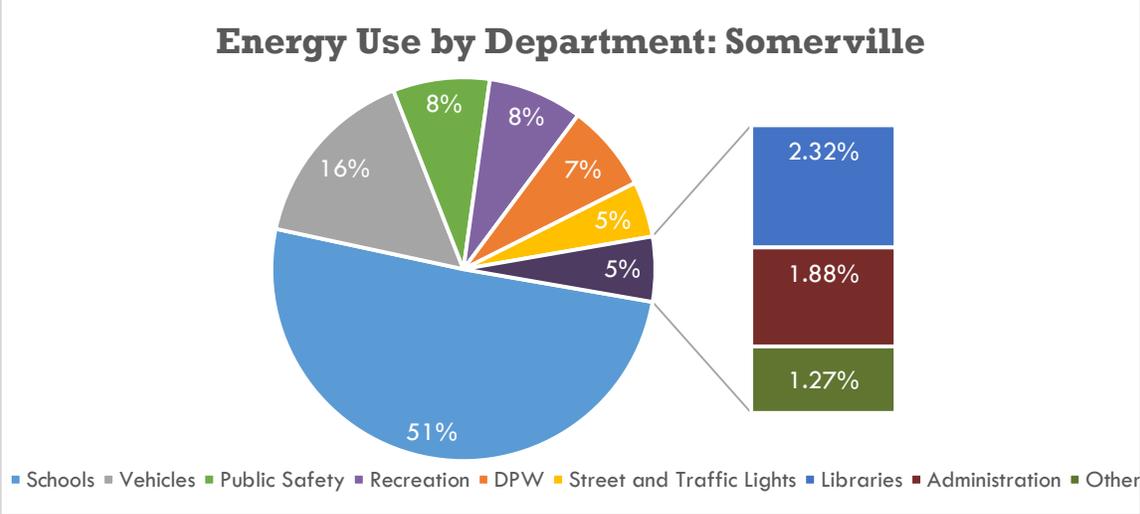


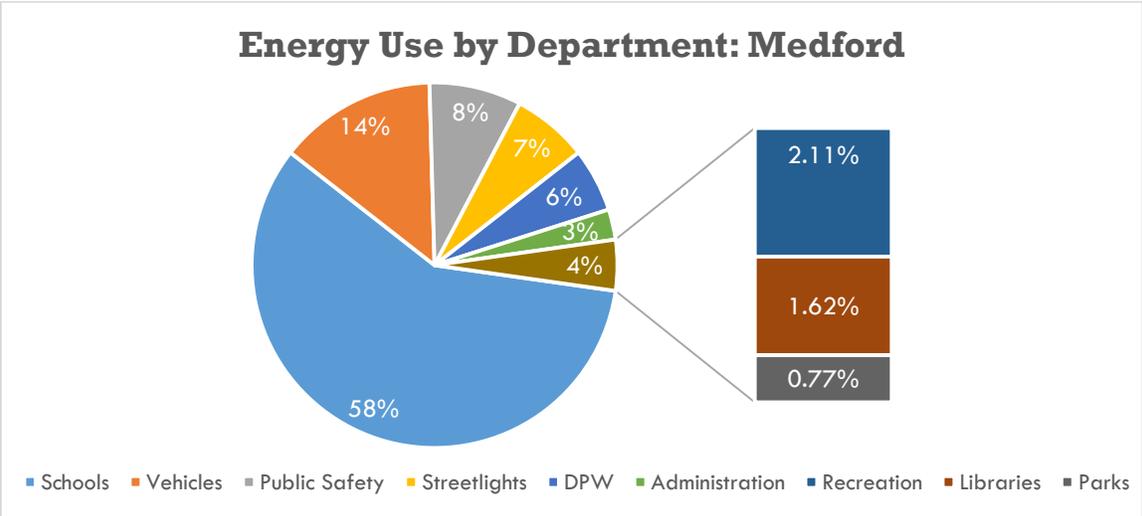
Municipal Energy Use by Category: Medford



The breakdown of municipal energy consumption by category is similar in Somerville, Cambridge, and Medford. Buildings account for the majority of municipal energy use in all three communities, while vehicle fuel and streetlights also make up a significant portion of energy consumption. It is also interesting to note that Cambridge’s water and sewer category accounts for over 9% of overall municipal energy consumption, primarily due to the presence of its drinking water treatment plant. Neither Somerville nor Medford have such a municipal facility, which explains why water and sewer energy consumption is insignificant for these two municipalities.

Municipal Energy Use by Department

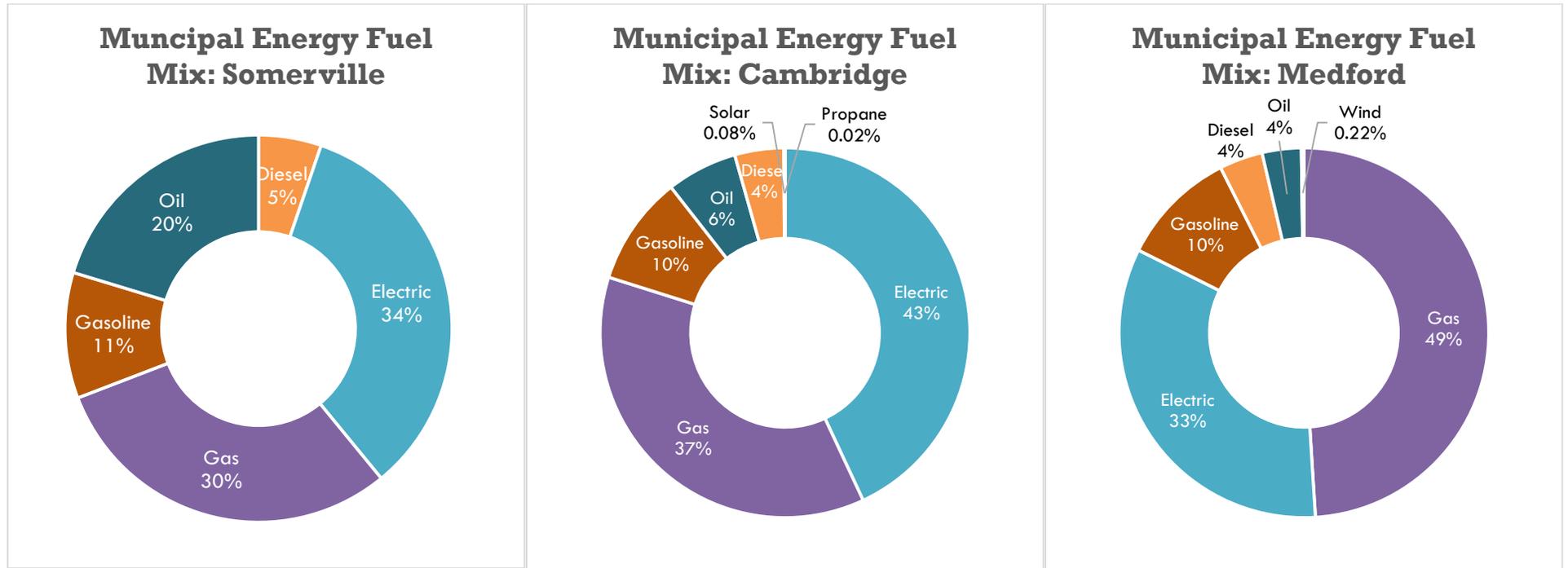




A comparison of energy use by department for Somerville, Cambridge, and Medford reveals a mix of similarities and differences. The Schools and Vehicles departments are among the top three highest consumers of energy for each community. However, while the percentage of energy used by vehicles is consistent (between 14% and 16%), there is much higher variability between the School departments. Cambridge’s schools account for 40% of their municipal consumption, whereas Somerville’s and Medford’s schools account for 51% and 58% of municipal energy use, respectively.

FUEL MIX

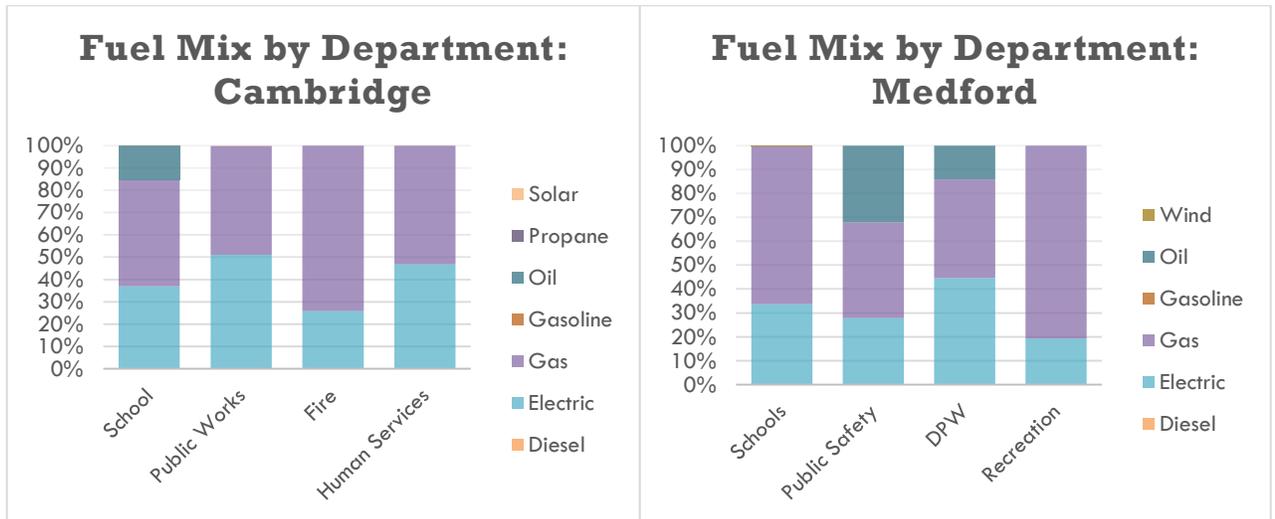
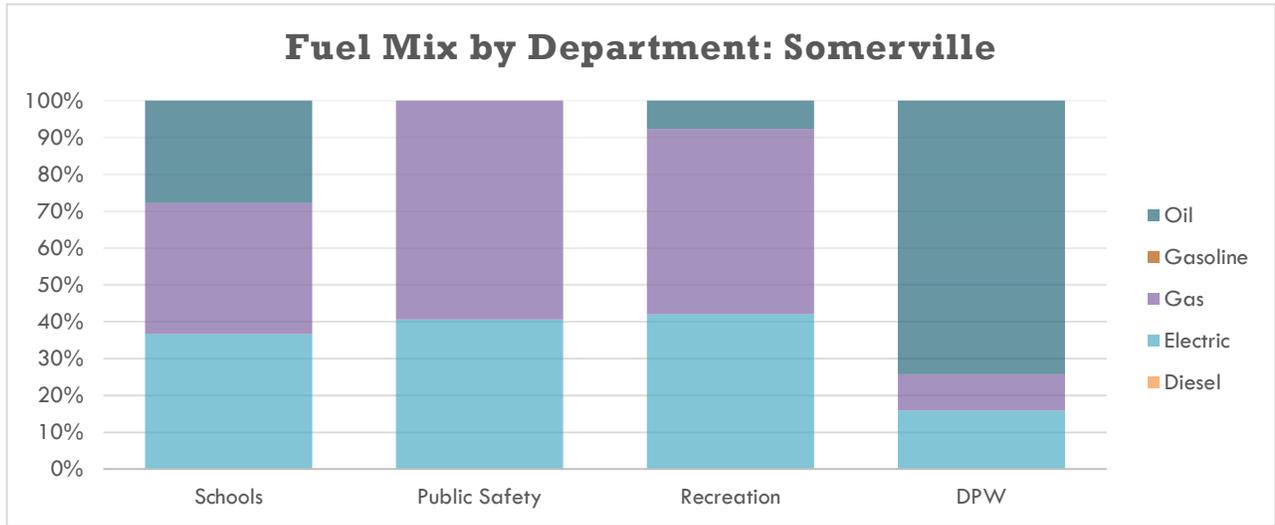
Municipal Energy Fuel Mix



Somerville, Cambridge, and Medford all rely on a variety of fuel sources to meet their municipal energy needs. Electricity and natural gas make up the two largest sources of fuel in all three municipalities, accounting for 64% of energy use in Somerville and over 80% of energy use in Cambridge and Medford. Natural gas usage is relied on the most in Medford (49%), whereas Cambridge's reliance on electricity (43%) is the highest among the three communities. While oil usage is similar in Cambridge and Medford

(4% and 6% respectively), the fuel makes up a significantly higher percentage of the energy mix in Somerville (20%). This high usage is primarily from the School and DPW departments, and is reflected in the departmental fuel mix charts on the next page. Gasoline and diesel use makes up a fairly consistent percentage of each community's energy mix, between 14% and 16%. Cambridge and Medford also have small percentages of their energy mix served by solar and wind power respectively.

Fuel Use by Department

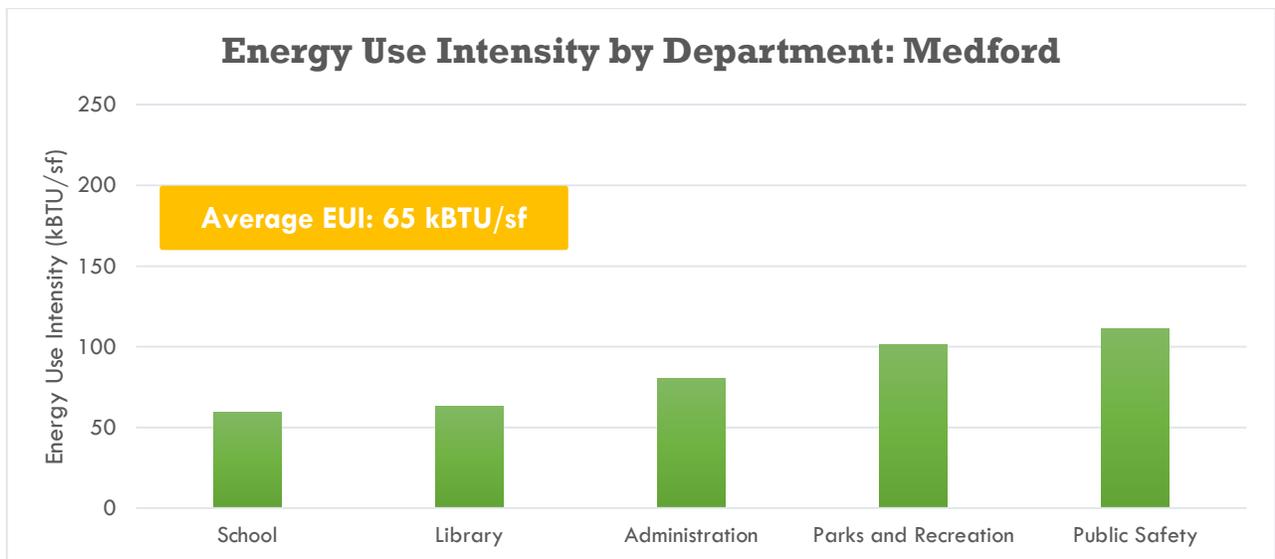
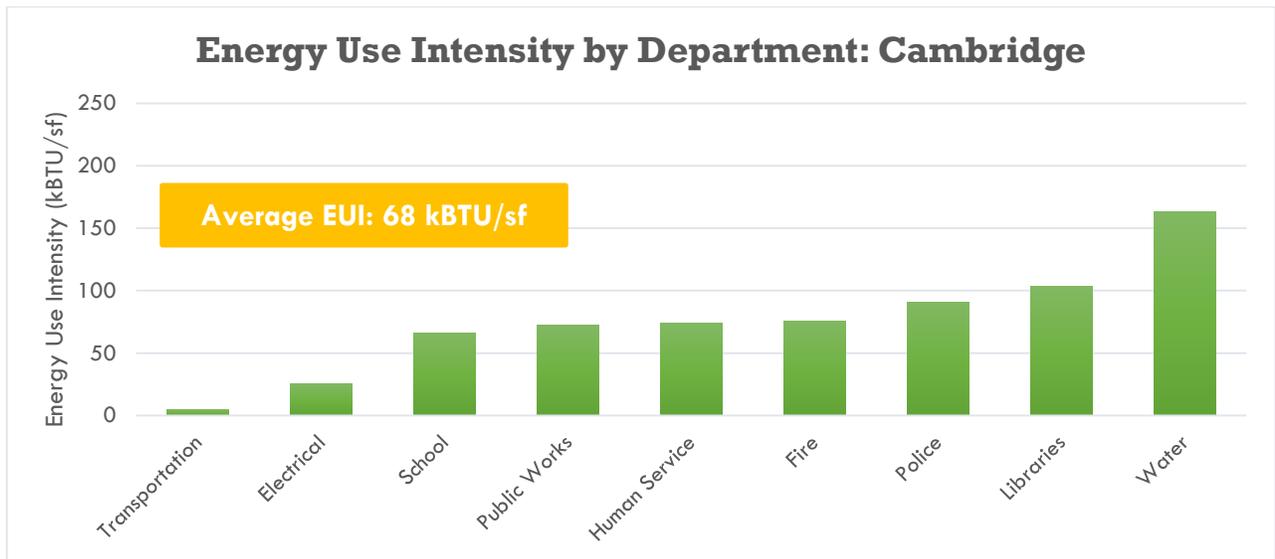
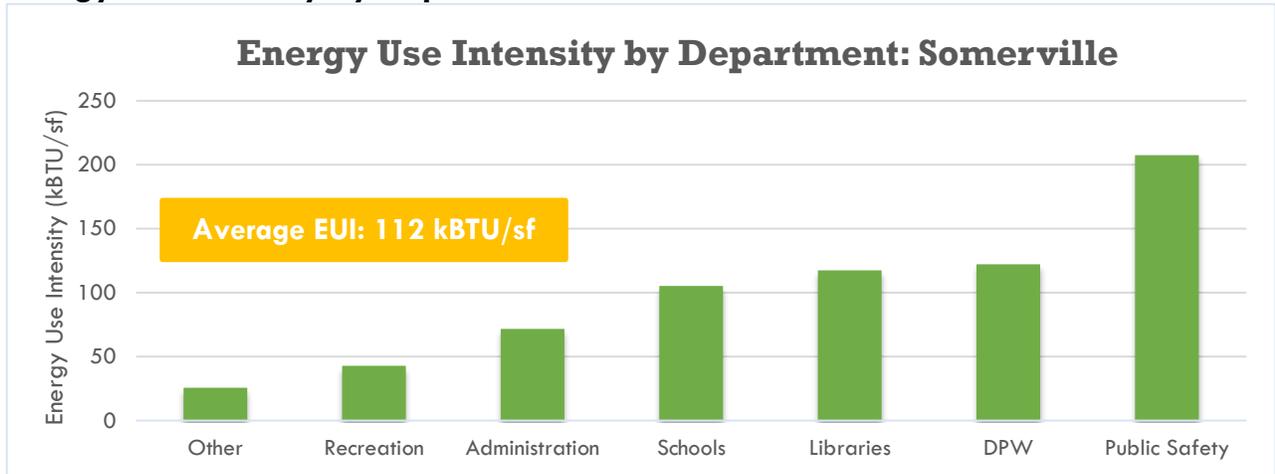


The Schools and DPW departments in Somerville together account for 58% of all municipal energy consumption in the city. These two departments rely more heavily on fuel oil in their energy mix compared to other departments – close to 30% in Schools, and over 70% in DPW. Analyzing the departmental fuel mix in Cambridge and Medford reveals that their respective Schools and DPW departments do not rely as heavily on fuel oil. The use of fuel oil is not necessarily tied to any specific departmental function; oil-powered equipment such as oil boilers are the primary contributors to municipal fuel oil use⁵. In addition to relying on a high-emissions source of energy, older fuel oil boilers tend to be significantly less energy-efficient than their electric- or natural-gas- powered counterparts.

⁵ Motor oil for vehicles (reflected in either the Vehicles or DPW department) also makes up a small percentage of a municipality's overall fuel oil use.

ENERGY USE INTENSITY

Energy Use Intensity by Department



Energy use intensity (EUI) refers to the amount of energy used per square unit of a facility, and is a useful measure to evaluate the energy efficiency of a facility. A low EUI indicates an energy-efficient facility. Medford's municipal facilities are the most efficient with an average EUI of 65 kBTU per square foot, while Cambridge's facilities average an EUI of 68 kBTU/sf. Somerville's municipal facilities, meanwhile, average a significantly higher 112 kBTU/sf.

The EUI of the Schools department is an important piece of information to pay attention to, given that the department is the largest consumer of energy in each community. Medford's schools consume 58% of the city's municipal energy consumption but have the lowest departmental EUI (59.5 kBTU/sf). Cambridge's school facilities have an EUI of under 66 kBTU/sf, whereas Somerville's schools have an EUI of 105 kBTU/sf.

It is also interesting to note that public safety facilities like police and fire stations tend to be some of the most energy-intensive for every community. Cambridge is alone in contending with a water treatment plant, which contributes to an EUI of over 160 kBTU/sf for their Water department. The average EUI for Cambridge without this plant would drop from 68 kBTU/sf to 63 kBTU/sf.

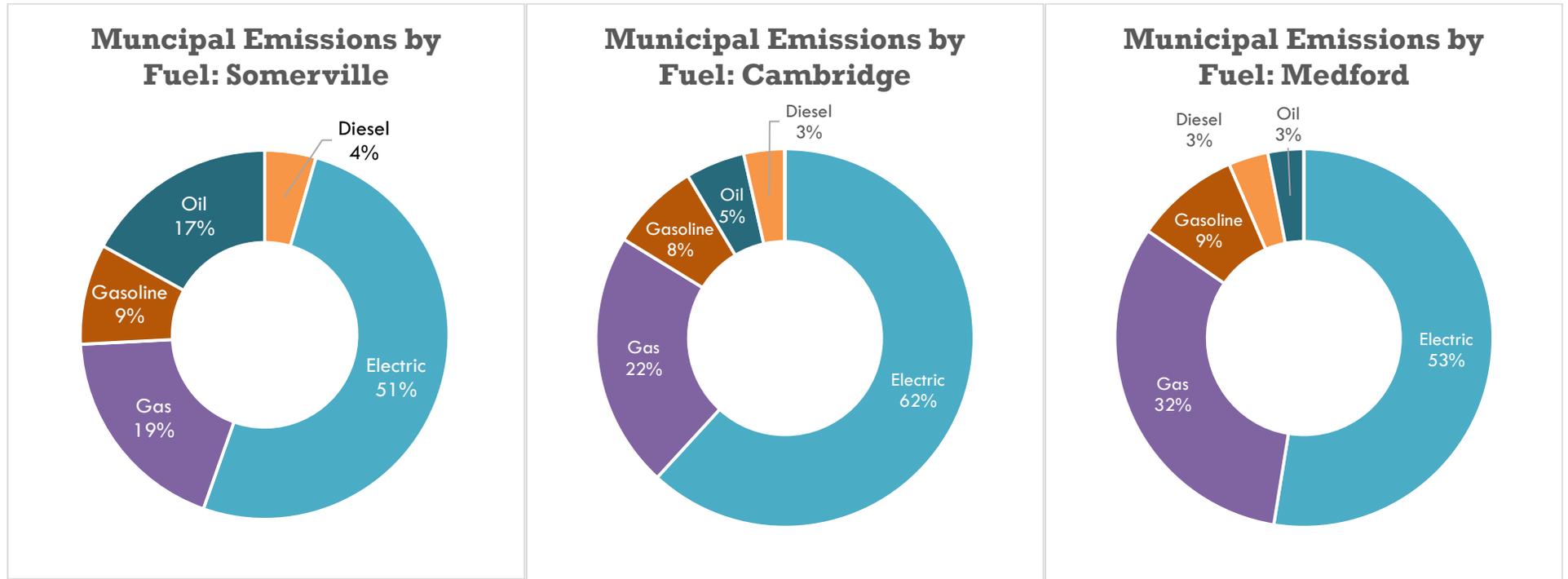
GREENHOUSE GAS EMISSIONS

Municipal Greenhouse Gas Emissions by Fuel Source

Every different fuel source has a varying level of greenhouse gases that are emitted per unit consumed. Evaluating greenhouse gas emissions by fuel type therefore provides more insight into the level of emissions that a particular fuel source is responsible for in a community. Across all three communities, electricity use is responsible for the majority of municipal greenhouse gas emissions. It is interesting to note that this is the case even in Medford, where natural gas is the primary source of energy. Natural gas is a much cleaner source of energy compared to electricity due to the latter's generation sources in the New England region. This contributes to natural gas' under-representation in the emissions mix.

While electricity and natural gas use are responsible for over 84% of emissions in Cambridge and Medford, the two sources account for only 70% of emissions in Somerville. Somerville's heavier reliance on fuel oil is reflected in the community's emissions mix, accounting for 17% of municipal emissions.

Gasoline and diesel usage accounts for between 11% and 13% of emissions in each community.



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Potential Energy Measures and Strategies

ENERGY EFFICIENCY

1. **Contact Eversource to discuss the possibility of receiving preliminary energy audits for facilities with high energy use intensity (EUI).** The energy audits will provide the City a facility-level snapshot of current energy consumption, and could identify various small- to medium-size energy efficiency projects to implement with high savings potential.
2. **Consider a retro-commissioning (RCx) project to improve the efficiency of existing facilities, specifically those with newer equipment.** Facilities with newer energy-efficient equipment are often more complex to monitor and maintain. RCx is a useful mechanism to ensure that equipment is performing optimally and maintenance needs are streamlined.
3. **Conduct a City-wide facility inventory assessment to ascertain age, quality, and remaining life cycles of existing equipment.** Inventory assessments can also facilitate the creation and adoption of customized maintenance plans for Somerville's facilities.
4. **Explore the feasibility of implementing climate-based building control software for added energy efficiency benefits.** Solutions such as MeteoViva Climate have the capability of determining a building's future energy needs for heating and cooling based on building physics, occupancy, and weather forecasts, and can significantly reduce energy consumption and CO₂ emissions.
5. **Develop a behavior-based energy efficiency pilot program at the Somerville High School.** Behavioral efficiency programs and strategies are a cost-effective way to reduce energy consumption, and can complement other capital investments in energy-efficient equipment. Piloting such a program at the Somerville High School could provide useful lessons for effective implementation in other City facilities.
6. **Continue to take advantage of utility incentives and rebates to implement high-potential energy efficiency projects.** Utilities offer attractive incentives for measures such as retrofitting indoor lighting with LEDs, installing programmable thermostats, and more. These measures offer significant energy and cost savings with short payback periods, and could mitigate the impact of older and inefficient building systems.

CLEANER FUELS

7. **Explore the replacement of the existing fuel-oil boilers at the Somerville High School / City Hall buildings with energy-efficient natural gas-powered versions.** Fuel oil is a more carbon-intensive energy source compared to natural gas, and older fuel oil boilers are typically less energy-efficient than their gas-powered counterparts. Upgrading to a natural gas powered boiler will represent a significant reduction in energy use as well as carbon emissions.
8. **Investigate the potential for solar arrays on municipal property.** Installing solar panels on feasible building rooftops, parking lots, and landfills through power purchase agreements (PPAs) is an attractive mechanism to increase the percentage of renewable energy in Somerville's municipal fuel mix. Additionally, the City can explore the adoption of a solar-ready policy to ensure that new roofs are well-equipped to host solar arrays in the future.
9. **Prioritize renewable energy sources when negotiating competitive supply contracts for electricity.** By selecting a higher percentage of suppliers that provide MA Class I renewable energy, Somerville will be able to outperform the state's Renewable Portfolio Standards as well as create 'additionality' of renewable sources of generation on the New England electricity grid.
10. **Explore the feasibility of organic waste diversion at municipal facilities.** Organic waste is a significant contributor to greenhouse gas emissions, and diverting this waste - to a composting or anaerobic digestion facility - through waste management services could reduce Somerville's carbon footprint.