Massachusetts
Green Communities Program
2016 Progress Report

December 2017

GREEN COMMUNITIES
Massachusetts
DEPARTMENT OF ENERGY RESOURCES

Cover images:

Top: Essex Town Hall courtesy of MA DOER.

Bottom left to right: Library Streetlight LED Retrofit courtesy of MA DOER; O'Malley boilers courtesy of MA DOER; Chelmsford rooftop A/C units courtesy of MA DOER; City of Revere municipal electric vehicle courtesy of MA DOER.

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Executive Summary

The Massachusetts Green Communities Designation and Grant Program provides a roadmap, along with financial and technical support, to municipalities that commit to meeting certain criteria, including reducing municipal energy use by an ambitious and achievable goal of 20 percent over five years.

Relative to their baselines, Green Communities reduced their consumption by 12 percent, or 1.2 million MMBtus, in 2016. This reduction in energy use is enough to power and heat more than 9,000 Massachusetts homes. These energy reductions represent emissions reductions of approximately 96,000 metric tons of CO_2 equivalent.

The Green Communities Program's success is driven by:

Thriving program uptake

- Participation in the Green Communities Program has grown steadily from the launch of the program in 2008 to include more than one-half of municipalities in the state and nearly two-thirds of the population.
- Thirty municipalities became Green Communities in 2016, the most in a year since the launch of the program.

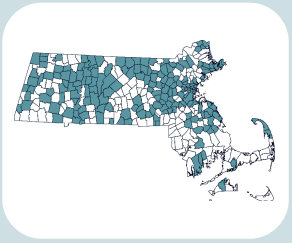
Broad and diverse participation

- The Green Communities Program is accessible to most municipalities across the state.
- Participants include communities in all regions, urban and rural, and large and small.

Goal achievement

- To date, 24 of the 86 Green Communities that have been in the program for at least five years have met their goal of reducing energy use by 20 percent.
- More municipalities accomplished this goal in 2016 than any prior year.

2016 Results



185 municipalities participating

energy reductions: 1.2 million MMBtus

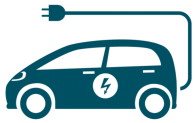
capable of powering and heating 9,000 homes

carbon reductions: 96,000 metric tons

The energy reductions are primarily due to lower use of electricity, natural gas, and oil.

Buildings represent roughly 70 percent of energy consumption across municipalities and nearly 80 percent of the energy reductions. Municipalities are implementing lighting upgrades and building controls, weatherizing buildings, replacing heating systems, and shifting away from the use of oil for heating.

Water treatment plants and pumping stations represent 6 percent of energy use and 5 percent of reductions. Municipalities are addressing pumps, motors, and drives as well as the overall efficiency of the buildings that house this equipment.



Vehicles comprise approximately 20 percent of energy use and account for 2 percent of energy reductions. Addressing vehicle fuel use remains a challenge for communities. However, recent increases in the purchase of electric and hybrid vehicles are promising.

Though only 6 percent of energy use, 14 percent of energy reductions are attributable to street lighting efforts. Communities have reduced their street lighting energy use considerably by converting to LEDs.

While the Green Communities program provides communities with many benefits, the program is also changing the ways municipalities do business. Many Green Communities are pursuing additional energy-related initiatives that are above and beyond the scope of the Green Communities Program.

1. Introduction and Purpose

The Green Communities Designation and Grant Program provides a roadmap along with financial and technical support to Massachusetts municipalities that (1) pledge to cut municipal energy use by an ambitious and achievable goal of 20 percent over 5 years and (2) meet specific additional eligibility criteria. The additional eligibility criteria include enabling zoning and permitting for renewable energy generation, manufacturing or research and development, purchasing higher efficiency vehicles to replace existing vehicles, and adopting more stringent building codes. As of the end of 2016, more than half of Massachusetts municipalities, 185 of 351, were designated Green Communities.[1]

Designated Green Communities are required to provide annual reports starting the first year after designation. These reports demonstrate the municipalities' continued program eligibility and their progress towards meeting the 20 percent energy reduction goal. In 2016, 121 of the 185 designated Green Communities supplied annual reports.[2]

This 2016 Progress Report presents the key findings and highlights based on the annual report data. The energy consumption and reduction data are based on actual energy use that is tracked and reported by municipalities. The baseline year is often the fiscal year prior to the designation year, and therefore varies by municipality. The current year represents the most recent fiscal or calendar year of program participation. Energy reductions are calculated as the difference in consumption from the baseline year to the current year. Unless otherwise specified, energy reductions are not weather-normalized.

Above all, these annual reports show that each Green Community is unique. Municipal energy use can vary greatly depending on the functions that are performed by the municipality or outsourced to vendors. For example, some municipalities have regional school districts that track energy use separately from the rest of the municipality, while others include schools in their energy accounting. Some communities outsource school busing and trash collection, while others own and maintain their own equipment. And lastly, each municipality has a unique blend of demographics, priorities, opportunities, and challenges that can impact clean energy goals.

"Above all, these annual reports show that each Green Community is unique."

Despite the distinct characteristics that drive each municipality's choice of strategies and solutions, collectively there are lessons learned and useful take-aways that can inform and refine program efforts going forward. The purpose of this 2016 Progress Report is to summarize program progress and key findings across all Green Communities. We also highlight specific efforts that support a broader key finding, exemplify an emerging trend, capture a new energy savings opportunity, or provide an interesting solution to a challenge shared by other communities.

[1] Municipalities served by both a municipal light plant and an investor-owned electric utility can be a Green Community. Municipalities served only by municipal light plants are not eligible for the Green Communities program unless they join the Renewable Energy Trust.

[2] Eight municipalities did not file an annual report in 2016. Municipalities that joined the program this year also did not supply annual reports as they have not been in the program a full year.

2. Report Organization

This year's report provides:

- A description of each of the key components of the Green Communities program (Section 3);
- An overview of state initiatives and practices supporting the Green Communities program (Section 4);
- A program summary (Section 5), with program-level key findings;
- Criteria 1 & 2 results (Section 6), with greater detail on renewable zoning and permitting efforts;
- Criterion 3 results (Section 7), featuring greater detail on municipal energy consumption and reductions in buildings, water and wastewater treatment plants and pumping stations, street and traffic lights, and vehicles;
- Criterion 4 results (Section 8), accompanied by greater detail on efforts to replace existing vehicles with more fuel-efficient vehicles;
- Criterion 5 results (Section 9), including greater detail on the impact of adopting more stringent building codes on new construction;
- A discussion of related, but separate initiatives municipalities are pursuing outside the reach of the Green Communities Program (Section 10); and,
- Concluding remarks (Section 11).

3. Green Communities Program Elements

To be designated as a Green Community, Massachusetts municipalities must meet five criteria as established in the Green Communities Act. This section describes each criterion. Collectively, these criteria put communities on a path to plan for and implement various forms of clean energy and energy saving measures to achieve an energy reduction goal, lower energy costs, and strengthen the local economy.

Once designated, communities apply for grants to support specific projects that drive further cost savings and provide economic development benefits to both municipalities and the state as a whole.

The following figure identifies the five criteria and provides a brief description of each one. Sections 6 through 9 provide additional detail on each criterion.

Figure 1. Green Communities Program elements

1 & 2
RENEWABLE ZONING AND PERMITTING

1. Allow zoning in designated locations for the as-of-right siting of renewable or alternative energy generating facilities, research and development facilities, or manufacturing facilities.

2. Develop, or have in place, an expedited application and permitting process of one year at most, for applicable facilities in the designated renewable zone from Criteria 1, above.

3
MUNICIPAL ENERGY CONSUMPTION

1. Establish an energy use baseline inventory for municipal buildings (including schools, drinking water, wastewater treatment plants and pumping stations and open spaces), street and traffic lighting, and vehicles; and

2. Adopt an Energy Reduction Plan (ERP) demonstrating a reduction of 20 percent of baseline energy use after five years of implementation.

4
VEHICLE FLEET

Municipal governments and school districts must:

1. Adopt a Fuel-Efficient Vehicle Policy requiring all municipal departments and divisions to purchase fuel-efficient vehicles,

2. Develop and maintain a vehicle inventory for all four-wheeled passenger vehicles, and

3. Provide a plan for replacing non-exempt vehicles with vehicles that meet specified fuel efficiency ratings.

5
NEW CONSTRUCTION

Municipalities must minimize the life cycle cost of all newly constructed homes and buildings and those undergoing major renovation.

Municipalities have satisfied this criteria by following DOER's recommendation of adopting the Massachusetts' Board of Building Regulations and Standards (BBRS) Stretch Code (780 CMR 115.AA).

For more information on the Green Communities Program, please see the program website at: https://www.mass.gov/orgs/green-communities-division-massdoer. Program guidance documents are also available at this website.

4. Relevant State Initiatives and Practices

Both the state energy statute that established the Green Communities program and a suite of supportive state energy initiatives and practices are essential to the success of the program today. For instance, Green Communities are leveraging ratepayer-funded energy efficiency program incentives (MassSave®) with Green Communities grant funds to complete energy savings projects. Green Communities are also coupling Green Communities funding with other state incentives for electric vehicles and charging stations to replace existing gasoline and diesel-powered vehicles with electric vehicles.

The table below lists and describes the state efforts that support and complement the Green Communities Program. We grouped the list into statutory/regulatory efforts and municipal practices that support clean energy. We also indicate the Green Communities Program criteria impacted by each initiative.

Table 1. Initiatives and practices supporting the Green Communities Program

Initiative	Description	Criteria			
		1&2	3	4	5
		Renewable Zoning and Permitting	Municipal Energy Consumption	Vehicle Fleet	New Construction
STATUTORY/REGULATORY INITIATIVES					
Green Communities Act	Comprehensive energy reform legislation promoting development of renewable energy, energy efficiency, green communities, and implementation of the Regional Greenhouse Gas Initiative. This policy created the Green Communities Program.				
Global Warming Solutions Act	Requires reductions in greenhouse gas emissions from each sector of the Massachusetts economy, summing to a total reduction of 25% below the 1990 baseline emission level in 2020 and at least an 80% reduction in 2050.				
Renewable Portfolio Standard (RPS)	Requires suppliers (including regulated distribution utilities and competitive supplies) to obtain a certain percentage of electricity from renewable energy.				
Alternative Portfolio Standard (APS)	Requires suppliers to procure a certain percentage of electricity from Combined Heat and Power (CHP), flywheel storage, efficient steam technologies, renewable thermal, and any other approved alternative energy technology.				

Table 1. Initiatives and practices supporting the Green Communities Program (cont'd)

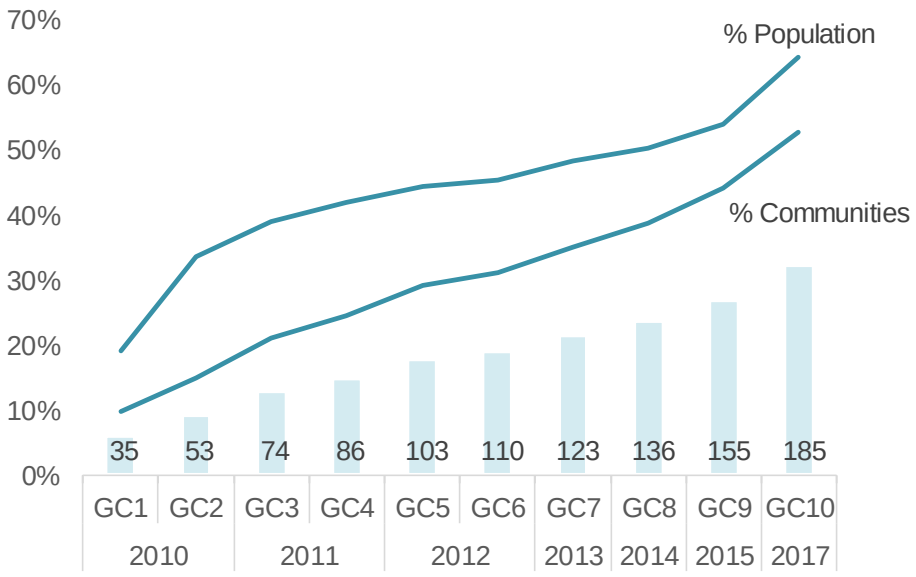
Initiative	Description	Criteria			
		1&2	3	4	5
		Renewable Zoning and Permitting	Municipal Energy Consumption	Vehicle Fleet	New Construction
MUNICIPAL PRACTICES THAT SUPPORT CLEAN ENERGY					
Purchase Power Agreements	Enable municipalities to host on-site solar PV systems and agree to buy energy, without owning the equipment.				
Community Choice Aggregation	Municipalities aggregate the electrical load of customers within their borders to competitively procure electricity supply. Through this approach, a community can increase the renewable energy content of its electricity supply.				
Net Metering	Customers generate their own electricity and offset their electricity usage. Any excess generation is exported to the electric grid. Public net metering facilities are entitled to special benefits, including larger maximum capacity and higher credit value for projects of a certain size.				
Renewable Heating and Cooling Incentives	Rebates to support the installation of renewable heating, hot water, and cooling technologies at facilities across the Commonwealth.				
Energy Efficiency Incentives for Municipalities	Through ratepayer-funded energy efficiency programs implemented by utilities, incentives are available for various projects.				
Streamlined ECM Procurement for Municipalities	A provision of the Green Communities Act (Ch. 25A Sec. 14) allows public entities to procure energy efficiency projects up to $100,000 through investor-owned utilities.				
Municipal-Owned Street Lighting	Massachusetts passed legislation requiring utilities to sell street lights to municipalities interested in purchasing and maintaining them.				
LED Street Lighting Tariffs	Massachusetts utilities updated street lighting tariffs to include LEDs, allowing municipalities to convert their street lights to LEDs.				
Electric Vehicle Fleets	Incentives to public entities for the acquisition of electric vehicles and the installation of charging stations.				

5. Program-Level Results Summary

This section summarizes key findings on program level participation in the program, baseline and current year energy consumption, and energy and emissions reductions.

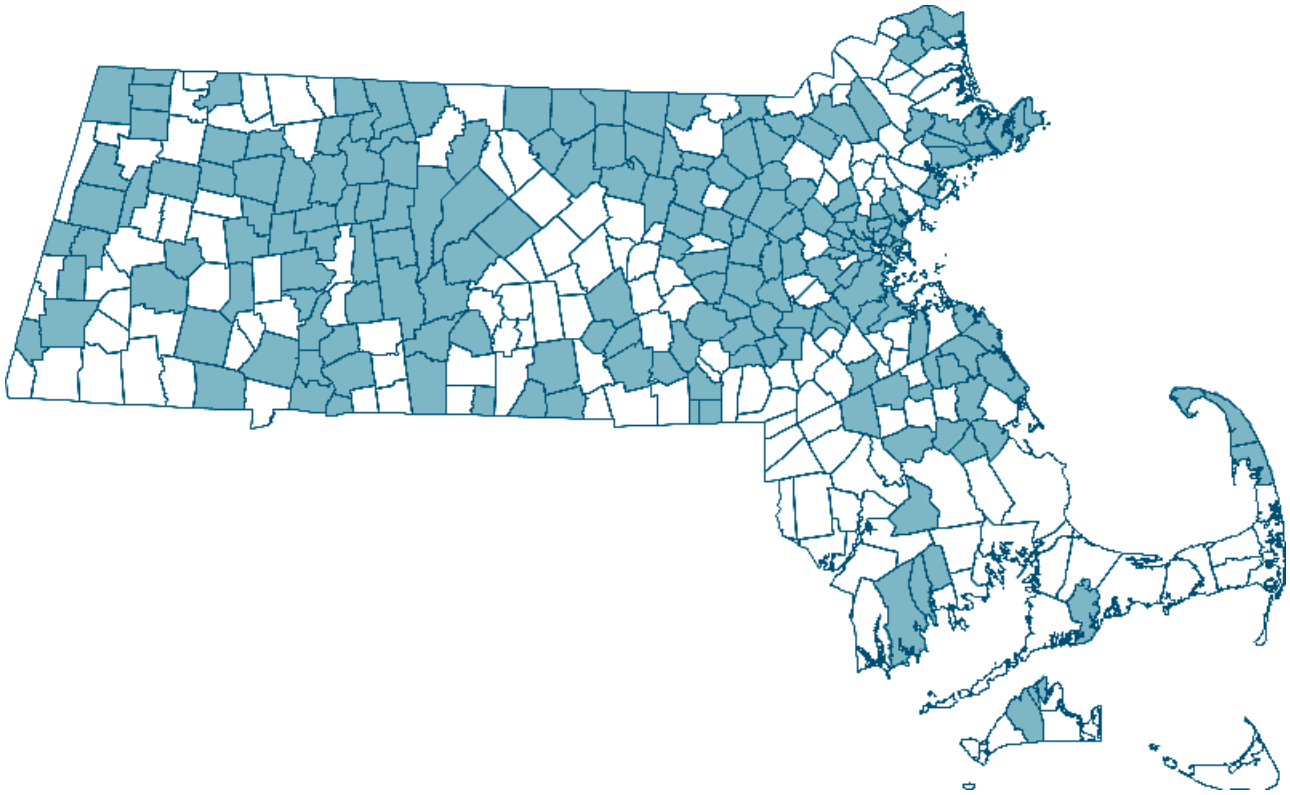
1. Program uptake is thriving. Participation in the Green Communities Program has grown steadily from the launch of the program in 2008 to include more than one-half of municipalities in the state. These communities represented nearly two-thirds of the population in 2016.

Figure 2. Growth of Green Communities Program participation



2. Green Communities are diverse. The map in the following figure shows that Green Communities are geographically diverse, spanning urban, suburban, and rural parts of the state. Municipalities also range in terms of population.

Figure 3. Map of Green Communities



The names of the Green Communities are provided in the table below.

Table 2. List of Green Communities

A

Acton
Acushnet
Adams
Agawam
Amesbury
Amherst
Andover
Arlington
Ashburnham
Ashby
Ashfield
Ashland
Athol
Auburn
Ayer

B

Barre
Becket
Bedford
Belchertown
Belmont
Berlin
Bernardston
Beverly
Blackstone
Blandford
Bolton
Boston
Bridgewater
Brockton
Brookline
Buckland

C

Cambridge
Carlisle
Charlton
Chelmsford
Chelsea
Chesterfield
Chicopee
Clarksburg
Cohasset
Concord
Conway

D, E

Dalton
Dartmouth
Dedham
Deerfield
Dover
Dudley

Easthampton
Easton
Egremont
Erving
Essex
Everett

F, G

Fitchburg
Framingham

Gardner
Gill
Gloucester
Goshen
Granby
Granville
Great Barrington
Greenfield

H

Halifax
Hamilton
Hanover
Hardwick
Harvard
Hatfield
Hawley
Holland
Holliston
Holyoke
Hopkinton
Huntington

K, L

Kingston

Lakeville
Lancaster
Lanesborough
Lenox
Leominster
Leverett
Lexington
Lincoln
Littleton
Longmeadow
Lowell
Lunenburg

M

Malden
Manchester
Marlborough
Marshfield
Mashpee
Maynard
Medfield
Medford
Medway
Melrose
Mendon
Middlefield
Millbury
Millis
Millville
Milton
Monson
Montague

N

Natick
New Bedford
New Salem
Newburyport
Newton
North Adams
North Andover
Northampton
Northbridge
Northfield
Norwell

P, Q, R

Palmer
Pelham
Pembroke
Pepperell
Petersham
Pittsfield
Plainfield
Plympton
Provincetown

Quincy

Revere
Richmond
Rockland
Rockport
Rowe

S

Salem
Salisbury
Saugus
Scituate
Sherborn
Shirley
Shutesbury
Somerville
Southborough
Southbridge
Springfield
Stockbridge
Stoughton
Stow
Sudbury
Sunderland
Sutton
Swampscott

T, U

Tewksbury
Tisbury
Topsfield
Townsend
Truro
Tyngsborough

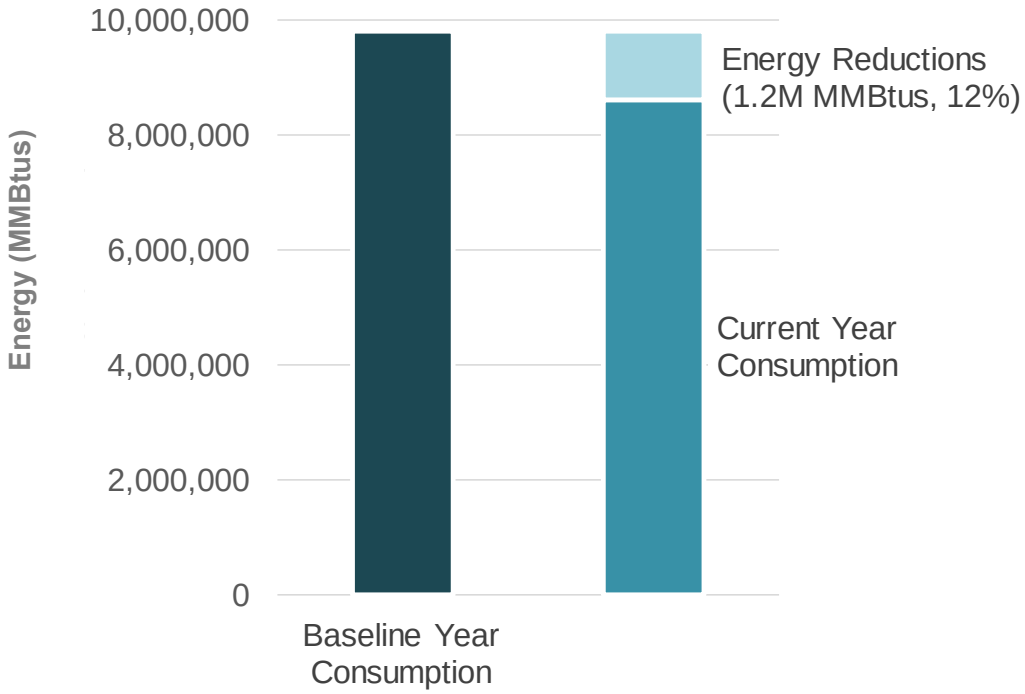
Upton

W

Ware
Warren
Warwick
Watertown
Wayland
Wellfleet
Wendell
Wenham
West Newbury
West Springfield
West Tisbury
Westfield
Westford
Westminster
Weston
Westwood
Weymouth
Whately
Whitman
Williamsburg
Williamstown
Winchendon
Winchester
Windsor
Winthrop
Woburn
Worcester

3. Green Communities are reducing their energy use. Municipalities reported consuming 1.2 million fewer MMBtus in 2016 than in their baseline years. This 12 percent reduction in energy use is enough to power and heat more than 9,000 Massachusetts homes. It represents reductions of approximately 96,000 metric tons of CO2 equivalent emissions. The figure below shows energy use reductions in 2016 relative to the aggregated energy use in the municipalities' baseline years.

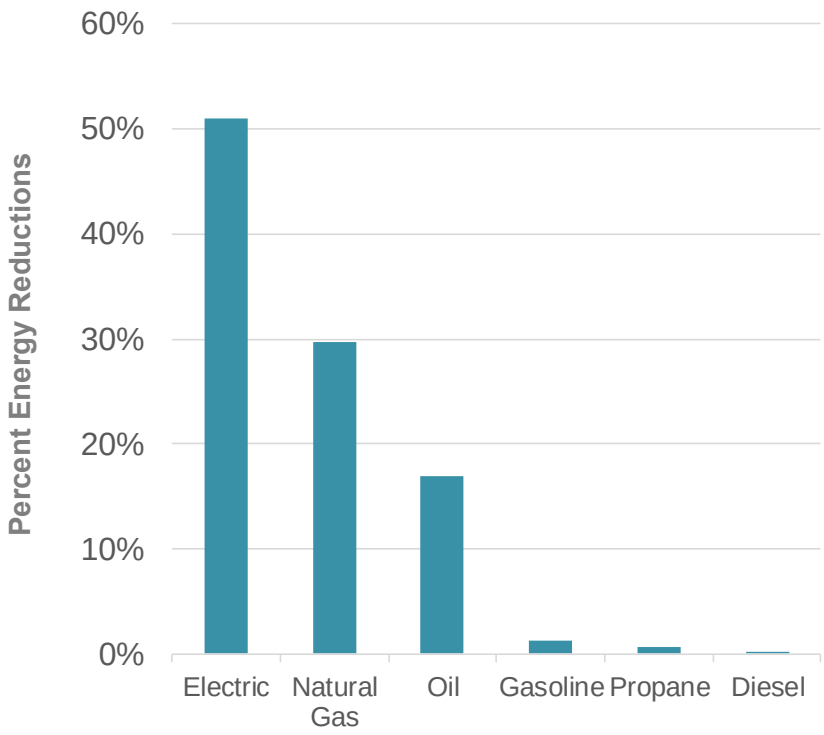
Figure 4. Reductions in energy use



4. These energy reductions are primarily due to electricity, natural gas, and oil savings. Approximately half of the energy reductions are electric, due to lighting upgrades. Another 30 percent of the energy reductions are natural gas, due to more efficient heating systems and building controls and weatherization efforts. Seventeen percent of the reductions in energy use relate to oil, due to the shift away from the oil-based heating and to weatherization efforts.

The figure below shows the percent energy reduction by fuel type.

Figure 5. Percent energy reductions, by fuel type



5. Municipalities are achieving the ambitious program goal of reducing municipal energy use by 20 percent. Twenty-four municipalities have accomplished this goal: two in 2013, five more in 2014, and 17 in 2016. It took six years, on average, for municipalities to reach this goal.

6. Renewable Zoning & Permitting: Criteria 1 & 2

To be recognized as Green Communities, municipalities must demonstrate that they meet two requirements related to renewable energy development. These include:

Criterion 1

Allow zoning in designated locations for the as-of-right siting of renewable or alternative energy generating facilities, research and development facilities, or manufacturing facilities.

Criterion 2

Develop, or have in place, an expedited application and permitting process of one year at most, for applicable facilities in the designated renewable zone from Criteria 1, above.

All Green Communities demonstrated they continue to meet these two renewable energy requirements. This section provides key findings and highlights of renewable energy efforts in Massachusetts Green Communities to date.

Key Findings

1. To date, 19 municipalities reported approvals for 41 permits for as-of-right siting of renewables on municipal land, including generators, research and development facilities, and clean energy manufacturers.
2. Solar generation accounted for more than 90 percent of the permits.[3] Several permits enabled companies conducting research and development activities associated with clean energy to start up business in the municipality. There were no permits issued for manufacturing activities.

[3] The development type was not identified for 12 projects.

Highlights

Siting renewable energy projects on land with limited development possibilities presents a big opportunity for communities to lower energy costs. Communities are implementing projects on brownfields, including Superfund sites and capped landfills.

Zoning amendments in some communities are increasing renewable energy zones.

Lexington

At its Annual Town Meeting in 2016, Lexington substantially amended its zoning bylaw and map. While these amendments were driven by other concerns, the changes expand the opportunities for the municipality to generate and use solar energy in the affected area and also throughout the community.

There are two specific changes to highlight. First, the amendment created an entirely new district, the Government-Civic Use District (GC District). This GC District comprises over 3,000 acres of land owned by federal, state, or local government agencies. Solar generation is allowed in the new GC District by right. Second, the municipality expanded the Commercial-Manufacturing (CM District) by adding a 30+ acre parcel of land that will host a ground-mounted solar project.

Clean energy is helping to revitalize municipal centers and create jobs.

Somerville

Greentown Labs, the largest clean tech startup incubator in the United States, chose Somerville as its base of operations in 2014. Its headquarters is a 33,000 square-foot building designed to provide prototyping, office, and event space for clean tech entrepreneurs. More than 100 startup companies have incubated at Greentown Labs since its opening, creating more than 500 jobs. In 2016, the municipality approved the company's request to expand its operations.[4]

[4] Please see Greentown Lab's website at: https://www.greentownlabs.com/.

7. Municipal Energy Consumption - Criterion 3

To demonstrate compliance with Criterion 3, municipalities must meet the following requirements.

Criterion 3

Establish an energy use baseline inventory for municipal buildings (including schools, drinking water, wastewater treatment plants and pumping stations and open spaces), street and traffic lighting, and vehicles; and

Adopt an Energy Reduction Plan (ERP) demonstrating a reduction of 20 percent of baseline energy use after five years of implementation.

Green Communities across the state are reducing energy use in existing municipal buildings, water treatment and pumping facilities, streetlights, and municipally owned and operated vehicles. Communities achieve energy reductions by weatherizing buildings, optimizing control of HVAC systems, installing energy management systems, replacing old and inefficient lighting and heating and cooling equipment (among other measures) with more energy efficient technologies, and adopting policies to reduce vehicle fuel use. This can also include converting a portion of the building's energy use from one heating fuel to another.

This section provides a more detailed description of the result of local efforts to reduce energy use. We start this section by recognizing municipalities that achieved the energy reduction goal. We then provide key findings and highlights—overall and by category—before drilling deeper into the variety of measure types included. Each municipality's report breaks out energy consumption and reductions into five categories: buildings, water and wastewater treatment plants and pumping stations, street lighting, vehicles, and open space. We feature separate sections for four of five categories representing a substantial portion of energy use, including buildings, water and wastewater treatment plants and pumping stations, street lighting, and vehicles.[5] The project counts in these sections are reported by municipalities and represent energy saving measures.

Municipalities Reaching 20 Percent Energy Reduction Goal

To date, 24 communities have reduced their energy use by 20 percent or more. These communities represent nearly one-third of the 86 municipalities that are eligible for this distinction. To be eligible, municipalities must be a Green Community for at least five years. Two municipalities reached this goal in 2013, five more in 2014, and 17 in 2016. On average, communities took six years to achieve the goal.

[5] Open space and other uses represent approximately 1 percent of energy consumption across municipalities. The other category includes efforts that were not categorized by municipality.

The table below shows the municipalities that reached this goal, the year they reached it, the percent energy reduction achieved in 2016, and the number of years it took for the community to achieve the goal. The communities are listed in alphabetical order by year, starting with the communities that reached the goal in 2013.

Table 3. Municipalities achieving 20 percent energy reduction goal

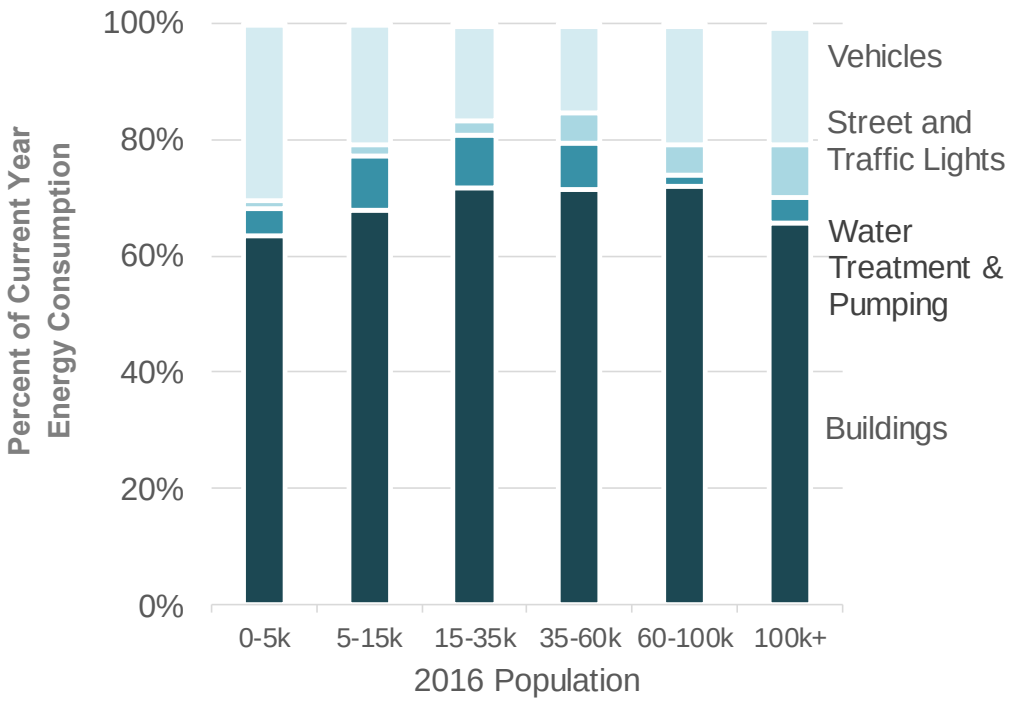
Municipality	Year Goal Achieved	Percent Energy Reduction	Number of Years to Achieve Goal
Natick	2013	27%	5
Springfield	2013	21%	5
Arlington	2014	22%	6
Belchertown	2014	25%	5
Cambridge	2014	29%	6
Palmer	2014	41%	5
Sutton	2014	40%	7
Acton	2016	26%	7
Becket	2016	31%	7
Gill	2016	37%	6
Greenfield	2016	26%	8
Holland	2016	25%	6
Holyoke	2016	21%	7
Lakeville	2016	20%	5
Maynard	2016	22%	5
Medford	2016	20%	7
Millbury	2016	22%	7
New Salem	2016	20%	7
Richmond	2016	32%	6
Sherborn	2016	25%	7
Sunderland	2016	24%	5
Tyngsborough	2016	21%	8
Wendell	2016	22%	5
Williamstown	2016	27%	8
Average			**6**

Overview of Energy Consumption and Reductions

This section summarizes key findings regarding energy consumption and reductions at the category and measure level.

1. Though it varies considerably by community, most energy is consumed by buildings (69 percent on average in the current year). Vehicles consumed 19 percent of municipal energy on average in the current year. Water treatment and pumping and street lighting each consumed 6 percent of municipal energy. Open space and other uses consumed 1 percent of municipal energy.
2. The proportion of energy use by category varies for municipalities of differing sizes.[6] The figure below shows the proportion of current year energy consumption by category for communities of differing sizes.

Figure 6. Percent of current year energy consumption, by category



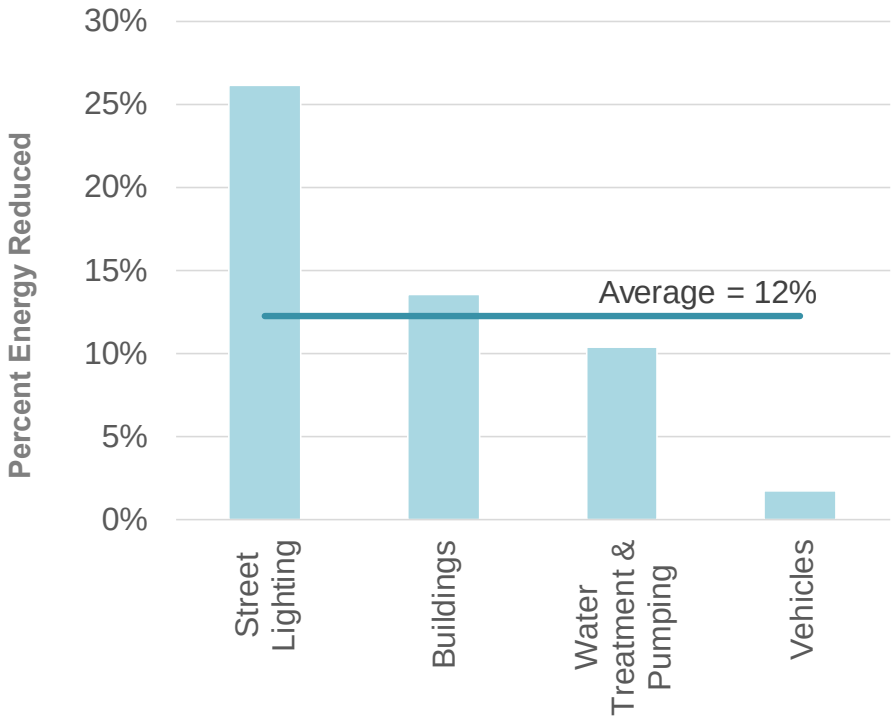
[6] Population by municipality is from the 5/25/17 release of the U.S. Census Bureau's 2016 MCD-Level Population Estimates, available at: http://www.massbenchmarks.org/statedata/news.htm.

Vehicles represent a larger portion of the smallest communities' energy use. Communities are finding that vehicle energy use reductions are challenging to attain. Therefore, the 20 percent energy reduction goal may be more of a reach for smaller municipalities as compared to larger municipalities.

Water treatment and pumping is a larger percentage of use by mid-sized communities. The portion of energy use by street and traffic lights appears to grow with the size of the municipality.

Street lighting and buildings represent the largest percent reductions in energy use to date. The figure below shows the reductions in energy use as a proportion of baseline year energy consumption for buildings, water treatment and pumping, street lighting, and vehicles. The line shows the average across all categories.

Figure 7. Reductions in energy use, by category



Weather Normalization

Weather can have a substantial impact on energy use. Warmer summers can drive up electricity use from air conditioning. Colder winters increase building fuel use for heating and snowier winters increase vehicle fuel use for snow removal. Conversely, a cooler summer or warmer winter can mitigate energy use.

Without normalizing for the impact of weather on energy use, a particularly cool summer and/or warm winter can enable communities to reach the energy reduction goal of 20 percent without taking commensurate energy savings actions. Weather-normalized energy use, an energy use adjustment to remove the impact of weather, more accurately represents the impact of municipal efforts to reduce energy use over time.

Most Green Communities use MassEnergyInsight© (MEI) to benchmark and track energy use. MEI began accounting for the impact of weather on overall energy use in 2015 and some municipalities provided weather-normalized energy use in 2015 and 2016.

The method used by MEI to calculate weather-normalized energy use in 2016 starts by determining the impact of weather on each fuel's usage. MEI divides the weather-dependent use for each fuel by the number of heating or cooling degree days in that year, producing a use-per-degree day for each fuel. Then, MEI uses the use-per-degree day for each fuel to scale back up to an annual value by multiplying by the number of degree days in an average year.

Weather normalization through MEI is a work in progress. There are a few drawbacks to the current methodology.

First, municipalities calculate adjustments in energy use due to building stock changes outside of MEI and these adjustments are not accounted for in MEI's weather-normalized energy use.

Second, facility-specific adjustments are more detailed and more accurate than municipal-level adjustments. However, facility level data, such as the hours each building is occupied, the temperatures at which each building needs to be heated or cooled, and the amount of energy each building uses when not doing any heating or cooling, is not provided in municipal data. Also, MEI normalizes buildings for cooling degree days even if they do not have air conditioning.

Third, MEI does not currently normalize vehicle fuel use to account for weather impacts.

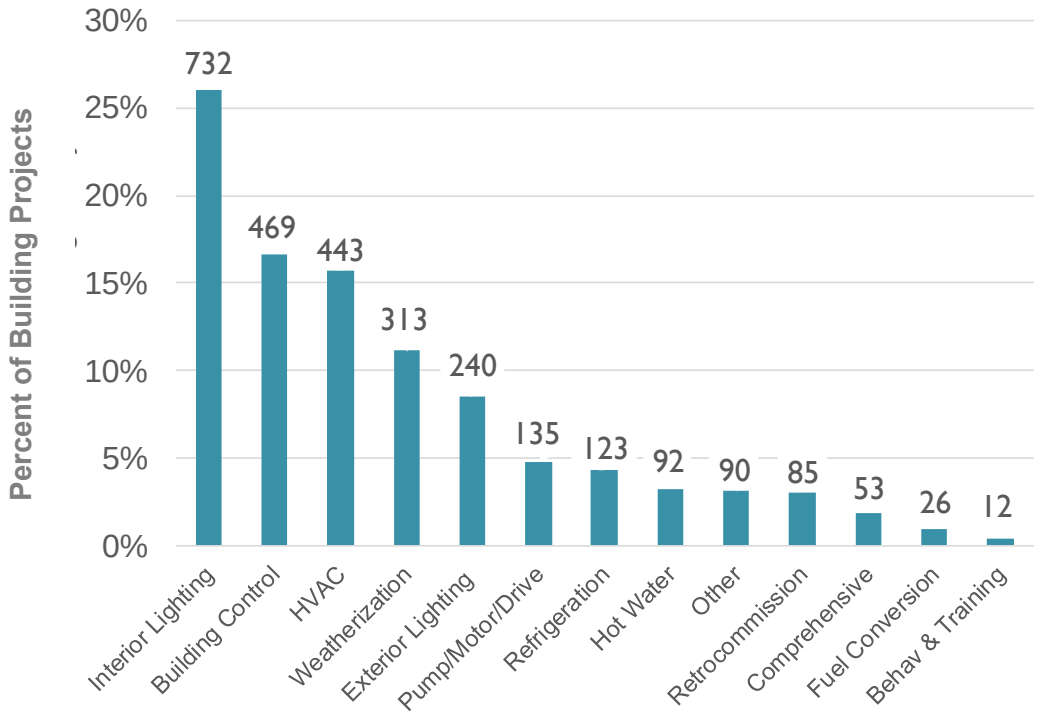
MEI's methodology to adjust energy use for weather will improve over time and some of these drawbacks will be addressed in the future.

Buildings

Key Findings

1. As of 2016, 114 Green Communities had implemented more than 2,800 energy efficiency projects in buildings, with energy reductions of nearly 925,000 MMBtus across all fuel types.
2. Green Communities use a variety of measures to reduce energy consumption in buildings. The figure below shows the breakout of projects by measure type for buildings.

Figure 8. Building projects, by type



Nearly half of the projects represent three measure types: (1) building controls, (2) heating, ventilation, or air conditioning systems (HVAC), and (3) weatherization. Building control measures include lighting and heating, ventilation or air conditioning system controls as well as some retro-commissioning efforts.[7] HVAC also includes fuel conversions. One-third of projects involved interior or exterior lighting measures. The remaining projects span eight measure types. The Other category includes appliances and equipment such as computers.

[7] Retro-commissioning includes building control measures as these types of measures are often conducted as part of retro-commissioning.

Highlights

Many municipalities are converting interior and exterior lighting to LEDs. Forty-nine have collectively implemented more than 250 projects to date to convert lighting in one or more buildings to LEDs.

Municipalities are reducing energy use and greenhouse gas emissions by converting from oil to natural gas or propane during heating system replacements. Ten communities have implemented 20 projects to convert from oil to natural gas. In late 2015, Holyoke converted furnaces and burners in two City Hall buildings from oil to natural gas during replacement, resulting in an estimated $53,164 in annual cost savings, 4,289 in annual MMBtu savings, and a 348-ton reduction in greenhouse gas emissions.

Heat pumps are emerging as a new savings opportunity for communities. Thirteen municipalities have implemented 15 heat pump projects. Communities are using heat pumps to reduce heating system oil use more often than to reduce natural gas use.

Gill

Gill implemented several improvements at its Riverside Building, resulting in an estimated $11,089 in annual cost savings, 534 MMBtus of annual energy savings, and enhanced conditions for employees and community members who use the building. As a multi-purpose building, some spaces are used daily, some weekly, and others monthly or less. The municipality first installed new windows and upgraded the building insulation and air sealing. Then, it installed air source heat pumps. The air source heat pumps enable the municipality to heat or cool specific rooms for specific uses and events. It is important to note that while the equipment has been reliable, the municipality had to budget time and resources to maintain the six outdoor and 13 indoor air source heat pump units, as opposed to servicing one boiler.

Greenfield

Greenfield's Davis Street Administration Building was an old brick neighborhood school that was the most energy intensive building in the municipality. This was due to large, single pane windows in poor condition and an old, failing oil-fueled boiler. The building was drafty and had window air conditioning units installed year-round. Thus staff relied on space heaters to supplement inadequate heat and were still largely uncomfortable throughout the winter. The boiler burned an average of 25,000 gallons of oil for each of the previous two winters. Although the building was scheduled to be decommissioned in 2016, the boiler failed and needed immediate replacement for one final winter of use.

The municipality intended to replace the old oil boiler with an inexpensive, inefficient new oil boiler to be used only for the one heating season. The Energy Department saw an opportunity to install Variable Refrigerant Flow (VRF) heat pump technology as it can be moved to another building and reinstalled once the building was vacant. Though the building shell remained inefficient, energy use for the building decreased substantially and the building staff reported being much more comfortable. The heat pump system is now scheduled to be reused in the Town Hall as part of a larger Green Communities grant-funded project.

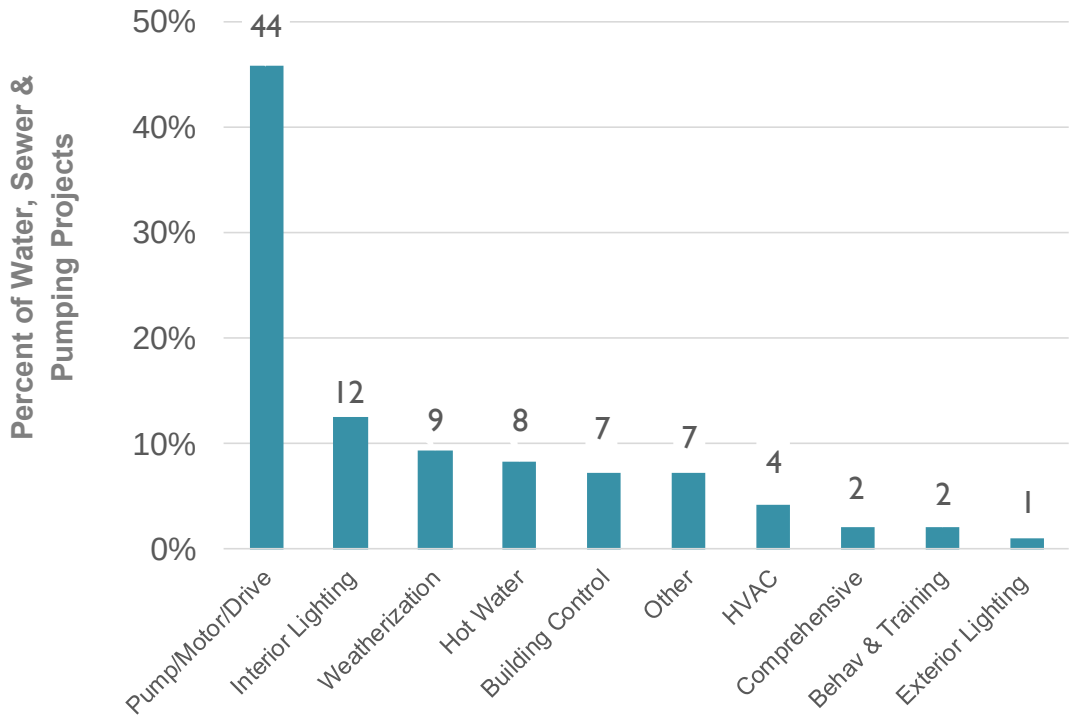
Water Treatment and Pumping Facilities

Key Findings

1. Since the start of the Green Communities Program, 39 Green Communities have implemented nearly 100 energy efficiency projects in water, sewer, and pumping facilities, with energy reductions of just over 63,000 MMBtus across all fuel types.
2. Nearly half of all measures were pumps, motors, and drives. Remaining measures included lighting, hot water, and HVAC measures.

The figure below shows water treatment and pumping projects by type.

Figure 9. Water treatment and pumping projects, by type



Highlights

Water and wastewater treatment plants and pumping stations offer substantial energy reduction opportunities for many communities.

Palmer

In Palmer, water and sewer infrastructure used 25 percent of the municipalities' total energy use. To meet environmental requirements, Palmer separated the flow of rainwater runoff from sewage by eliminating 26 combined sewer overflows. Now only the sewage is directed to the communities wastewater treatment plant, which has made the plant's load more consistent. The municipality then improved the plant's energy efficiency during a plant upgrade by: (1) installing a smaller, more efficient model to serve as the primary aeration blower, (2) removing a blower that was original to the plant and (3) using the two remaining, less efficient blowers only for backup. In total, these changes cut the wastewater treatment plant's energy consumption by 50 percent in less than five years. The municipality is currently considering opportunities to further optimize the system by downsizing equipment in pumping stations to match the reduced flow rate .

Street Lighting

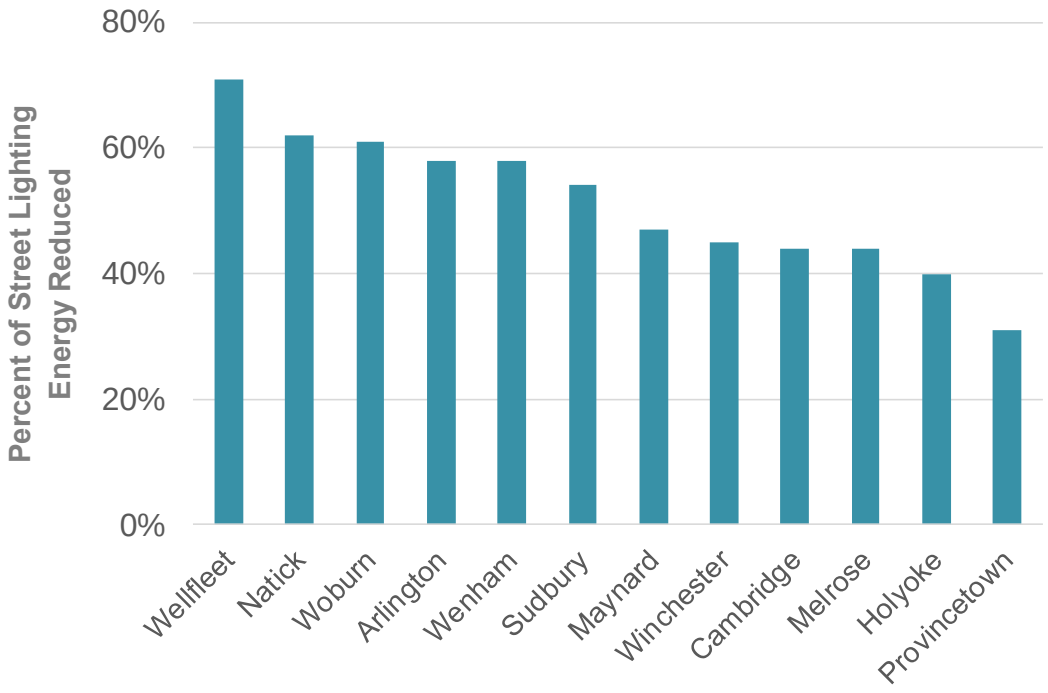
Key Findings

1. Fifty-six Green Communities implemented over 100 street and traffic lighting projects, reducing more than 170,000 MMBtus (roughly 50,000 MWh) to date.
2. Most of these projects (approximately 85 projects across 47 municipalities involved converting a portion of municipal street lighting to LEDs.

Highlights

Communities that invest in converting street lighting to LEDs experience substantial street lighting energy reductions. To date, nine municipalities reduced two-thirds or more of the energy they use for street lighting by converting all or a portion of their street lights to LEDs.

Figure 10. Municipalities with the highest reductions in street lighting energy use



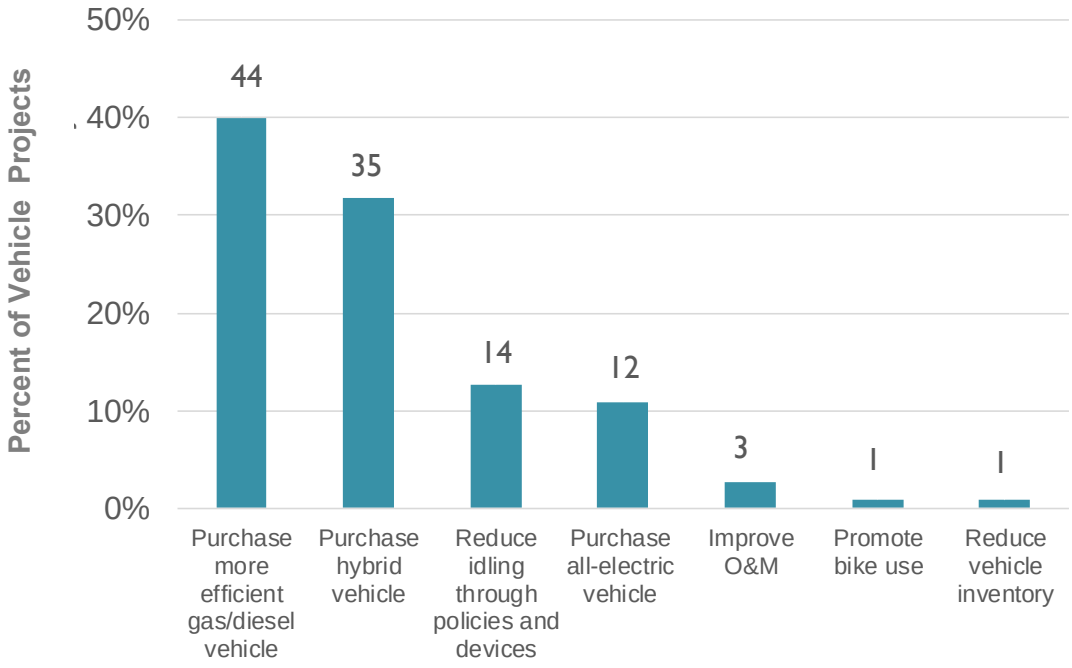
Vehicles

This section provides findings and highlights of policies and practices intended to reduce vehicle energy use.[8] These policies and practices include vehicle replacements with high efficiency vehicles, vehicle retirements, and anti-idling technologies and policies.

Key Findings

1. Thirty-nine Green Communities implemented roughly 110 vehicle-related projects, reducing energy use by more than 27,000 MMBtus to date.
2. Some municipalities are achieving modest levels of vehicle energy reductions through a combination of vehicle replacement and policies and practices such as improvements to the tracking of vehicle use, fuel use, and idling.
3. Most projects involved replacing an existing vehicle with a more fuel-efficient gas/diesel, hybrid, or electric vehicle. The following figure shows the breakout of vehicle projects by project type.

Figure 11. Vehicle projects, by type



Highlights

Municipalities are purchasing hybrids to replace fire and police administration vehicles.

Arlington

In Arlington, the Town Manager noted that the price, fuel savings, and the comfort of the municipalities mechanics with the technology has advanced to a point where it made sense to purchase hybrid vehicles.

[8] Section 8 provides findings and highlights on vehicle fleets, a related topic that is treated as a separate section in this report.

8. Vehicle Fleet - Criterion 4

Criterion 4 requires all departments within Green Communities to purchase fuel-efficient vehicles for municipal use, whenever such vehicles are commercially available and practicable. To meet this requirement municipal governments and school districts must meet the following requirements.

Criterion 4

Municipal governments and school districts must:

- Adopt a Fuel-Efficient Vehicle Policy requiring all municipal departments and divisions to purchase fuel-efficient vehicles,
- Develop and maintain a vehicle inventory for all four-wheeled passenger vehicles, and
- Provide a plan for replacing non-exempt vehicles[9] with vehicles that meet specified fuel efficiency ratings.

This section provides key findings and highlights of efforts by Green Communities to replace vehicles in their inventory with more fuel-efficient vehicles or to adopt alternative compliance mechanisms if all vehicles are exempt. Energy consumption and reduction data are not provided by vehicle in the reporting. Therefore, this type of data is not presented in this section.

As shown by the vehicle-related energy reductions described in the previous section, municipalities can reduce their vehicle energy use by purchasing smaller, more efficient vehicles (i.e., that get higher miles per gallon of fossil fuel, including gasoline or diesel). They can also purchase vehicles that use different fuels such as electric, natural gas, and hybrid vehicles.

If a municipality's inventory contains all exempt vehicles, it must propose an alternative compliance mechanism and commit to purchasing fuel-efficient vehicles should the community need to purchase any non-exempt vehicles in the future. Alternative compliance mechanisms can include carpooling incentives for municipal employees; preferred parking for employees with hybrid vehicles; bicycle racks at municipal buildings; incentives to encourage employees to bike to work; a bicycle-sharing program for employees to travel within the municipality, installation of electric vehicle charging stations; and use of alternative fuels such as biodiesel blends for heavy duty fleets.

Notably, the policies and practices identified above as alternative compliance mechanisms could provide benefits to all communities, regardless of the exemption status of municipal fleets. Section 8 reports on policies that municipalities have implemented to reduce vehicle fuel use.

[9] For more information on the definition of exempt and non-exempt vehicles, please see the Criterion 4 guidance at: https://www.mass.gov/files/documents/2016/08/pp/criterion-4-guidance.pdf.

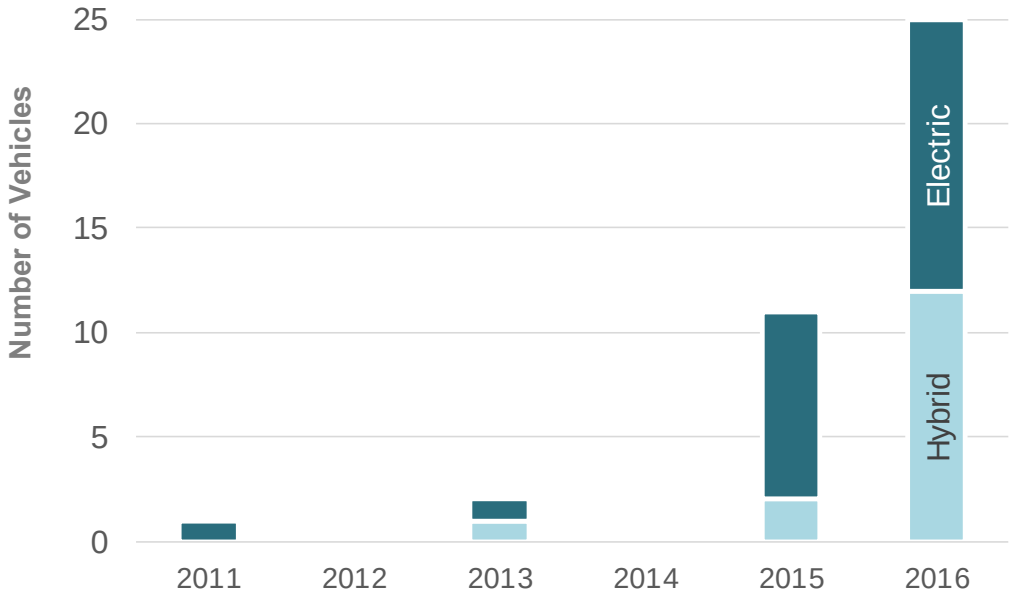
Key Findings

1. Eighteen municipalities are using alternative compliance mechanisms to comply with this criterion, including implementing anti-idling policies and promoting bicycle use.
2. There are 13 Green Communities in which all vehicles are exempt, most of which are very small (i.e., with fewer than 5,000 inhabitants).
3. In many communities, most municipal vehicles are exempt. Roughly 75 percent of all vehicles for municipal use are exempt, leaving only 25 percent of the vehicle stock as eligible for replacement.
4. The newly acquired vehicles influenced by the Green Communities' Fuel-Efficient Vehicle (FEV) policies operate at an average fuel efficiency of 26 miles per gallon.
5. Some communities have difficulty adhering to their fuel-efficient vehicle policy (FEV). Since the program's inception, 16 communities have violated FEV policies and were required to submit Corrective Action Plans to ensure the violations do not happen again. The Corrective Action Plans included FEV policy updates, yearly reminders to all departments highlighting the main points in the FEV policy, notices reminding all municipal departments that vehicle transfers between departments must meet fuel efficiency criteria, and designated individuals and committees to oversee vehicle purchases and transfers across departments.

Highlights

Purchases of hybrid and electric vehicles increased noticeably in 2015 and 2016. From 2011 to 2016, communities purchased 24 electric and 15 hybrid vehicles. Most of these vehicles were purchased in the last two years. The following figure shows the number of hybrid and electric vehicles purchased by year. Starting in 2015, Green Communities could use grant funds to purchase electric vehicles and electric vehicle charging stations.

Figure 12. Number of hybrid and electric vehicle purchases, by year



9. New Construction - Criterion 5

Buildings constructed to the Stretch Code use significantly less energy than buildings built to other current and previous building codes. Municipalities must meet the following requirements.

Criterion 5

Municipalities must minimize the life cycle cost of all newly constructed homes and buildings and those undergoing major renovation.

Municipalities have satisfied this criteria by following DOER's recommendation of adopting the Massachusetts' Board of Building Regulations and Standards (BBRS) Stretch Code (780 CMR 115.AA).

This section provides key findings and highlights of new construction efforts in Massachusetts Green Communities.

Key Findings

1. Penetration of the Stretch Code in Massachusetts communities is high—driven in part by Green Communities requirements. As of November 2017, 215 Massachusetts municipalities had adopted the Stretch Code.[10] This represents more than half of all municipalities. As all Green Communities adopted the Stretch Code, Green Communities represent a substantial portion of the Massachusetts communities adopting the Stretch Code.
2. To date, Green Communities have issued certificates of occupancy for nearly 7,000 new or substantially renovated, high-efficiency homes and buildings.
3. Most projects (95 percent) are residential projects, and most of these projects are new construction projects.
4. The efficiency of new homes and homes undergoing major renovation appears to increase between 2011 and 2016.[11] The figure below shows the percent of residential projects for several groupings of HERS scores over time. A HERS Score of 70 and under complies with the version of the Stretch Code that was in place through 2016. A HERS Score of 55 and under complies with the version of the Stretch Code effective in 2017. A HERS Score of zero is a net-zero energy home. A HERS Score of 71 and above does not comply with any version of the Stretch Code for new homes, so these projects are most likely major renovations.[12]

[10] Please see Massachusetts' Department of Energy Resources Stretch Code Adoption, by Community at: https://www.mass.gov/service-details/building-energy-codes.

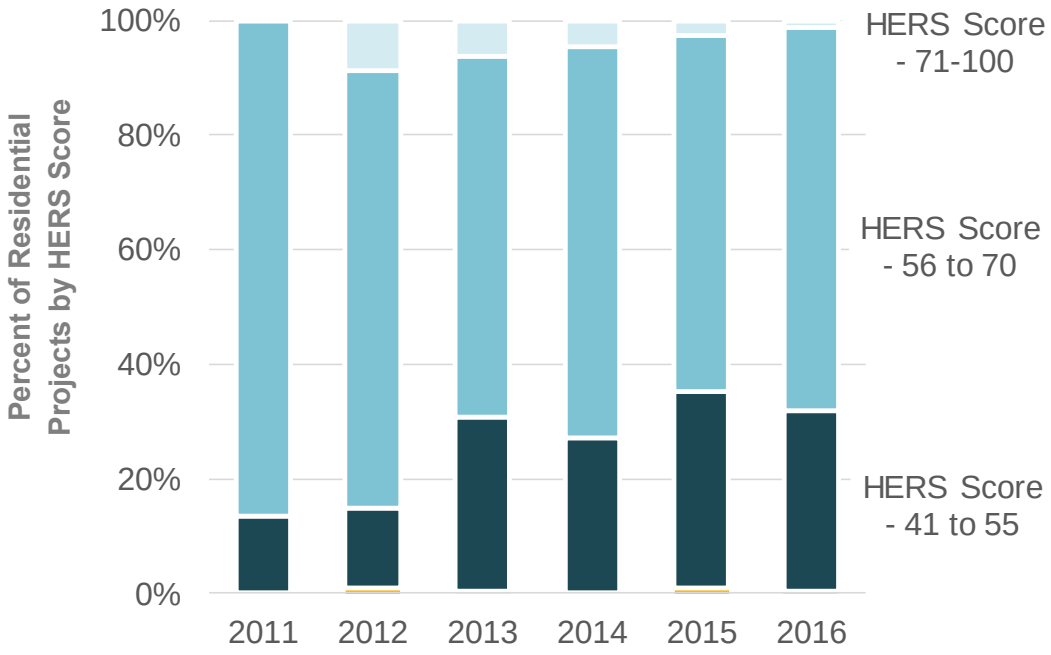
[11] Municipalities did not see a substantial number of projects until 2011.

[12] Renovations have less stringent energy performance requirements than new buildings.

Over time, a greater proportion of homes received a HERS Score of 41 to 55, as compared to those with HERS Scores of 56 to 70. Over the same period, the proportion of residential projects with HERS Scores of 71 and higher decreases. This is likely due to adoption of the Stretch Code, which prohibits new homes and buildings with HERS Scores above 70.[13]

There may be several reasons for the improved energy efficiency of residential new construction over time. Builders may be gaining knowledge of and experience with new materials, designs, and technologies needed to build efficient homes. They may also be becoming aware of declining costs and receiving recognition for demonstrating leadership and saving customers money.

Figure 13. Percent of residential projects by HERS score, by year



[13] With Massachusetts' adoption of the 2015 International Energy Conservation Code, new homes and buildings will be required to achieve a HERS Score of 55 under the Stretch Code starting January 1, 2017.

Highlights

Many Green Communities indicated that homeowners understand the benefits of the Stretch Code and want better-built homes with lower energy costs.

"With rising energy costs homeowners are eager to have more energy efficient homes."

"Homeowners continue to report that the Stretch Code has saved them money on their utility bills and are satisfied with the result of it at their homes."

"Adopting the stretch energy code has not adversely affected the towns' growth. In fact, it is being used as a selling point."

"Town inspectors believe that market forces appear to be driving builders to exceed Stretch Code standards."

"After going through the initial learning curve, and having to learn some unique ways of insulating a home, local builders have said they wished the code was in place when they built their own homes. Builders who were skeptical of the change now fully support and recognize the Stretch Code as a better way to build homes."

However, the adoption curve may be longer for builders, developers, and contractors for a variety of reasons.

"There is a need for more education regarding the long-term savings which offsets increased building costs."

"[The Building Inspector] still gets questions from local contractors about the Stretch Code and what is required of them."

"There is a need to simplify the energy code so that compliance can be increased."

"Not having a single/simplified energy code for the state (and the country for that matter) makes the learning curve for architects/ designers even more confusing."

"The Stretch Code continues to be a challenge to enforce. The [Building] Department has to chase down builders for HERS ratings and often gets push-back since there is a cost to get the rating."

Municipalities are beginning to build net zero emission homes and adopt policies supporting building to net zero.

Cambridge

Cambridge's City Council adopted a Net-Zero 25-Year Action Plan in June 2015. The Plan aims to reach zero greenhouse gas emissions from buildings over a 25-year period and includes retrofits of existing buildings, new construction, and energy supply.[14]

Ashland

Ashland's ultra-efficient homes on Wilson Drive created a dialogue in the community about the benefits and cost savings that can be achieved with these efficient building efforts.

Sudbury

In designing their new police station, Sudbury gained experience with Advanced Building Design, which is more energy efficient than the current stretch energy code.

10. Links to Other Efforts

Importantly, we found that Green Communities are participating in energy-related initiatives that are above and beyond the scope of the Green Communities Program.

Fifty-six out of the 63 municipalities that have participated in Solarize Mass since its launch in 2011 were Green Communities. Solarize MA is a DOER and MA Clean Energy Center (CEC) administered program which promotes small scale residential and commercial solar PV installations through grass roots marketing and group purchasing. Green Communities have installed approximately 160 solar PV projects since the start of the program in 2008. Other types of renewable energy projects implemented include wind, solar thermal, wood pellet boilers, and combined heat and power (CHP). Some of these projects are being integrated directly with load, including water and wastewater treatment plants and pumping stations, for maximum benefit.

Also, some Green Communities are using municipal aggregation programs to increase the proportion of renewable resources used to meet energy needs for residents and businesses community-wide. Dozens of municipalities in Massachusetts have deployed municipal aggregation programs in the past few years, many of which incorporate renewable electricity.

[14] Please see the Cambridge Community Development Department website for more details, at: http://www.cambridgema.gov/cdd/projects/climate/netzerotaskforce.

Greenfield

Greenfield operates a municipal aggregation program known as Greenfield Light and Power that provides 100 percent green electricity to all participating electric customers. The program purchases all renewable energy credits (RECs) required for renewable portfolio standard compliance from local and regional renewable energy projects.

Some Green Communities are indicating that they may start to work towards 100 percent renewable electricity. One way to accomplish this is by formally adopting a 100 percent renewable electricity goal for government energy use, in line with the proposed state legislation. Communities can also support renewables through a combination of power purchase agreements for energy, government REC retirement, and voluntary residential REC retirement. Power purchase agreements can be combined with increases to the allocation of renewable resources in their electric supply contracts. In tandem with efforts to increase renewable generation elsewhere, communities may want to embark on longer-term planning for locally sited renewable energy projects. As installation of renewable generators takes place in the community, municipalities can rework contracts to prioritize the use of this renewable generation to meet their energy needs.

The Green Communities program is changing the way municipalities do business by broadening the choices they have and accelerating their readiness and enthusiasm for change.

11. Conclusion

The Green Communities Program's success is driven by wide applicability and interest, broad and diverse engagement, and concrete progress towards goal achievement. Municipalities are signing up for the program at an increasing rate. This program year is particularly notable as more municipalities accomplished their energy reduction goal in 2016 than any prior year.

Despite the longer-term challenge of reducing vehicle fuel use, municipalities are accomplishing their energy reduction goals. Communities have been particularly successful in reducing the use of electricity, natural gas, and oil in buildings and streetlighting, which account for the majority of municipal energy use. These energy reductions are lowering emissions of greenhouse gases, in line with broader state policy objectives.

Massachusetts Department of Energy Resources

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www.mass.gov/orgs/massachusetts-department-of-energy-resources