Massachusetts Green Communities: A Model Program for Energy Efficiency

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ABSTRACT

Municipalities represent a small portion of the C&I portfolio, but play an important role in efficiency programs through their ability to serve as leaders and role models. Massachusetts has created a unique state "Green Communities" designation and grant program for municipalities that meet five energy-related criteria. Notably for efficiency, these criteria include a commitment to reduce municipal energy usage by 20% within five years and the passage of a local "stretch" building code. There are currently 123 Green Communities, representing 48% of the Massachusetts population, that have met the five criteria and have unique grant opportunities for clean energy projects. The Massachusetts Department of Energy Resources (DOER) has worked with the state's Mass Save® efficiency programs to tailor efficiency services specifically to the needs of municipalities, including designated Green Communities. From 2010-2012, a greater portion of municipalities designated as Green Communities completed an efficiency project receiving Mass Save® incentives than municipalities not designated, and they accrued more than 1.5 times greater total electric savings. This suggests that Green Communities projects are able to acquire deeper energy savings with the same amount of funding or, alternatively, that they require a lesser amount of incentives to be completed. Through Green Communities grants and Mass Save® incentives, many Green Communities are beginning to see substantial reductions in their overall energy use. Energy efficiency program administrators can work to leverage similar programs that encourage municipalities and other governmental entities to reduce their energy use and their greenhouse gas emissions to achieve greater energy savings.

Introduction

The passage of the Green Communities Act (GCA) in 2008 revolutionized the energy efficiency market in Massachusetts (GCAa 2008). The Act mandated the acquisition of all cost-effective energy efficiency and has resulted in the Program Administrators (PAs)[1] in Massachusetts collaborating and marketing together using the Mass Save® brand (Halfpenny et. al., 2012). The GCA also charged the Massachusetts Department of Energy Resources (DOER) with developing a Green Communities Program to assist municipalities to meet five energy-related criteria: 1) siting, 2) permitting for alternative and renewable energy facilities, 3) planning to reduce municipal energy consumption by 20% in five years, 4) purchasing fuel-efficient vehicles, and 5) adopting a more efficient building code (the "stretch" code). Both of these programs rolled out in full force in 2010, the PAs with the start of their first three-year

[1] Program Administrators refers to the entities that administer the energy-efficiency programs in Massachusetts. With one exception, the gas and electric utilities in Massachusetts administer their own energy-efficiency programs. Cape Light Compact is a municipal aggregator that administers energy-efficiency programs for 21 municipalities in Cape Cod and Martha's Vineyard.

energy efficiency plans[2] and the Green Communities Program with the designation of the first 35 Green Communities in June of that year.

There are currently 123 Green Communities (Figure 1), representing 48% of the Massachusetts population. They range in population from 393 to 617,594 and span the state geographically from Cape Cod to the Berkshires. These municipalities have used a variety of avenues to pursue Green Communities designation, from DOER-funded planning assistance to dedicated municipal energy offices to volunteer energy committees.

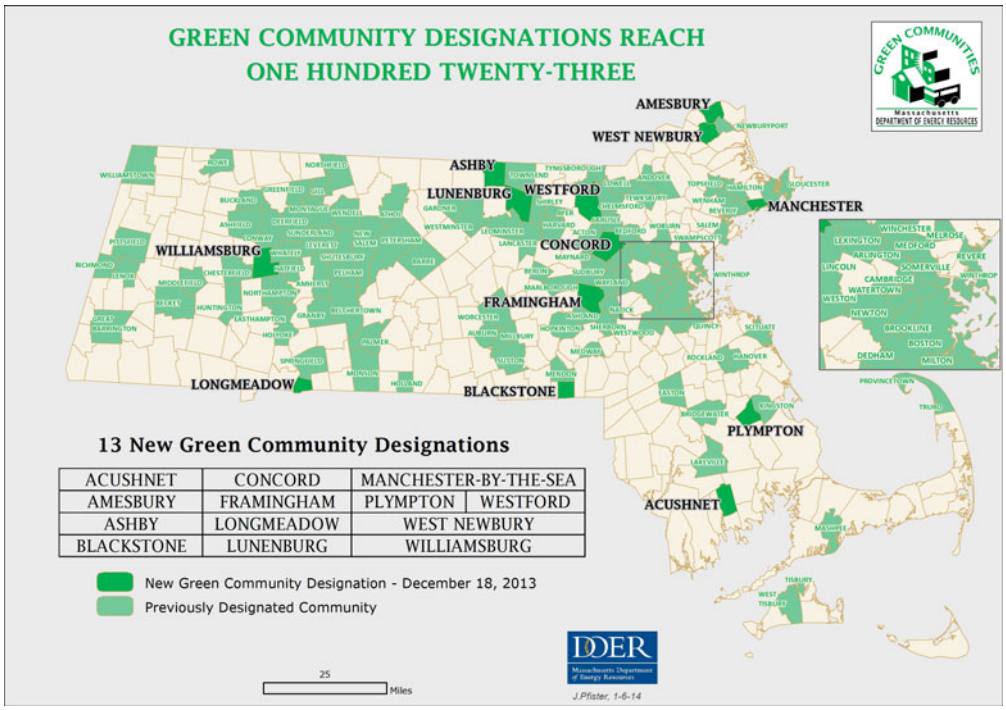


Figure 1. 123 Massachusetts Designated Green Communities. *Source*: http://www.mass.gov/eea/docs/doer/green-communities/grant-program/map-summary-green-communities.pdf.

Upon designation as a Green Community, a municipality becomes eligible to receive grant funding for energy-related work. A variety of sources fund these grants, including carbon allowance auctions under Regional Greenhouse Gas Initiative and Alternative Compliance Payments under the Massachusetts Renewable Portfolio Standard (GCAb 2008).[3] Each community is awarded a designation base grant of $125,000 to $1 million, depending upon factors such as population and their selection of siting and permitting parameters for alternative and/or renewable energy. These grants must be used to implement clean energy projects - either energy efficiency or renewable energy. In total, more than $23 million in designation grants have been awarded to the 123 Green Communities. Once a Green Community has expended its

[2] The PAs must submit a collective three-year statewide energy-efficiency plan and budget for approval to the Department of Public Utilities, as well as their independent plans and budgets.

[3] Alternative Compliance Payments are made by made by electricity suppliers that don't meet their statutory Renewable Portfolio Standard obligation under 225 CMR 14.00 to purchase a sufficient percentage of renewable energy.

designation grant funds, it becomes eligible to participate in an annual competitive grants round; an additional $6 million in competitive grant funds have been awarded as of March 2014.

Tracking Municipal Energy Use

Green Communities grants have been used primarily for energy efficiency projects in order to fulfill their commitment to reduce municipal energy use by 20% in five years. This commitment requires a great deal of dedication on the part of the municipality, from the time and effort expended to compile a baseline of energy use, to identifying and implementing energy efficiency measures and fulfilling reporting requirements for annual energy usage tracking and grant fund expenditures. In order to facilitate these processes, DOER funded the creation of an online energy tracking tool for municipalities called MassEnergyInsight (MEI).[4] MEI is similar in concept to the U.S. Environmental Protection Agency (US EPA)'s Portfolio Manager® in that it tracks energy usage at the account and building level. Expanding upon this concept to include the full range of energy uses by municipalities, MEI also tracks energy use and cost from buildings, streetlights, open spaces, vehicles, and drinking and waste water facilities.

A critical feature of MEI is the automated loading of electric and natural gas usage and cost data for all municipal accounts served by an investor-owned utility. DOER is authorized to request this information from the utilities and to keep the information subject to confidential treatment (GCAb). The consultant managing MEI loads the information into the system on a monthly basis. By removing much of the burden of tracking energy data, many more municipalities are able to assess and communicate the impact of their energy use and cost to their community without overburdening their limited staff resources. It should be noted that the use and cost of other fuels, such as oil and propane, which are commonly used for heating in Massachusetts, and gasoline and diesel, used to power vehicles, must still be loaded into MEI manually by communities. Additionally, because the Massachusetts electricity and natural gas markets have been restructured, many municipalities must load competitive supply costs to accurately track their energy costs. The flow of energy information into MEI is depicted in Figure 2.

Figure 2. MassEnergyInsight information flow.

MEI compiles the energy use and cost information and provides a variety of visually-appealing graphics for the municipality as a whole, for departments, and for individual facilities.

[4] http://massenergyinsight.net/home

Municipalities can compare their facilities to similar facilities in other communities.[5] They can examine their energy use across months and years, as an energy use intensity per square foot, and when normalized for heating degree days and cooling degree days. Drinking water and waste water energy consumption data can be viewed as total energy consumption and as energy use per million gallons of treated water.

More than 240 Massachusetts municipalities, of the total 351 municipalities in the state, are currently authorized to use MEI.[6] These 240 municipalities, plus approximately 15 regional school districts, have assigned 28,000+ electric or gas accounts to over 8,000 facilities, including more than 4,500 buildings. An additional 2,000 accounts represent all other fuel types.

Using data in MEI, the Green Communities Division was able to examine the electricity and natural gas used by municipal facilities in FY2013 (July 1, 2014-June 30, 2013). Buildings accounted for approximately 95% of all municipal natural gas usage. For electricity, buildings accounted for approximately 60% of all usage; treating water and waste water accounted for nearly 34% of usage; and most of the remainder was used for street and traffic lights (Figure 3).

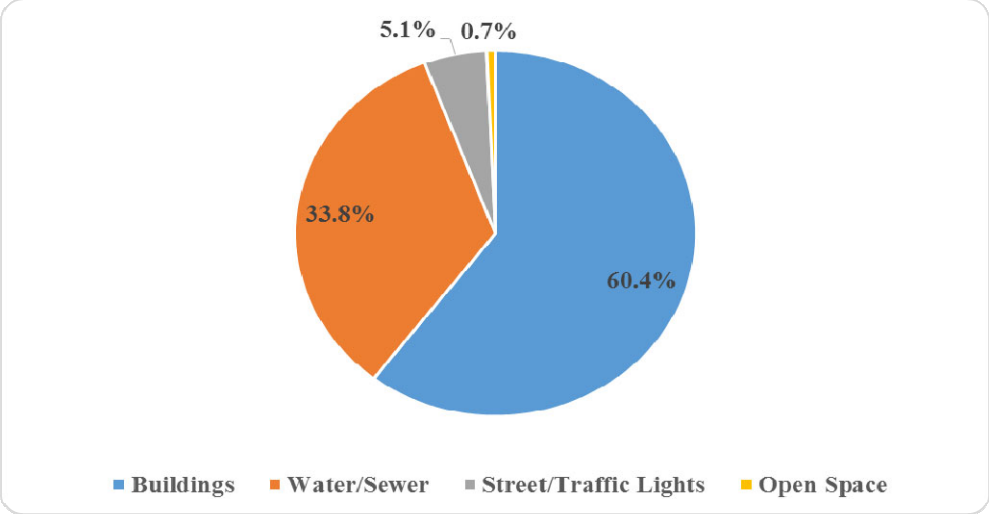


Figure 3. Massachusetts Municipal Electricity Consumption Profile, FY2013.
Source: MassEnergyInsight March, 2014.

MEI has enabled municipalities to gather and analyze all of their energy use and cost information with relative ease in one place for the first time. This, in turn, has stimulated energy discussions within municipalities. For example, many communities use MEI to track energy use and answer questions from their Select Boards, finance departments and school committees (DOER, 2012). Perhaps most importantly, MEI is an effective tool for municipalities to become Green Communities and, once designated, for them to prioritize how to spend their grant funds most effectively and to track the resulting energy savings.

Municipal Energy Baselines

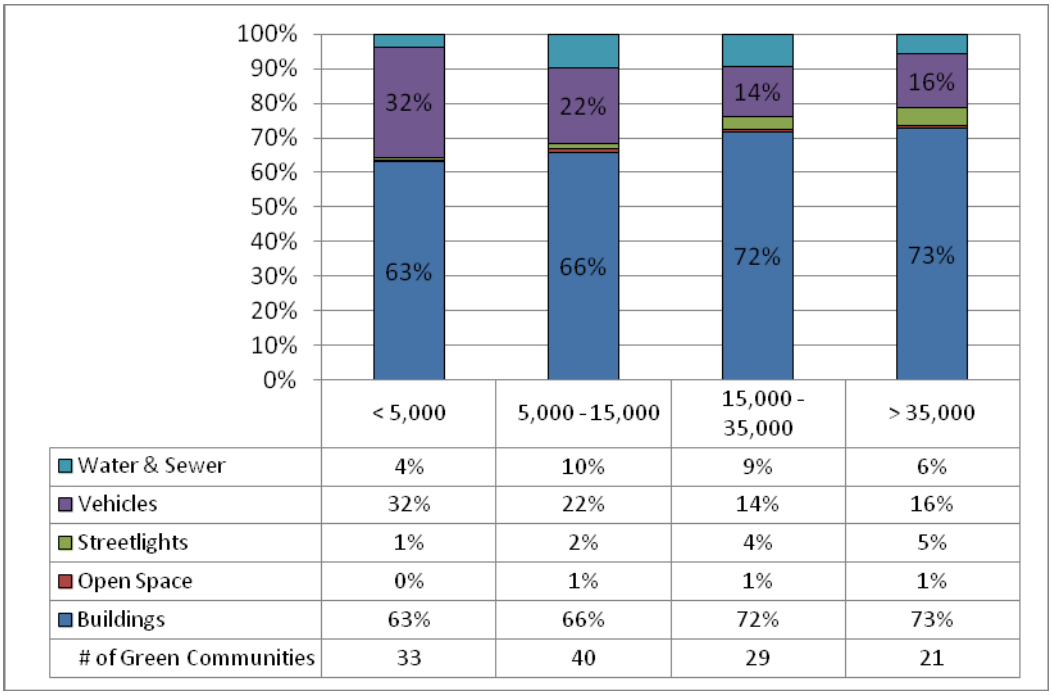
The third criterion that must be met to become a designated Green Community is for a municipality to "establish an energy use baseline inventory for municipal buildings, vehicles and

[5] The names of comparison facilities and communities are hidden in order to protect data confidentiality.
[6] http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/massenergyinsight.html

street and traffic lighting, and put in place a comprehensive program designed to reduce this baseline by 20% within five years of initial participation in the program." MEI has enabled municipalities to easily create an accurate energy use baseline for Green Communities designation and subsequently to track and report on their progress in reducing their energy consumption. The majority of Green Communities use MEI, although several use other tools such as Portfolio Manager® or School Dude.

Each Green Community is unique in both its energy use profile and its strategies for energy reduction. Some Green Communities had invested heavily in energy efficiency before designation and therefore must reach beyond the "low hanging fruit" in order to meet their 20% commitment. Other Green Communities have historically deferred investments in their infrastructure and use comprehensive energy saving performance contracting to both fulfill their Green Communities energy reduction commitment and to upgrade their facilities. Still others work each year on the energy conservation measures with the lowest payback period or those that are timely for the municipality, for example replacing near-failing pieces of equipment.

As can be seen in Figure 4, one can group Green Communities by population size and examine their average energy use by each category. The majority of energy used by Green Communities is for buildings, with its proportion increasing as the population increases. The next highest use of energy in Green Communities is for municipal vehicles, although here the proportion of energy use generally decreases as the population increases.



	< 5,000	5,000 - 15,000	15,000 - 35,000	> 35,000
Water & Sewer	4%	10%	9%	6%
Vehicles	32%	22%	14%	16%
Streetlights	1%	2%	4%	5%
Open Space	0%	1%	1%	1%
Buildings	63%	66%	72%	73%
# of Green Communities	33	40	29	21

Figure 4. Green Communities Energy Usage by Category and by Population Range.
Sources: Green Communities Designation and Grant Program and U.S. Census, 2010.

One can see that the smaller communities tend to have a lower percentage of their energy baseline from buildings. This can be explained at least in part by their rural nature, and the resulting higher usage of vehicle fuel, and in part by their regionalization of services. The most common types of regional public entities are regional school districts (RSDs); these can include the entire range of schools from elementary through high school or can just be a single higher

educational facility, such as a technical high school. The other types of regional entities are drinking water and waste water districts. The largest of these, the Massachusetts Water Resource Authority, provides water and/or sewer services to 61 metropolitan Boston communities.

Green Communities that belong to an RSD or a water or sewer district have the option of including the district's facilities in their energy baseline in order to fund projects at those facilities. One fairly common occurrence of this is the inclusion of an elementary school that belongs to an RSD located in a Green Community. Another option is to include a portion of the energy usage from an RSD (e.g. water/sewer) facility that is proportionate to the percentage of students, as a proxy for usage, from the Green Community. However, in the majority of cases, these regional facilities have not been included in the energy baseline of a Green Community.

Mass Save® Municipal Services

A significant factor that has contributed to the success of the Green Communities program in Massachusetts is the energy efficiency programs run by the Program Administrators (PAs).[1] Municipalities are served under commercial and industrial (C&I) programs; what this has meant in the past is that larger municipal facilities, such as high schools, often received much more comprehensive energy assessments and services than did smaller municipal facilities. In 2010, when the GCA-mandated efficiency plans first went into effect, this was the model for municipal efficiency services.

A collaborative approach between the Green Communities Division of DOER and the PAs has led to the evolution from the traditional model of efficiency services as a large or small C&I customer to a much more customized initiative. Since mid-2010, the director of the Green Communities Division has been invited to participate in quarterly meetings of the C&I Management Committee[7] to discuss municipal efficiency services and participation. These meetings provide a forum to review the participation of municipalities in the Mass Save® programs, the consistency of municipal efficiency services across different PAs, and the coordination between Green Communities Division municipal programs and the Mass Save® efficiency programs. For example, DOER now requires proof of communication between designated Green Communities and their PA(s) in order for Green Community grant funds for efficiency projects to be fully disbursed. The PAs encourage their vendors to provide comprehensive energy efficiency assessments in both small and large facilities in communities intending to become designated Green Communities to inform their energy reduction plans; indeed, some vendors have created a niche market for themselves by advertising their assistance in this process.

The driving force behind the evolution of the municipal efficiency services provided by the PAs is the Green Communities designation and grant program. The Green Communities program provides certainty that municipalities will implement efficiency projects rather than leaving an energy assessment on a shelf. It also provides a dedicated funding stream, improving the probability of efficiency projects that require borrowing being approved at town meetings. These factors brought the needed assurance to the PAs to provide more comprehensive assessment services to small municipal facilities.

Relationships between the outreach staff from the PAs and DOER have been cultivated in order to improve municipal participation in the efficiency programs. Three core elements have

[7] The C&I Management Committee meets biweekly to provide strategic oversight for all C&I programs in Massachusetts run under Mass Save®.

made these relationships successful: having a single point of contact at each organization, an understanding of each others' programs and requirements, and building the trust to be able to communicate freely regarding challenges and opportunities. In 2010-2011, much of the work to build these relationships was done through on-site meetings with municipalities that had applied to receive energy assessments through DOER's Energy Audit Program (EAP). EAP was run in two application rounds in 2008 and 2009. DOER hired consultants to provide efficiency assessments for participating municipalities from the first round of the EAP. After the first three-year Mass Save® efficiency plans went into effect in 2010, the PAs provided efficiency assessments for participating municipalities from the second round of the EAP. In total, 165 municipalities participated; of these, 86% have completed an energy efficiency project receiving a Mass Save® incentive. The EAP energy assessments thus paved the way for significant municipal participation in the Mass Save® efficiency programs. Additionally, many of the efficiency measures identified through the EAP were included in Green Community's energy reduction plans.

A final and critical factor that has expedited the rate of efficiency project implementation is a new procurement method for "energy conservation projects" enabled by the GCA (GCAb). This procurement method allows a limited exemption for public entities from the competitive requirements of the Massachusetts public construction bid laws for energy conservation projects with a total project cost of $100,000 or less when they contract directly with their gas or electric utility supplier (DOER, 2009). In practice, the electric PAs have selected vendors to participate in their municipal programs through a competitive solicitation; each PA has its own independent selection process. Municipalities are then able to choose one of those vendors working with an electric PA to perform an efficiency project with a total project cost of $100,000 or less without going out to bid. This enactment of an expedited procurement process for qualifying efficiency projects has vastly decreased the amount of work and increased the speed of completion of municipal energy efficiency projects in Massachusetts.

Municipal Participation in Mass Save® Efficiency Services

The PAs have had remarkable success in reaching the municipal sector during the first three-year statewide energy efficiency plan. Data from the PAs on municipal efficiency projects shows that 76% of eligible municipalities completed one or more efficiency projects through Mass Save® between 2010 and 2012 (Table 1).[8] To look at the impact of the Green Communities program upon the Mass Save® efficiency program participation and savings rates, we can assign the electric and gas efficiency savings to municipalities that were designated as Green Communities between June of 2010 and December of 2012 or to municipalities that were not designated as Green Communities during that timeframe.[9] The Mass Save® participation rate by

[8] There are a total of 351 municipalities in MA. Eligible municipalities are those having electric and/or natural gas service provided by the Mass Save® PAs; these number 313 and 254, respectively. Service refers to service to the municipality but not necessarily to municipal facilities. Additionally, Massachusetts has forty-one municipal light plants providing electricity and three municipal light plants providing gas. 30 municipalities served by electric municipal light plants have Mass Save® gas service.

[9] Green Communities are able to claim their baseline year for their Energy Reduction Plan up to two year prior in order to claim the savings from projects that have already been completed. Although the nineteen municipalities designated in 2012 and thirteen designated in 2013 were not able to complete efficiency projects prior to the end of 2012 using Green Community grants, we have seen that the majority of Green Communities claim a baseline prior to their designation year. Thus, we have included these municipalities as Green Communities in this analysis.

Green Communities designated in or before 2012 was 95% for the electric efficiency program and 53% for the gas efficiency program. As discussed above, this very high participation rate can be attributed to several program design elements, including the municipality's commitment to reduce its energy use by 20% in five years and the leveraging of Mass Save® incentives with grant funds.

Table 1. Mass Save® municipal participation rates 2010-2012

2010-2012 Mass Save® municipal efficiency program	Municipal Green Community status in 2012	Number of participants	Number in service territory	Percentage of participating municipalities
Electric Program	Total	244	313	78%
	Green Community	103	108	95%
	Not Green Community	141	205	69%
Gas Program	Total	112	254	44%
	Green Community	51	97	53%
	Not Green Community	61	157	39%
Combined Electric and Gas	Total	262	343	76%

Source: Mass Save® PAs.

In addition, Green Communities completed projects that accrued a greater total energy savings than non-Green Communities through the Mass Save® efficiency programs from 2010-2012. In total, over these three years, municipal and regional entities[10] saved more than 135,000 megawatt hours (MWh) of electricity and nearly 3,200,000 therms of natural gas as can be seen in Figure 5.

Interestingly, the Mass Save® incentives for Green Communities and non-designated municipalities were similar for electric efficiency projects, but the projected energy savings were more than 1.5 times greater for Green Communities. This suggests that Green Communities electrical efficiency projects are able to acquire deeper energy savings with the same amount of funding or, alternatively, that they require a lesser amount of incentives to be completed. Based upon the average cost per kWh, it appears that Green Communities need less incentive to reach the same level of electricity savings.

The average cost per therm, however, shows that Green Communities require more incentive to reach the same level of natural gas savings (Figure 4). One potential explanation is that Green Communities are pursuing more costly upgrades and replacements of heating equipment compared to non-Green Communities, thus requiring more incentivizes to complete the project. A closer look at the gas efficiency data shows that HVAC upgrades (45% of total therm savings), operational controls (34% of total therm savings), and hot water (17% of total therm savings) comprise the majority of the gas energy savings overall.

[10] Savings from the two regional entities that were eligible to receive Green Communities grant funds during this time period were included in the Green Communities group.

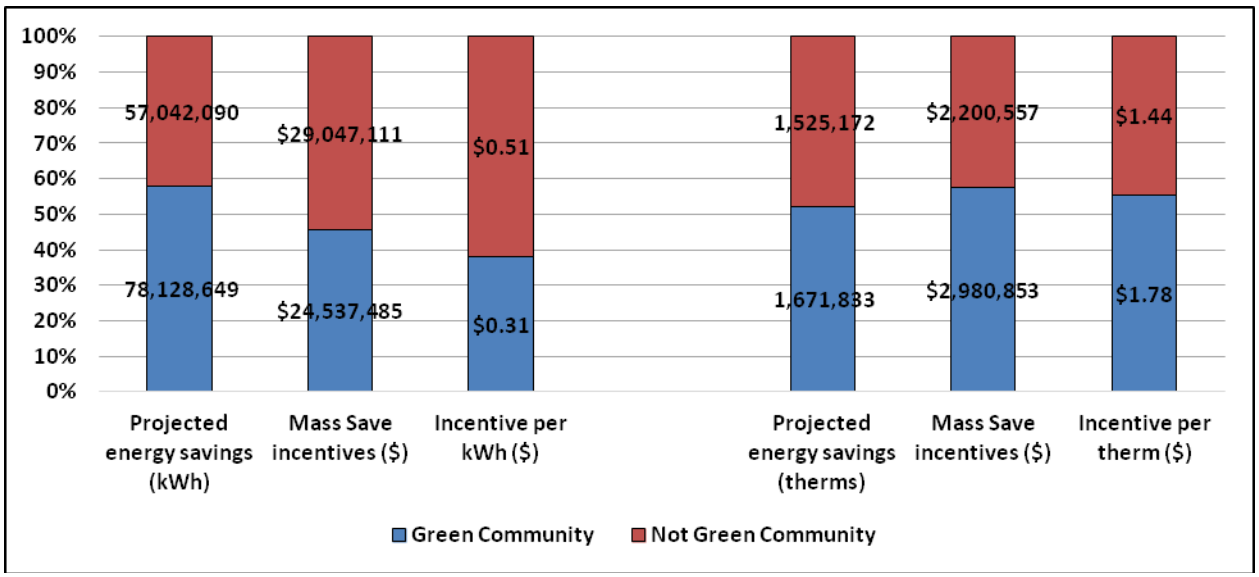


Figure 5. Mass Save® Municipal Efficiency Projects. *Source:* Mass Save® PAs.

Looking at the differences between Green Communities and non-Green Communities for these measure types, one can make a number of observations: a) Green Communities completed a higher number of these gas efficiency project types, b) the average incentive per therm was substantially lower for Green Communities for hot water retrofits and substantially higher for operational projects, and c) HVAC project incentives per therm were relatively independent of Green Communities status (Table 2).

Table 2. Mass Save® Gas efficiency incentives cost-effectiveness and green community status

Measure Type	Project number	Average annual savings (therms)	Average Mass Save® incentive	Average incentive per therm
Hot Water				
Green Community	41	11,835	$2,430	$0.19
Not Green Community	23	306	$444	$1.39
HVAC				
Green Community	124	4,743	$9,966	$1.96
Not Green Community	97	5,807	$12,087	$1.78
Operations				
Green Community	90	5,848	$17,488	$2.82
Not Green Community	53	10,043	$11,460	$1.08

Source: Mass Save® PAs.

Taking a closer look at the operational controls projects, a trend was observed in that Green Communities tended to pursue more complex energy management system installations and upgrades. In contrast, non-Green Communities tended to pursue simpler projects like programmable thermostats and boiler reset controls. Thus, Green Communities tended to install more costly technologies that have energy savings and non-energy benefits. It will be interesting

to see if this trend continues or becomes more pronounced in the future as Green Communities pursue deeper energy savings.

Green Communities Grants and Energy Reductions

Many of the Mass Save® efficiency projects receiving incentives also substantially leveraged Green Community grant funds. In total, 92 Green Communities have completed clean energy projects to-date using a total of more than $17 million in Green Community grant funds (Table 3).[11] The vast majority of these projects and expenditures have been for energy efficiency measures, with more than $15 million in Green Community grants funds awarded. In comparison, relatively little in Green Community grant funds have been expended upon renewable energy projects or administrative costs and energy assessments. The total cost for these projects was more than $26 million with an annual estimated cost savings of about $3.7 million.

Table 3. Green community program grant-funded clean energy projects

2010-2013 Green Communities projects	Number of Green Communities completing projects[12]	Total project cost ($)	Green Community grant funds ($)	Mass Save® incentives ($)	Annual cost savings ($)
Energy Efficiency	69	$24,243,724	15,227,978	$4,207,757	$3,679,724
Renewable Energy	14	$1,064,433	$781,749	$0	$37,002
Admin & Studies	46	$1,435,555	$1,148,733	$37,678	$14,736
Total	92	$26,743,712	$17,158,460	$4,245,435	$3,731,462

Source: DOER, Green Communities Designation and Grant Program, May 9, 2014.

Mass Save® incentives for the Green Community efficiency projects totaled more than $4 million, or approximately 17% of the estimated total project costs. The question arises as to whether the Mass Save® funds are, in fact, incentivizing these projects or whether, without Mass Save® funds, the Green Communities would use additional grant or municipal funds to complete their efficiency projects. In practice, Green Communities have effectively leveraged their Mass Save® incentives with their grant funds to allow additional efficiency projects to be completed. Oftentimes, a Green Community will apply for a grant based upon a total project cost without an accurate estimate of a Mass Save® incentive. The grant is awarded based upon the application's requested amount. However, the full disbursal of grant funds requires verification of Mass Save® incentives. Thus, the grant award is often larger than the final project cost after Mass Save® incentives are applied and the Green Community has remaining grant funds to invest. For Green Community designation grants, municipalities typically work to identify and complete additional

[11] As of May 9, 2014.
[12] Note: The number of Green Communities completing projects does not sum because Green Communities typically complete more than one type of project.

efficiency projects with any "repurposed" grant funds. Thus, because the Green Communities have committed to an energy reduction goal of 20%, they are effectively leveraging the Mass Save® incentives received from one efficiency project to complete another efficiency project.

The energy efficiency projects completed by Green Communities using grant funding and Mass Save® incentives have already contributed to substantial energy use reductions. Sixteen Green Communities have completed their fifth or sixth year following the year of their energy use baseline.[13] On average, they have reduced their total energy use by 15% (Table 4). Substantial reductions can be seen in the energy used by buildings, streetlights and open space in these municipalities. As we saw in Figure 4, buildings comprise the majority of energy use for Green Communities; for this subset, buildings account for an average of 71% of their baseline energy use. Thus, the 17% average reduction in building energy use contributes significantly to the overall energy reductions. In contrast, as a relatively minor component of energy use, open space energy reductions contribute little to the overall energy reduction. Streetlights are a small but significant portion of municipal energy use because of the large energy reductions achievable through conversion to LED technology. Efficiency retrofits in the water and sewer sector can also achieve significant energy reductions, however for many Green Communities these services are regionalized and thus are not included in their baseline; this moderates the average impact of any efficiency retrofits across multiple community analyses. The energy used by municipal vehicles remains a challenge, although some Green Communities are experimenting with electric vehicles and anti-idling retrofits for police cruisers. In summary, sixteen Green Communities have had the most success in reducing their total energy use through efficiency projects focused on buildings and streetlight retrofits.

Table 4. Baseline energy use and year 5/6 energy reductions of Sixteen green communities

Category	Average baseline energy use	Average reduction from baseline (%)
Buildings	71%	17%
Open Space	1%	21%
Streetlights	3%	31%
Vehicles	16%	5%
Water & Sewer	8%	5%
Total	100%	15%

Source: DOER, Green Communities Designation and Grant Program 2013 Annual Reports, May 9, 2014.

Looking Forward

The dedication of the Green Communities to pursuing energy efficiency and renewable energy sources is already having a significant impact on clean energy in Massachusetts at both the local and state levels. Completed projects funded with Green Community grant funds are projected to save an amount of energy approximately equivalent to the annual energy usage of

[13] DOER assesses a Green Communities' energy use reduction six years following the year of their energy use baseline in order to allow for efficiency measures installed in the fifth year to achieve a full year of energy savings.

1,025 typical Massachusetts homes and to avoid the amount of greenhouse gas emissions equivalent to the annual emissions of 2,320 cars. As more Green Communities reach their fifth and sixth years following the year of their energy use baseline, DOER anticipates a growing impact on municipal energy use and municipal budgets in these communities.

The leveraging between the Green Communities program and the Mass Save® efficiency program has created a positive reinforcement loop for achieving the efficiency goals for both programs. DOER is confident that this symbiosis will continue to develop as challenging energy efficiency questions arise in the future.

One of these questions is how to continue to achieve significant, cost-effective energy efficiency savings once the low-hanging fruit are harvested. How best to pursue deeper, but typically higher capital, energy efficiency projects will be an ongoing challenge in Massachusetts. Several promising technologies, such as wholesale conversion to LED streetlights and use of heat pumps, represent significant sources of potential efficiency savings that municipalities are likely to pursue.

In conclusion, the Green Communities program is a replicable model that enables municipalities of all types to demonstrate their commitment to reducing energy use, adopting renewable energy and saving taxpayer dollars. Energy efficiency program administrators can work to leverage similar programs that encourage municipalities or other governmental entities to reduce their energy use or their greenhouse gas reductions to achieve greater energy savings.

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