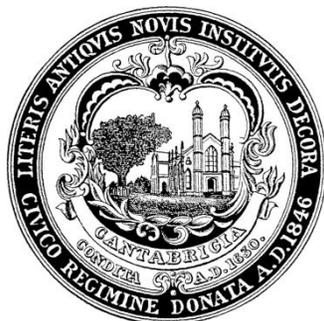


City of Cambridge Energy Reduction Plan



**Submitted by Robert W. Healy, City Manager
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Introduction

The City of Cambridge serves a population of approximately 105,000 residents. The City operates 68 municipal buildings, including 18 School Department buildings, 28 pumping stations, 347 vehicles, 1,050 park lights, 6,565 streetlights, and 191 traffic lights. Buildings are typically powered by NSTAR electricity and natural gas, with some school buildings being heated by oil. The City currently has about 42 kilowatts of solar photovoltaic systems installed on its facilities.

Reducing energy consumption in City operations has been a priority in Cambridge for over a decade. In 1999, Cambridge became a member of ICLEI's Cities for Climate Protection program and was also an early signatory of the US Mayors Climate Protection Agreement. The Cambridge City Council approved the Climate Protection Plan in December of 2002. Table 1 outlines additional key milestones since 1999. The City's goal is to lead by example by reducing energy consumption within its municipal buildings and operations. Becoming a Green Community is the next logical step for the City in its efforts to reduce greenhouse gas emissions, minimize energy use, and serve as a leader among municipalities in achieving sustainability.

The City has already taken many steps to reduce energy consumption and green its municipal building stock and operations. It is City policy since 2004 that all new municipal construction and major renovations follow USGBC LEED standards. Two City buildings – City Hall Annex and Russell Field Fieldhouse—have already been certified (Annex is certified LEED Gold) and 5 additional projects are in the process of achieving LEED status—the Main Library, West Cambridge Youth Center, War Memorial recreational facility, the Robert W. Healy Public Safety Facility, and the Cambridge Rindge and Latin High School. City Hall Annex was the first municipal building in Massachusetts to achieve LEED certification; it was certified at the Gold level. The City Manager established an inter-departmental Energy Management Work Group in 2004 to track energy consumption and target buildings for energy-efficiency improvements. Details on energy improvements already made are described below.

The City of Cambridge has been tracking its energy consumption since 2006 in an online database called the Energy Information System (EIS). This system served as the prototype for the Commonwealth's new MassEnergyInsight system and the City's data is currently being transferred into MassEnergyInsight. The City has established Fiscal Year 2008 as its energy baseline and aims to reduce its consumption (298,638 MMBTU in FY08) by at least 20% by the completion of FY13. Actions already implemented have resulted in approximately 15% energy reductions from the baseline by the completion of FY10. The City has additional actions and programs planned that will maintain these reductions and reach the additional 5%, and possibly more, over the next 3 years. These plans are described in more detail throughout the following Energy Reduction Plan.

Table 1: Cambridge Climate & Energy Milestones

<i>Year</i>	<i>Milestone</i>
1999	Cambridge joins ICLEI – Local Governments for Sustainability
2000	Cambridge completes first community greenhouse gas emissions inventory
2002	City Council approves Climate Protection Plan
2003	City Manager appoints Climate Protection Action Committee
2004	City Manager convenes Energy Management Work Group to identify and implement energy efficiency measures in municipal facilities
2005	Cambridge signs U.S. Mayors Climate Agreement
2005	City begins converting traffic signals to LEDs
2005	City Manager issues Energy Star Purchasing Policy; all departments required to purchase Energy Star rated office equipment
2005	City Council issues a policy order setting goal that 20% of municipal power come from renewable sources
2005	City Hall Annex receives LEED Gold rating from the U.S. Green Building Council; first City building to be LEED certified
2006	Public Works Department partners with Mass. Department of Energy Resources to install web-based Energy Information System to track energy use in municipal buildings
2006	City Manager convenes Green Fleet Committee to increase fuel efficiency of municipal vehicles; starts Green Fleet vehicle acquisition procedure
2007	Cambridge Energy Alliance launches by the City and Henry P. Kendall Foundation with the support of Governor Deval Patrick
2009	City receives \$1.1 million Energy Efficiency & Conservation Block Grant by formula from the U.S. Department of Energy under ARRA; 2/3 allocated to municipal energy projects and 1/3 to community energy efficiency
2009	City Council adopts Stretch Energy Code
2009	City Council adopts resolution recognizing climate emergency; works with citizens to hold Cambridge Climate Emergency Congress

Energy Use Baseline Inventory and Data Tracking

In partnership with the Commonwealth's Rebuild Massachusetts program, administered through the MA Department of Energy Resources, the City conducted a baseline inventory and began tracking electricity, gas, and oil consumption, costs, and associated greenhouse gas emissions. Since 2006, the City has tracked energy and fuel consumption and cost data for all City buildings, vehicles, pump stations, streetlights, and traffic lights through the EIS. The database contains data as far back as 2005. The City uses this tool to assess municipal energy performance over time and against national benchmarks in order to develop a comprehensive strategy for future building improvements that maximize the benefit per cost. The tool also facilitates reporting on results from initiatives already taken. In addition, the City has used the EPA's Energy Star Portfolio Manager tool to track usage and assess building efficiency. Most recently, the City is transitioning all energy data over to the new DOER sponsored MassEnergyInsight (MEI) tool. The City anticipates that MEI will also be able to integrate with Portfolio Manager in the near future so that the City will be tracking energy data in both places and be able to track Energy Star achievement. Thus far the City has had 40 facilities benchmarked in the Portfolio Manager system, and aims to benchmark all facilities once integration with MEI occurs.

Tracking of data in MEI will primarily be managed within the Department of Public Works, and additional users will be trained, particularly fiscal staff in other departments, to take full advantage of the system. The Energy Specialist within DPW, along with Peregrine Energy Group, the contractor managing the EIS, currently work together to compile all necessary utility data to provide monthly updates on the EIS and regularly review data for quality control purposes. As the data is transitioned over to the MEI tool, the Energy Specialist will continue to provide monthly updates and reports, which will be used by buildings operations, fiscal staff, and department heads to monitor energy consumption and target areas for improvement.

Perhaps unique to Cambridge, the City is also maintaining vehicle fuel use in the same EIS database. This data will also be transferred to the new MEI system. This facilitates regular monitoring of the entire universe of the City's energy use and fuel consumption and puts the City in a good position to implement strategies and measure reductions. See page 13 for further details on the integration of the City's fuel key system with the EIS. Appendix A includes a sample of the types of vehicle fuel data the City is able to track.

Table 2: Cambridge Energy Use FY08-FY09

Category	Fiscal Year MMBTU	
	2008	2009
Building	234,655	212,419
Streetlight	19,280	19,343
Open Space	4,419	4,190
Traffic Signal	2,153	1,719
Pump Station	162	175
Floodlight	35	35
Non-Vehicle Totals	260,705	237,882
Vehicle fuel MMBTU	36,434	36,096
GRAND TOTAL	297,140	273,978
Change		23,162
% Change		-8%

The above table includes data taken from the EIS tool. It demonstrates that the total energy consumption for FY08 was 298,638 MMBTU, including 36,434 MMBTU from vehicle fuel consumption. In FY09, consumption decreased by 24,660 MMBTU to a total of 273,978 MMBTU. Projections for FY10 are a total of 253,511 MMBTU representing a 15% reduction from the baseline FY08 by the end of FY10. As evident in Table 2, the majority of municipal energy use is from buildings, followed by vehicles, then streetlights. To achieve the full 20% energy reduction by the conclusion of FY13, the City must reduce its total consumption by an additional 15,180 MMBTU. Most of this reduction will come from building upgrades and performance improvements. More details about planned reduction projects follow.

The City currently owns and operates 347 vehicles, including passenger vehicles, public safety vehicles, motorcycles, sedans, light-duty trucks, vans, mid-duty trucks, SUVs, heavy duty trucks, and 45 bicycles. The City gives serious consideration to the fuel efficiency of its vehicle fleet. The inventory includes 22 hybrid vehicles. In 2006 the City Manager instituted a “Green Fleet Committee” and vehicle review procedure. This procedure requires all departments requesting to purchase new vehicles to do a comparison of vehicles and select the greenest option based on fuel efficiency and greenhouse gas emissions that still meet operational and safety needs. This review procedure is a solid jumping-off point for the City to meet Criteria 4 of the Green Communities designation – the purchasing of only fuel-efficient vehicles.

Efficiency Measures already implemented

The City chose FY08 as its baseline year, in part, because it reflects implemented projects that have resulted in energy reductions Citywide. The baseline year includes data for all City and School buildings, except for 4, which were completed after the baseline year and are discussed in a later section of this plan. It also includes all vehicles, traffic lights, streetlights, and park lights. Please see Appendix B for a detailed inventory of property and baseline energy use. The following tables as well as the 5-year energy reduction plan on page 15, outline a large percentage of reductions that occurred in FY09 and FY10 (projected)¹. This section outlines the improvements that Cambridge has already implemented during that time that have resulted in long-lasting energy reductions. Looking at the charts below, one can see that the City’s emphasis on energy efficiency has created a downward trend in overall energy consumption beginning even before our baseline of FY08. The City is confident not only that specific improvements made are responsible for the reductions achieved thus far, but also that these are not just temporary fixes. The City has put significant effort into establishing policies and procedures that will keep the efficiency improvements in place and promote further reductions into future years.

Table 3: City Energy Data Trends				
	FY06	FY07	FY08	FY09
ELECTRIC Use (kWh)	40,760,084	39,458,977	38,628,584	37,416,986
GAS Use (therms)	677,343	668,174	673,571	620,171
OIL Use (gallons)	561,057	516,982	439,182	348,215
ELECTRIC Use (MMBTU)	139,114	134,673	131,839	127,704
GAS Use (MMBTU)	67,734	66,817	67,357	62,017
OIL Use (MMBTU)	78,548	72,377	61,485	48,750
VEHICLE FUEL Use (MMBTU) ²	35,607	35,568	36,434	36,096
ELECTRIC Use per sq ft (kWh)	2,495	2,356	2,327	2,230
GAS Use per sq ft (therms)	49	49	52	43
OIL Use per sq ft (gallons)	3	5	4	4
Total site MMBTU (MMBTU)	319,624	308,058	297,139	273,978
Total site kBtu/sq ft (kBtu)	13,850	13,332	13,561	12,246

¹ Energy data within this plan and associated documents includes actual data through March 2010. Consumption from April through June of FY10 is projected.

² The data in this table shows a higher amount of vehicle fuel in FY08 and 09 over FY06 and 07. It is worth noting that vehicle fuel is the smallest contributor of all fuel types to the City’s total MMTBU. This can be seen in the chart below. Furthermore, it is estimated that 3-8% of fuel use was not captured prior to the new fuel tracking system described on p.13. Actual fuel consumption is likely more of a downward trend than can be seen in the chart.

Chart 1: Energy Use by Fuel Type

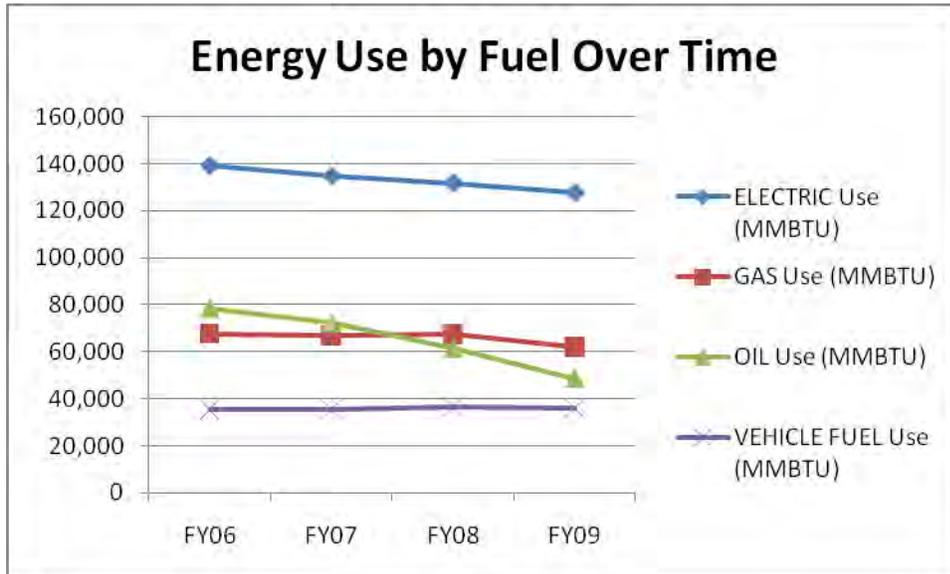
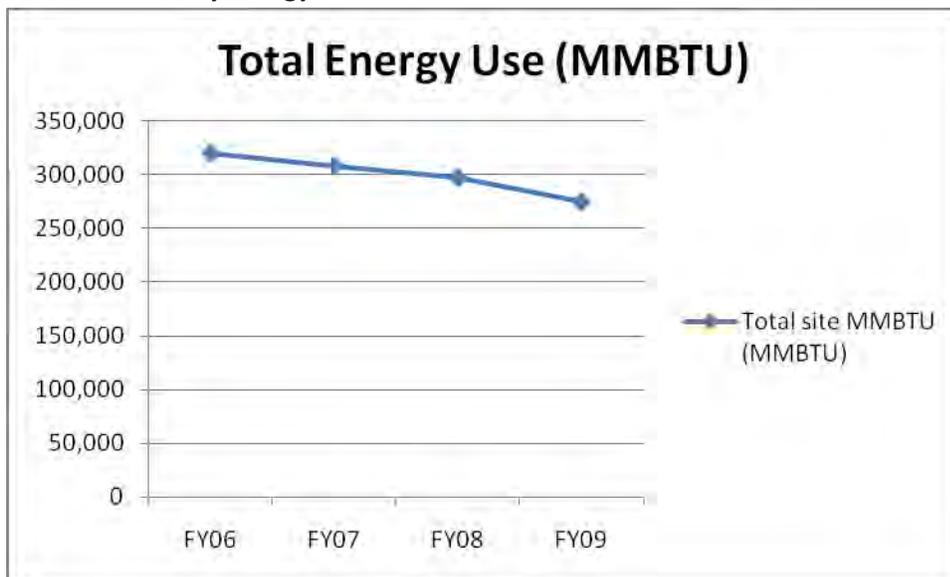


Chart 2: Total City Energy Use



Building Improvements

The City has had numerous energy audits completed to assess potential energy saving upgrades. As of May 2010, 22 municipal and school buildings have been audited. In addition to a recent round of audits performed by Prism Energy Services as part of the City's Energy Efficiency and Conservation Block Grant work, past audits have been completed by Kilojolts Consulting Group and the Cambridge Energy Alliance in 2007 and 2009. As a result of these audits and monthly energy consumption data tracking, the City has identified and implemented numerous energy reduction projects. Lighting upgrades have been

completed in the following buildings: Danehy Park Comfort Station, Harvard Square parking garage, Traffic Meter and Maintenance Office, Area IV Youth Center, Green Street Garage, First Street Garage, Central Square Library, and the Sullivan Water Purification Facility. These lighting upgrades have resulted in over 600,000 kWh saved.

HVAC improvements have included air conditioning efficiency improvements, boiler replacements, installation of building energy management systems (direct digital controls), programmable thermostat installations, and improved insulation at numerous buildings, including the Lombardi Building, City Hall, Senior Center, Fire Headquarters, Coffon Building, Public Works Administration Building, Cemetery Complex, and Water Purification Facility. These improvements have resulted in an estimated total savings of 33,000 therms. There have also been Vending Miser installations at several buildings resulting in an estimated 24,000 kWh savings.

Over the past seven years Cambridge Public Schools converted 3 elementary school buildings from oil to natural gas. The Peabody School was converted in 2000, the Kennedy Longfellow School in 2003, and the Cambridgeport School in 2005. Another conversion is planned for the Longfellow School for FY11.

Standard Contract Language

HVAC Upgrades: When upgrades of HVAC equipment are required in municipal buildings, it is now standard buildings operations practice to specify high-efficiency and properly sized HVAC equipment and to commission the systems to ensure that the most efficient system possible is installed and that it performs to specification. Standard language that is now included in annual HVAC maintenance specifications and all other HVAC installation and upgrade specifications includes:

It is the intent of this specification to prevent failures of the City of Cambridge heating, ventilation and air conditioning systems by performing scheduled preventative maintenance. It is also the intent of this specification to ensure that systems function optimally and operate in an energy-efficient manner. It is therefore recommended that all bidders have demonstrated familiarity and experience with energy efficiency practices, including but not limited to utility incentive programs, selection of high efficiency equipment, energy-efficient installation procedures and energy-efficient operation and maintenance practices.

Additionally, the technical specifications include:

- (1) Contractor must install equipment that is Massachusetts State Building Code compliant as well as meeting U.S. EPA's Energy Star Program (or equivalent) requirements;*
- (2) Contractor must install equipment that meets the appropriate utility's (NStar Gas or NStar Electric) incentive levels for high-efficiency equipment when available. Contractor must include the dollar amount of the rebate or other incentive available; and*
- (3) Any motors powering new equipment or any motors replaced under this contract must be NEMA premium types as approved by the Massachusetts Motor Up Program.*

White Roofs: Additional standard contract and specification language is for municipal building roof replacements. Any roof replacements performed now specify Energy Star high-reflectivity white roofs. Such replacements have already been made on the Frazier Administration Building, Engine 5 Fire Station, City Hall Annex, and Engine 9 Fire Station's roof will be replaced this summer. It is also anticipated that the Department of Public Works' Ryan Garage and Simard Building will both have their roofs replaced in FY11 with Energy Star white gravel and white adhesive (or white pour) roofs. The re-roofing projects will also likely include additional insulation. While energy-saving calculations have not been performed to quantify the exact savings for the City, the EPA has stated that cool roof replacements can result in an annual energy savings of 20%³. Even if the savings are not this high, the practice of installing highly reflective, highly insulated roofs on City buildings will produce long-lasting energy savings for the City, reduce the urban heat island effect, and avoid associated greenhouse gas emissions. When replacing the roofs, the City will also be assessing opportunities for solar panel installations.

Peak Demand Reduction

Since the summer of 2007 the City has targeted peak load demand reduction to help reduce the City's demand charges (costs) and to help reduce the New England Region's peak demand. The effort has been citywide, including all municipal facilities. The Water Department, the largest single municipal electrical user, made a major impact by instituting a number of load shifting measures, e.g. running systems (aeration, residuals pumping, lighting) during off peak hours, optimizing process control, and limiting pumping rates during the peak demand periods. The shift of water treatment processes to non-peak periods results in a lower overall demand during peak times, which reduces the need for peak demand generation, and provides the environmental benefits of reduced pollution from that generation. This demand reduction effort continues.

Outdoor Lighting, Streetlights, and Traffic Signals

Traffic Signals: In February and March of 2009, there were 370 walk signals replaced with LED signals by the Traffic Department. The savings attributed to this upgrade totaled 218 MMBTU in FY09 and an additional 464 MMBTU projected for FY10. Prior to the conversion of the walk signals, 160 traffic signals had been converted to LED in phases over a 4 to 5 year period beginning in 2005. This conversion resulted in an average savings of 57.5%, totaling 787,188 kWh (2,686 MMBTU) annually. While this conversion took place before the City's baseline year of FY08, it is a clear indication of the City's efforts to implement significant energy-saving projects. These savings will be maintained in the coming years.

Streetlights and Outdoor Lighting: Recently, the City completed an evaluation of LED street lighting technology. With the assistance of PB Americas, the City conducted a month-long test in the summer of 2009 of LED streetlights on Inman Street, a residential street. Four high pressure sodium cobra head

³ <http://www.epa.gov/heatisd/resources/pdf/CoolRoofsCompendium.pdf>, p.8

luminaires were replaced with LEDs of equivalent wattage and the LEDs were tested at different lighting levels. A longer term pilot on a non-residential street was started in March of this year. Additionally, some pedestrian-scale metal halide lights will be replaced soon as a means to test the performance of LED technology for pedestrian scale lighting.

Energy Star Purchasing Policy

The City Manager issued an Energy Star purchasing policy in 2005. All new equipment purchased must meet the federal Energy Star standards or equivalent energy efficiency wherever practical. Official language of the policy:

In accordance with the City's stated commitment to climate protection and energy efficiency, it is the policy of this City that any purchase or solicitation by a department for the purchase or lease of an energy-using product, the department shall specify and purchase, where practicable, a product that carries the Energy Star label. For product categories not rated by Energy Star, it is the policy of this City that departments shall specify, where practicable, that the product be in the top 25% of its product category with regards to energy efficiency.

While many energy efficient products are currently available for no price premium, should a price differential exist, the City shall apply a simple life cycle cost analysis. For purchases where the payback period is five years or less, the department shall, where practicable, purchase the Energy Star labeled or energy efficient products, with the exceptions listed below. Where the payback period is longer than five years, the purchase of Energy Star compliant or energy efficient products is still encouraged. The Purchasing Department will offer guidance to department staff in determining the payback periods. In all cases the Purchasing Department will be available to consult with Departments relative to any issues with procurements to ensure the highest compliance with the policy.

As the City replaces older equipment, new Energy Star equipment will reduce the energy load in City buildings. In 2008, the City Manager instituted a policy that all computer monitors in municipal buildings were required to be flat screens. Because the energy and cost savings were significant, the City replaced all CRT monitors with flat screens instead of waiting till they needed to be replaced. CRT monitors use twice as much energy as flat screens. While no exact savings calculations were run at the time, this changeover likely saved the City more than 80,000 kWh per year.

GreenSense

In addition to building improvements, the City recognizes that building performance is just as importantly dependent on occupant behavior within those buildings. In 2008, the City launched the Cambridge GreenSense municipal employee energy awareness program. GreenSense engages 75 municipal employees in more than 40 City buildings as "Energy Champions" to educate colleagues and promote energy-conserving practices in their departments. The first year of the program introduced four "tips", including "Turn It Off," "Power Down," "Summer Sense," and "Use Your (Green) Senses." The tips encourage all employees to turn off unnecessary lights and other equipment, power down computers at the end of the day, reduce peak demand in the summer, and use their "green senses" to identify and report air and water leaks. In its first year, the program helped reduce electricity

consumption by 5% in participating buildings, a total of over 200,000 kWh. *(Please see Appendix C for sample materials from the GreenSense program.)*

Vehicles

As described above, the City has created a Green Fleet Committee and vehicle purchase review policy, which will serve as a basis for adopting Criteria 4 for Green Communities designation *(please see Criteria 4 documentation for further detail)*. In addition to reducing fuel consumption from vehicles through the purchase of more fuel-efficient vehicles, the City has implemented other strategies to reduce the overall use of vehicles and reduce air pollution emissions.

Green Vehicles

The City currently has 22 hybrid vehicles in its fleet, along with 15 bicycles between the Traffic Department and Public Works. In addition, the Police Department has 30 bicycles that are operational and deployed regularly to officers assigned to the Community Relations Unit and to other officers assigned to patrol. There have been a number of hybrid vehicles purchased by the City. Five (5) gas vehicles (including pickup trucks) have been replaced with hybrid sedans and one more hybrid vehicle will be purchased in FY11 by the Water Department. The City Manager, Deputy City Manager, and Mayor also all drive hybrid vehicles.

GPS Systems

The Water Department has piloted 24 vehicle global positioning system (GPS) units and found that this can be very helpful in reducing fuel usage by reducing vehicle trips and idle times. In the first year of this program, alongside other green fleet practices, the Water Department saw a 10% decrease in vehicle fuel use, equal to 2,000 gallons of gasoline (248 MMBTU). The City intends to expand this GPS program to other departments.

Fuel Key System

Another vehicle fuel efficiency measure was implementation of a new fuel key system, which allows for better tracking and management of fuel usage. The key data system is integrated into our Energy Information System database (and will also be integrated with the new MassEnergyInsight system). The fuel system was installed in FY09 and replaced an older system that used a magnetic card reader to record fuel usage. The new system uses a fuel key—users must enter a PIN number (unique to each user) and current vehicle mileage in order to obtain fuel. This provides more accurate fuel usage and mpg info. As with building energy, an essential step in vehicle fuel reduction is knowing the baseline and being confident that consumption records are accurate. This system allowed Cambridge to take that first step.

Re-routing of Rubbish Vehicles

Another strategy was to re-route rubbish packer vehicles to reduce the total distance traveled to perform the job. In the initial phase of this strategy, the trucks were re-routed two days a week. It is estimated that the average daily mileage was reduced by approximately one mile. Since the vehicles get

approximately 3 miles per gallon, and eight packers are used on any given day, it has resulted in a savings of about 5 gallons per week. This strategy will soon be rolled out to all trucks all days, for a savings of about 12.5 gallons per week, or 650 gallons per year. This will result in a savings of approximately 90 MMBTU per year.

Evaluating Next Steps

To assess the City's next steps in reducing energy consumption even further, contributors to this plan evaluated buildings based on a matrix of performance. Buildings were evaluated and prioritized for energy improvements by looking at overall energy use as well as energy *efficiency*. In other words, buildings using little energy and performing more efficiently than others are not current priorities for energy efficiency upgrades. Similarly, large consumers that are not very efficient are priority buildings for improving efficiency and reducing overall consumption. This will be a win-win for the environment with regard to reduced fossil fuel consumption and for the City's budget as utility costs are expected to continue to rise in coming years. After adopting this Energy Reduction Plan, the City will continue ongoing evaluation of building energy performance and prioritization for targeted improvements. The MassEnergyInsight tool has numerous reporting features that will assist the City in this process.

Plan Summary

GREEN COMMUNITIES ENERGY USE REDUCTION STRATEGY					
			Total Energy Use (mmbtu)	Reduction Target (mmbtu)	Cum Change (%)
Baseline Year FY08			297,139	59,428	20.0%
				Change (mmbtu)	
Year 1	FY09	Energy Use FY09	272,259	22,943	7.7%
		Energy Use FY09 - Traffic Signals ⁴	1,719	218	0.1%
Year 2	FY10	Proj Energy Use FY10 - non Traffic	252,370	19,425	6.5%
		FY10 Proj - Traffic Signal LED conversions (walk)	1,141	464	0.2%
Year 3	FY11	FY11 EECBG Lighting Upgrades (10 bldgs)		2,495	0.8%
		Water Treatment Plant audit		-	
		EMS Improvements and Monitoring		2,620	0.9%
		Boiler Replacements (3 bldgs)		2,000	0.7%
		Retro-Commissioning (Area IV, Engine 8, Fire HQ, Lombardi, Peabody)		863	0.3%
		IT Power Management		873	0.3%
		CRLS (heat comes online; overall savings from oil to gas change)		3,283	1.1%
		Non-lighting/HVAC improvements		6,480	2.2%
		Renewables (72 kW of PV) ⁵		300	0.1%
Year 4	FY12	Lighting Upgrades at 7 Add'l Schools		1,746	0.6%
		Lighting Upgrades at 8 High-Use Municipal Buildings		516	0.2%
		Coffon Building Energy Improvements		193	0.1%
		EMS in Elementary Schools		8,000	2.7%
		CRLS renovations complete		(5,423)	-1.8%
Year 4-5	FY12-13	Additional Energy Saving Projects ⁶		2,000	0.7%
Year 5	FY13	Water Plant Upgrades and Process Improvements (10%)		4,074	1.4%
		Lighting Upgrades at 19 Lower-Use Municipal Buildings		292	0.1%
		Total Reductions		73,362	24.7%
		Balance		(13,934)	-4.7%

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⁴ The traffic signal reductions in FY09 and FY10 can for the most part be attributed to conversion of walk signals to LED (218 mmbtu savings in FY09 and projected 464 mmbtu savings in FY10).

⁵ Does not include potential Water Department renewable energy projects.

⁶ Includes conservative estimate of savings from additional energy-reducing projects (such as those described on p.20-21), including GreenSense expansion into school buildings, vehicle fuel reduction from Big Belly, School Dept energy reduction projects, revolving energy fund.

Planned Energy Reduction Measures

Energy Efficiency and Conservation Block Grant

A significant part of the City's energy reduction plan will come from projects to be implemented under the US Department of Energy's Energy Efficiency and Conservation Block Grant program. The City of Cambridge has been approved for \$759,600 for a Municipal Building Energy Efficiency Program. This program is already in its early stages of implementation.

Lighting Upgrades

Energy audits have been conducted by Prism Energy Services in 9 buildings, including 4 schools. Initial lighting upgrade projects identified would result in a savings of 2,239 MMBTU (see Appendix D for a summary project list). Additional financial incentives to carry out this work will be leveraged from the NSTAR municipal rebate program.

City Hall

Bluestone Energy Services, Ltd. recently completed an analysis for energy efficiency upgrades at Cambridge's City Hall. Lighting retrofits and installation of occupancy sensors is projected to save 74,963 kWh annually. Bluestone also recommended installation of a wireless energy management system (EMS) to control air conditioning units based on occupancy. This is projected to save an additional 35,252 kWh annually. There are also plans to improve insulation at City Hall for a savings of over 600 MMBTU annually. All projects at City Hall combined will result in an annual savings of 982 MMBTU. It is anticipated that this work will all be completed during FY11 using EECBG funds.

Coffon Building

In the summer of 2009, the Cambridge Energy Alliance completed an energy audit of the Coffon Building. This building has not been performing efficiently and has had numerous thermal comfort complaints. CEA suggested that the nature and extent of the thermal comfort issues indicates that the building should undergo a thorough retro-commissioning effort. In addition to investigating performance and control issues with the existing HVAC systems, the retro-commissioning will focus on reviewing zone control and developing solutions to address comfort issues in the space. It was also recommended that thermostats be re-programmed with an emphasis on extending the unoccupied time frame. Additionally, light switches need to be added/relocated to better suit the private office/common space layout of the building and motion sensors can be added to certain areas. Finally, CEA recommended installation of point-of-use direct hot water heaters in each of the bathrooms. Combined energy savings estimates for Coffon Building upgrades come to 193 MMBTU.

HVAC Upgrades

Additional energy audits focusing on non-lighting measures were conducted by Prism Energy Services in 9 buildings, including 4 schools. Prism identified energy conservation measures for each building with an estimated total annual energy savings of 6,480 MMBTU if all measures were implemented. Energy conservation measures include installation of direct digital control systems, demand controlled

ventilation, equipment scheduling, variable frequency drives on certain motors, fans, and hot water pumps, re-commissioning, and economizer control programs. Please see Appendix E for a summary project table.

Boiler Replacements

The City also plans to replace the boilers at three buildings—the Public Works Frazier Administration Building, Moore Youth Center, and Longfellow School. Savings from these replacements are estimated to be 2,000 MMBTU. The commissioning of these replacement projects will ensure that maximum energy savings are achieved.

Upgrades in Additional Buildings

Energy audits have identified lighting and HVAC upgrade projects in 10 buildings, which the City plans to implement, partly with EECBG funding through FY11. The City does not intend to stop at those 10 buildings, however. It is anticipated that, if funding permits, the City will perform lighting upgrades at 7 additional school buildings and 8 additional high-use municipal buildings in FY12. Based on equipment comparisons and estimates from the Prism Energy Services audits, additional upgrades would produce 2,262 MMBTU in energy savings. Following that, the City believes that the short payback on lighting upgrades further supports this type of energy-saving work and will likely perform additional lighting upgrades at 19 lower-use municipal buildings for another 292 MMBTU savings. This will reduce overall electricity usage and make the City's lighting stock up-to-date and as energy efficient as possible.

Walter J. Sullivan Water Purification Facility

The Water Department plans an investment-grade audit done at its Sullivan Water Purification Facility. This audit will produce recommendations for process improvements that will reduce energy consumption at the City's most energy-consuming facility. The goal of this audit is to review all aspects of the water treatment facility's operation, e.g. HVAC, lighting, treatment process and pumping. It is anticipated the recommendations will include raw and finished water pumping optimization (may include the addition of raw water VFD's, pump control logic changes, and changes in time of day pumping schedules (demand management and demand response)); treatment unit processes will be reviewed for energy savings while maintaining water quality and regulatory compliance; and additional HVAC improvements. It is anticipated that some of the recommended measures may be implemented immediately and result in reductions of energy usage and costs. Other recommendations are expected to be capital and equipment intensive and will be evaluated and budgeted for future energy and cost savings. Overall it is anticipated that implemented improvements could result in a 10% reduction in energy use for a savings of more than 4,000 MMBTU. Previous facility improvements have included lighting and HVAC improvements.

Building Energy Management

Retro-commissioning

The Department of Public Works plans to have a set of City buildings retro-commissioned during FY11, including the Area IV Youth Center, Engine 8 Fire Station, the Fire Headquarters, Lombardi Building, and the Peabody School/Gately Youth Center. Based on a review of energy consumption data and cost, it's clear that these buildings have not been performing as efficiently as they could. The primary objective for retro-commissioning these buildings is to identify operational and maintenance improvements in energy efficiency, occupant comfort, and indoor air quality. Additionally the process will identify O&M training needs, improve training and documentation, document baseline conditions and measure improvements, and optimize control systems through calibration of critical sensors, review of metered data and trend logs, and equipment functionality testing. Retro-commissioning typically has a quick payback, produces energy savings, extends the lifetime of equipment, and reduces maintenance costs. We have currently estimated a conservative 10% savings in energy consumption in these buildings due to retro-commissioning activities. This anticipated savings will come to approximately 860 MMBTU in FY11, while the process can serve as a model for improved O&M and energy savings throughout other buildings in future years.

EMS monitoring contracts

Cambridge has budgeted for FY11 an improved EMS (Energy Management System) monitoring, maintenance and repair contract. The contract will be for remote monitoring, alarm response, and routine preventive maintenance for 7 existing direct digital control systems at City Hall, City Hall Annex, Coffon Building, DPW Complex, Fire Headquarters, Lombardi Building, and the Senior Center, and also 3 new systems at the Robert W. Healy Public Safety Facility, Main Library, and West Cambridge Youth Center. It is projected that the improved EMS monitoring contract will reduce annual energy use in these buildings by 10%⁷. As the contract is planned to be finalized during FY11, the City will likely begin seeing savings in those buildings during FY12.

Similarly, the School Department is currently preparing bid specs for the design and purchase of an energy management system (EMS) that will digitally control all access points that are currently on existing HVAC systems to better manage energy consumption and occupancy comfort in the school district's 13 elementary school buildings. The system is expected to be purchased and installed within the next 12 months. As with the municipal buildings, the City will likely begin to see savings of approximately 10% for these school buildings beginning in FY12. A 10% savings from FY08 consumption would be over 8,000 MMBTU.

⁷ Industry findings typically average a 10% annual energy savings from EMS systems and monitoring. Links to a few articles supporting this:

<http://www.automatedbuildings.com/news/apr07/articles/esource/070322105430kamm.htm>

http://www.energy.rochester.edu/efficiency/ems_analysis.pdf

<http://www.buildings.com/tabid/3413/ArticleID/9111/Default.aspx>

PC Power Management

In 2008, the City Manager established a policy that all City employees power down computers and other peripheral equipment at the end of each work day. To supplement and promote this policy, powering down computers became the focus of the second GreenSense energy tip as well. Off-hours audits and observations indicate that despite City policy and efforts to encourage this behavior, there is still a significant percentage of employees that do not power down their computers before leaving. Some arguments against the policy have been that system upgrades must be performed outside of work hours and therefore computers cannot be powered off. However, the City's IT Department has recently implemented new strategies that will allow computers to be remotely turned on and off to perform system upgrades. The GreenSense program, in collaboration with the IT Department will be moving forward in the coming year to roll out a revised PC Power Management program that will combine technology improvements and improved behavioral practices so that computers are not running when not in use. While the baseline cannot be determined exactly, the City estimates that electricity use could be reduced by over 255,000 kWh.

Vehicles

The most significant source of vehicle fuel use reduction will come from adoption of the City's Green Fleet Policy (see Criteria 4 documentation). Through the implementation of the Green Fleet Policy, the City will:

- Increase average fuel economy of the City fleet
- Minimize vehicle miles traveled to the extent operationally feasible
- Minimize greenhouse gas emissions and other forms of air pollution
- Reduce vehicle size when appropriate
- Incorporate alternative fuels vehicles into the City fleet when feasible
- Reduce costs of operating and maintaining fleet
- Eliminate unnecessary or non cost-effective vehicles from the fleet

A complete inventory of vehicles will be maintained by the Department of Public Works and fuel usage monitored through MassEnergyInsight. Fuel usage will be tracked in this system as well to ensure that green fleet policy implementation is producing reductions as expected. The Policy also calls for compliance with the state's anti-idling law (MGL Ch.90, s.16A), which will reduce unnecessary fuel consumption while idling.

Additional Energy Savings

There are additional initiatives the City plans to carry out over the next few years that are likely to result in additional energy reductions. These are not projects that have been quantified – either because they are too early in the planning stages or because it is too difficult to isolate the variable to determine the definite cause of the energy reductions—but are worth mentioning as they will further support the City’s efforts in reducing energy consumption by 20% by FY13. One example of this is the LED lighting pilots mentioned previously.

Revolving Energy Fund

As part of the City’s emphasis on sustaining energy conservation work, Cambridge also plans to establish a revolving energy fund. The concept for the fund is that savings from energy efficiency projects will be transferred into a designated fund, which would then be used to further energy efficiency work. The fund will provide additional incentive for energy conservation among all City departments because money saved can then go into the fund for future projects. The fund would have a steering committee to direct and approve the use of funds.

Sustainability Project Manager

Beginning July 1, 2010, the position of Sustainability Project Manager has been created in the School Department’s FY11 submitted budget. Reporting directly to the Director of Plant Maintenance the position will be responsible for identifying opportunities for the reduction of energy consumption and managing the necessary changes in building operations to achieve those reductions. The position is funded through the School Department’s energy budget and will continue to fund itself through energy savings. This will sustain the position and continued energy reduction efforts in the School Department.

Sustainability Standards

Cambridge plans to form a committee and possibly hire a consultant to help the City develop and adopt a formal set of sustainability standards and protocols for buildings and outside areas. The City would build upon criteria such as LEED for Existing Buildings or other similar sustainability guidance for the review of design specifications, renovations, and operations and maintenance protocols. As has been described throughout this plan, the City already has in place many standard specifications, policies, and protocols that require energy efficiency, green cleaning, and sustainable building operations. This initiative would bring all of these pieces together under one set of guidelines for all facilities and operations to which the City would be committed. These efforts will produce additional energy savings, reduce waste, reduce pollution and greenhouse gas emissions, and promote a healthier and cleaner environment—both indoors and out.

Expanding and Continuing GreenSense

The GreenSense program will continue to serve as the foundation for employee energy-reducing and sustainable behavior. Audits have been conducted and a building occupant survey is planned that will provide useful information about to what extent the program has been truly integrated into the culture and behavior of all the departments. These will also help determine what remains as problem areas and

should be targeted for future initiatives and education. Additionally, the School Department, which prior to now has not been a participant in the program, will begin to fully implement the initiative. A conservative savings estimate of 3% electricity reduction in school buildings comes to 1,575 MMBTU.

Demand Response

The City is currently evaluating the option of participating in an energy Demand Response program. In such a program the City would agree to reduce electricity use during peak demand periods. Since demand response reduces electricity generation needs and thus, the cost of generation overall, the City would be given payments for participation dependent on the amount it commits to reduce consumption. The City is in initial stages of evaluating at what level it will be able to participate in such a program, and anticipates that within the 5-year reduction period would see reduced energy consumption during those peak periods, a financial benefit to the City, but also an environmental benefit by reducing overall electricity use and greenhouse gas emissions.

LED Pilot

The City gained valuable information from the smaller pilots recently conducted (described on p.11). This experience will be used to develop a larger-scale pilot test of LED street light technology, to be implemented during the 5-year plan period. The City will be collaborating with the Clinton Climate Initiative on the design of such a pilot to build on the knowledge they have developed from pilots conducted in large cities across the US, including Anchorage, Los Angeles and San Francisco. This experience gained from pilot testing in these cities has demonstrated that the LED lighting technology is advancing very rapidly. The City has also recently joined the Seattle Street Lighting Consortium to continue to learn from pilot tests conducted elsewhere. It is our expectation that, based on the outcomes of our LED pilot tests, at least a portion of city street and park lights could be converted to LED technology in coming years, possibly within the City's 5-year plan period, which could lead to reductions in municipal energy use.

Big Belly Solar Compactors

Over the past several years, the Department of Public Works has been replacing standard curbside litter receptacles with Big Belly Solar Compactors at several locations throughout the city. The goal is to reduce a truck route by cutting down on the number of times a barrel needs to be serviced. The compactors are able to hold five times the amount of a standard receptacle. Reduced collection trips will reduce fuel consumption and greenhouse gas emissions. All new parks specify these units. Central Square, a major business district in Cambridge, has the compactors and DPW has begun to alter pickup schedules in that area.

Renewable Energy

In 2005, the City Council adopted a goal that 20% of the municipal electricity load should come from renewable sources by 2010. With support from the MA Renewable Energy Trust, the City has installed photovoltaic systems on the City Hall Annex, Frisoli Youth Center, and Public Works Frazier Administration Building. In addition, the City is purchasing renewable energy certificates (a total of 2,800 MWh) from Renewable Choice Energy and the Energy Consumers Alliance of New England as a short term step toward meeting the goal. The renovated Cambridge Rindge and Latin School will meet the Massachusetts Renewable Energy Trust's Green Schools Initiative criteria and has received funding for a 30 kW photovoltaic system for the building producing approximately 37,000 kWh of electricity annually. The PV system is expected to be installed this spring.

In April 2009 the Water Department conducted a hydropower feasibility study that identified two potential sites for power generation from the water flow in the conduit supplying the terminal reservoir, Fresh Pond (180kw). The Water Department is exploring permit issues related to these projects and, when completed, the City and the Water Department will evaluate both sites as potential sources of renewable energy.

The Water Department is also conducting a solar feasibility study (to be completed at the end of May 2010). Two sites are being evaluated, 1) the roof of the treatment facility and 2) the top of the eight acre Payson Park finished water storage reservoir. The latter site will require permitting in the town of Belmont, MA. Preliminary estimates of the potential capacities are 108 kW and 910 kW respectively. The City and the Water Department will evaluate both sites as potential sources of renewable energy.

New Construction and Additions

There are four buildings which were not included in our baseline year of FY08. The Robert W Healy Public Safety Building, Main Library, West Cambridge Youth Center, and War Memorial were all completed after the FY08 baseline year. These buildings were under construction during the baseline year and their energy consumption would significantly increase the overall load for the City if added back in for later years. However, these buildings are closely monitored for energy consumption along with the rest of our building, streetlight, traffic light, and vehicle inventory. They have been monitored since their opening and will continue to be monitored under the new MassEnergyInsight system to ensure they are performing efficiently and to identify any problem areas. These buildings, in accordance with City green building policy were built to be energy-efficient, green buildings, and are in the process of LEED certification. After a full year of operation, we will review the buildings' energy consumption compared against their energy models.

West Cambridge Youth Center

The West Cambridge Youth Center has been open for less than a year, but is already performing well. It has submitted enough points to be certified as a LEED Silver building, but the submittal is still under review. Based on data from the months it has already been in use, the building is performing approximately 29% more efficiently than comparable buildings (*compared to 2003 CBECS Public Assembly building consumption*).

Robert W. Healy Public Safety Facility

The Robert W. Healy Public Safety Facility is the new Cambridge Police Department Headquarters. It opened its doors in December 2008 and also houses the City's Emergency Communications Center. This building contains numerous energy-saving features, including an extensive green roof, chilled beam heating and cooling system, high-efficiency mechanical and electrical equipment, and an energy management system (EMS).

War Memorial

The War Memorial is a 73,000 square foot recreational facility serving Cambridge youth and families. This major renovation project was a recipient of an AGC Build New England performance award in 2009 and includes improved use of space, high-efficiency mechanical equipment, efficient lighting, upgraded insulation and numerous other features to improve the energy efficiency and overall sustainability of the building. It is also currently seeking LEED Silver certification.

Main Library

The Main Library opened in October of 2009. It involved the renovation of the historic Main Library and a significant addition. Because the library was closed for renovations prior to FY08, included a large addition, and did not open until after the FY08 baseline, it is not included in the baseline data. This building will also be seeking LEED certification and includes many energy saving features, such as enhanced daylighting, energy-efficient lighting, occupancy sensors, and more.

All 4 of these buildings were commissioned as part of the LEED program to ensure high-efficiency energy performance is attained and maintained. Commissioning reports have been completed and also include systems, operations and maintenance, preventive maintenance, and re-commissioning management manuals. Included are guidelines for energy accounting, including assurance that future renovations and equipment upgrades will not result in decreased energy efficiency and will maintain the owner's requirements. These buildings are also all participants in the GreenSense behavior program to ensure that behavior of building occupants does not offset the green features of the buildings.

Cambridge Rindge and Latin School

Cambridge Rindge and Latin School (CRLS)—the City’s high school—is in the midst of a major renovation project that calls for the building to achieve, at a minimum, LEED Silver certification. Energy reduction components in the project include:

- A cogeneration plant that will generate electricity and utilize waste heat to heat the facility’s 3 indoor swimming pools
- A chilled beam heating and cooling system that will heat and cool the buildings with a motorless system that is acoustically appropriate for a classroom setting
- Room occupancy sensors for both heating and lighting
- All new energy efficient lighting throughout the complex
- Installation of 30kW of photovoltaic panels on the rooftop

The renovations at CRLS are occurring in two phases. During each phase, part of the school complex will be under construction and closed to regular activity. Construction began in July of 2009 and is expected to be complete in August 2011. We have made adjustments in our 5-year reduction plan data to account for the renovations occurring at CRLS and the impacts on energy consumption. During the first year of renovations, the contractor used approximately 300,000 kWh of electricity, which was on the school’s bill, but will actually be billed to the contractor. Remaining energy consumption during that time is included as billed in our reduction plan. The renovations have resulted in an overall reduction in energy use at CRLS, given that half the complex was closed. Phase 2 will have a similar impact except that the heating system (fueled by natural gas) is expected to be fully operational next winter. Overall, from pre- to post-renovations, it is anticipated that CRLS will use less energy. It will be a more efficient building, first and foremost, for all the reasons highlighted above. Also, the conversion of the heating system over to natural gas will result in less energy consumption. Sometimes architects’ energy models turn out to be too low once the building becomes operational. To account for this, we have increased their estimates by 30% for both electricity and natural gas use, and even with those more conservative projections, the building will be using less energy than it was prior to renovations. The City is further supported in this projection given that the School Department will be closely monitoring the building on an energy management system, will be promoting energy-saving behavior among building occupants, and will have a Sustainability Project Manager who can help identify and manage further energy reduction opportunities.

Financing and Program Management

Cambridge's plan is ambitious – the five-year plan for energy reduction will go beyond the 20% minimum, and total costs could well exceed \$3.5 million. Full funding has not yet been identified, but the City has identified certain funds and a strategy to begin implementation:

Operating Budget

Components of the plan related to staffing and maintenance of building systems have been incorporated into the Public Works and School Departments' operating budgets in FY11 and will likely be maintained in subsequent years.

Utility Rebates

The City will continue to seek to maximize utility incentives for retrofit and longer-payback.

Federal American Recovery and Reinvestment Act (ARRA) Funds

\$759,600 of federal stimulus funds in the form of Energy Efficiency and Conservation Block Grants (EECBG) have been designated for building lighting and boiler upgrades.

Capital Funds

The City's conservative approach to taking on debt has enabled it to attain a "AAA" bond rating. The additional capital upgrades identified in this plan will be considered for incorporation in the City's annual capital improvement plans in upcoming years, resources permitting.

Revolving Fund

As part of the City's emphasis on sustaining energy conservation work, Cambridge also plans to establish a revolving energy fund. The concept for the fund is that savings from energy efficiency projects will be transferred into a designated fund, which would then be used to fund further work. The fund will provide additional incentive for City departments to pursue energy conservation among all City departments because money saved can then go into the fund for future projects. A steering committee will direct and approve the use of funds. The City plans to apply for a Green Communities grant for seed money for the revolving fund. Utility rebates and demand response payments are also potential sources of revenue for the fund.

Additional Sources

The City will continue to explore federal grant opportunities for energy initiatives.

Program Management: The Cambridge Approach

The City is committed to integrating the energy reduction program into its operations in order to ensure that the reductions are sustained beyond the initial five-year period. A description follows.

The City has already developed a successful staffing structure for energy management that it will continue to fine tune. Somewhat in opposition to the conventional wisdom, the City has chosen not to consolidate its energy management functions into a single energy manager position. The City has a

strong history of interdepartmental commissions and working groups and has adopted this approach in recent years. While planning for environmental sustainability has generally come from the Environment and Transportation Planning Division within the Community Development Department, operating departments have led the way in implementation. In 2003 the City Manager created an interdepartmental Energy Management Work Group chaired by the Department of Public Works. Work Group members recognized the need for tracking the City's energy use and educated themselves on energy conservation practices and utility programs.

These and other measures have enabled operating departments to develop in-house expertise and allow sustainability leaders to emerge from within. The Department of Public Works enhanced its in-house expertise with a Supervisor of Building Systems hired within the Buildings Division in 2005 and the addition of a part-time Energy Specialist in 2009. As noted previously, the School Department's FY11 submitted budget includes a full-time Sustainability Project Manager to coordinate energy efficiency and sustainability projects and work in partnership with municipal departments.

Operating departments will identify potential energy efficiency and renewable energy projects. Recommendations for project implementation to the City Manager will be coordinated through the work group. Funding options will be identified and selected, and any utility incentives and grant opportunities will be pursued. The appropriate operating department will be responsible for project management and measurement and verification. The City will tap consultants for feasibility assessment, commissioning, and measurement and verification when appropriate through utility contracts, "house doctor" contracts, state contracts, or by utilizing the Cambridge Energy Alliance. The City has been authorized through a home rule petition to the Legislature to engage CEA directly for energy advisory and financing services. Operating departments will share information, project results, and best practices through the Energy Management Work Group and ensure that the overall objectives of the Energy Reduction Plan are being met. The City's overall energy performance will be tracked regularly through the MassEnergyInsight system.

Conclusion and Long-Term Goals

The City of Cambridge is well-positioned to be a leader among Massachusetts communities in operating sustainably and efficiently. The goals of the Green Communities program are in clear alignment with those of the City. The long term goals for the City go significantly beyond what has been laid out in this 20% reduction plan. Cambridge and its municipal and school leaders view all of these steps as part of an overall strategy to institutionalize and sustain its energy and sustainability efforts. The City continues to find new ways to integrate sustainability into all of the day-to-day but also the bigger picture planning of municipal and school operations. It continues to educate staff from both the top down and bottom up in an effort to create a culture of sustainability. Making Cambridge a “green community” starts within its own government. This energy reduction plan includes many specific actions for achieving green operations, and becoming a Green Community is, for Cambridge, an important component of the next phase of ensuring a sustainable Cambridge. A sustainable Cambridge embraces a sustainable way of thinking and operating, and is setting new standards, protocols, and policies within this framework of sustainability. The City believes that this plan and its Green Community designation will serve as an important foundation for this approach.

Appendix A: Sample Vehicle Fuel Tracking Data Fields

FISCAL YEAR
FISCAL MONTH
CITY
DEPARTMENT
ACCOUNT NAME
CARD HOLDER
CARD #
FUEL-Cost (\$)
FUEL-Cost - diesel (\$)
FUEL-Cost - unleaded (\$)
FUEL-Date and Time ()
FUEL-MPG (miles/gal)
FUEL-Miles (miles)
FUEL-Odometer ()
FUEL-Price (\$/gal)
FUEL-Price - diesel (\$/gal)
FUEL-Price - unleaded (\$/gal)
FUEL-Product ()
FUEL-Pump ()
FUEL-Transactions ()
FUEL-Use (gallons)
FUEL-Use - diesel (gallons)
FUEL-Use - unleaded (gallons)
EMISSIONS-CO2 (Lbs)
EMISSIONS-CO2 - diesel (Lbs)
EMISSIONS-CO2 - unleaded (Lbs)

Appendix B: City of Cambridge Property and Energy Consumption FY08-March FY10

	FY08	FY09	FY10
Property	Total MMBTU	Total MMBTU	Total MMBTU
Buildings	234,655	242,173	188,159
489 Broadway (former ECC)	1,521	1,211	673
5 Western Ave (Old Police Station)	6,069	4,219	553
Area IV Youth Center	2,411	2,073	2,332
Baldwin School	5,929	5,322	4,565
Cambridge Rindge & Latin School	45,723	35,475	15,515
Cambridgeport School	5,081	4,025	3,231
Cemetery Complex (3 Bldgs)	1,131	886	621
Central Sq. Branch	623	895	806
City Hall	5,289	4,250	3,331
City Hall Annex (McCusker Bldg)	2,066	2,116	1,603
Coffon Building	2,586	2,029	1,619
Corporal Burns Building	137	119	116
Danehy Park Comfort Station	238	204	185
DPW Complex (3 Bldgs)	8,254	8,159	6,605
Engine 2	1,225	1,248	952
Engine 3	1,572	1,462	1,137
Engine 4	1,113	944	723
Engine 5	1,086	1,014	772
Engine 6	649	617	481
Engine 8	2,488	2,573	2,215
Engine 9	730	645	491
Fire Headquarters	1,437	1,388	1,165
Fletcher-Maynard Academy	4,369	4,107	2,564
Frisoli Youth Center	1,648	1,762	1,381
Garage	4,710	4,714	3,585
Gate House	119	87	112
Gately Youth Center	285	278	193
Gold Star Pool	88	79	72
Golf Course Clubhouse	941	845	495
Golf Course Maintenance Building	185	219	150
Graham & Parks School	4,375	4,821	1,778
Haggerty School	5,800	5,556	5,071
Heritage Branch	1,789	463	372
Kennedy/Longfellow School	9,468	10,250	8,442
King Open School	8,460	6,839	6,977
King/Amigos School	9,974	9,618	6,854
Lombardi Building	2,324	2,090	1,649
Longfellow Building (HS Extension)	4,021	3,325	3,740
Main Library		7,786	12,470
Moore Youth Center	910	861	696
Morse School	7,440	7,385	5,735
Mt. Auburn Branch	334	317	219
No. Camb. Branch	257	215	194
North Cambridge Crime Task Force Trailer	42	41	32

Appendix B: City of Cambridge Property and Energy Consumption FY08-March FY10

North Cambridge Senior Center	55	55	33
Observatory Branch	101	95	73
Old Graham & Parks School	2,242	3,272	2,283
Peabody School	6,667	6,618	4,952
Robert W. Healy Public Safety Facility		12,805	11,622
Russell Field Field House	845	935	729
School Administration Bldg.	3,232	3,059	2,741
Senior Center	3,626	3,536	3,074
Solomon Garage	3,023	2,498	2,258
Sullivan Purification Facility	40,741	38,192	27,795
Tobin School	8,400	9,363	6,948
Traffic Meter and Maintenance Shop	135	97	82
Valente Branch	478	462	385
Valve Chamber	132	121	98
VFW Post 3273	65	70	54
War Memorial		8,277	11,146
Water-Shed Barn	19	13	14
West Cambridge Youth Center		175	1,398
Floodlight	35	35	28
Open Space	4,419	4,210	3,247
Ballfield	1,291	1,244	1,024
Park	2,936	2,779	2,079
Parking Lot	180	181	138
TBD	13	6	5
Pump Station	162	174	133
Brush Screen	2	2	2
CSO Meter	1	1	1
Drain pump	136	142	109
Drain Vault	6	10	7
Flush Vault	13	14	11
Sewer Pump	4	4	3
Streetlight	19,280	19,259	14,088
Metered	3,214	3,209	2,655
Unmetered	16,108	16,071	11,451
Traffic Signal	2,153	1,713	917
Flasher	43	35	21
Garage	50	51	39
Parking Lot	7	7	5
School Zone	7	6	4
Stop and Go	2,045	1,614	847
Vehicles	36,434	36,096	23,741
CITY TOTAL	297,139	303,659	230,313
CITY TOTAL - ADJUSTED (usage excluded from baseline)	297,139	273,978	169,955

Appendix C: GreenSense Sample Materials

**PLEASE
TURN IT
OFF**

IT'S AN EASY WAY TO
CONSERVE ENERGY
AND HELP PROTECT
THE ENVIRONMENT.

DID YOU KNOW?
We can prevent the release of 6 tons of
greenhouse gas emissions just by turning off
unnecessary equipment and lights
in just one City building.

**CAMBRIDGE
GreenSense**
Use Less. Gain More.

Cambridge GreenSense brings City of Cambridge employees together to cut energy use and minimize our impact on the environment. Learn more at www.cambridgema.gov/greensense.

**SUMMER
SENSE**

WHEN SUMMER HEAT
IS AT ITS PEAK LET'S
KEEP ENERGY SAVINGS
GOING STRONG.

Close curtains/blinds in the afternoon
Turn off window AC/fans when you leave for the day
Continue to turn off lights, equipment,
and computers when not in use

DID YOU KNOW?
The City saved \$90,000 last year simply by reducing its electricity consumption
during summer months. We can keep costs down AND reduce greenhouse
gas emissions by using our GreenSense during peak months.

**CAMBRIDGE
GreenSense**
Use Less. Gain More.

Cambridge GreenSense brings City of Cambridge employees together to cut energy use and minimize our impact on the environment. For more information contact Kari Hewitt at 617-349-6947 or khewitt@cambridgema.gov.



Energy Champion's Guide for Tip #3: SummerSense!

The Opportunity

As the summer heats up, it takes a lot of electricity to keep us cool. So more than ever, we should be extra aware of our electricity use and do all that we can to reduce it. In addition to the lights, computers, and other office equipment that we run year-round, the summer also requires fans and air conditioning. **Summer is the time of “peak demand” for electricity** and the City of Cambridge is counting on its Energy Champions to use their SummerSense to keep that demand low.

What's the Impact?

- **Environmental:** During peak demand, when the summer heat pushes an increase in air conditioning, more power plants have to operate to supply the needed electricity. Increased power plant operations results in more air pollution, which is dangerous for public health, and also more greenhouse gas emissions that contribute to global warming.
- **Financial:** The City of Cambridge pays a capacity charge for its electricity consumption. How much that capacity charge is gets determined by a “~~to~~” —the electricity demand of the City during the highest peak of the summer. It is unknown when peak demand—“~~Tag~~ Day”—will occur, so the City strives to keep demand as low as possible throughout the summer months. **This past year, the City was able to save \$90,000 by reducing its peak load 28% in August 2007.**
- In just one City building, running 50 window air conditioning units 24 hours a day instead of turning them off at the end of the day **can waste \$10,000 per cooling season.**

Tips for Employees to Reduce Energy Use and Peak Demand

Lighting

- On hot days, **close shades, blinds, and curtains during the afternoon** or time of most direct sunlight to prevent the sun from heating up your space. At night, open them back up to allow heat to escape.

Cooling

- In buildings that do not have a central air conditioning system **try opening windows instead of running window air conditioners**, especially on mild days. However, **if a.c. units are running, keep the windows closed** to prevent wasted energy.
- **Ceiling and portable fans** use much less electricity than a.c. units. Try to use them instead of the air conditioning when you can.



- If you control over the a.c. unit or thermostat, **set the temperature between 74 and 76 degrees**. Each degree you raise the temperature can save 3-5% on air conditioning costs. You and your colleagues will still be comfortable and the a.c. will have to work less. (If you have to put on a sweater, your a.c. is working too hard and wasting electricity!!!)
- Turn off a.c. units and fans at the end of the day
- If you have any issues with space temperature, contact the Operations and Maintenance line at ext 4841 or 4840 or contact the appropriate designee in your department.

Off-Peak Charging

- If you have equipment or vehicles that need to be charged, try to do so during off-peak hours. In summer months, this would mean **charging between 6pm and 9am**.

Don't Forget Tips 1 and 2!

- Continue to **turn off lights, computers, and all other equipment** when it's not being used and at the end of the day—and remind your colleagues! These things give off heat and add to the need for more cooling.

Tips for Facility and Maintenance Staff

- Set cooling points higher (74-78°) to lower demand on the cooling equipment.
- Make sure that lights, fans, and air conditioning units are turned off after closing.
- Turn up the temperature setting on window a.c. units by a couple degrees if it feels cooler than necessary in the room. Don't leave window a.c. units on to run all night.
- Report and/or fix any air leaks in windows, walls, doors, or ductwork. Replace old filters or put in a request for replacement.

Sources and More information

American Council for an Energy Efficient Economy—Efficient Home Cooling:
<http://www.aceee.org/consumerguide/cooling.htm>

Energy Star –Heating and Cooling:
http://www.energystar.gov/index.cfm?c=heat_cool.pr_hvac





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CITY OF CAMBRIDGE ENERGY EFFICIENCY NSTAR MUNICIPAL PROGRAM PROJECT SUMMARY (4/16/10)

BUILDING	TOTAL PROJECT COST	UTILITY INCENTIVE	INCENTIVE AS % OF TOTAL COSTS	OUT-OF POCKET COSTS	kWh SAVINGS	ANNUAL ENERGY SAVINGS	EFFECTIVE PAYBACK (YRS.)	ANNUAL ROI
HAGGERTY SCHOOL	\$55,004.26	\$13,952.78	25.37%	\$41,051.48	55,811	\$7,255.45	5.3	19%
HAGGERTY SCHOOL (NON ARRA)	\$1,524.16	\$0.00	0.00%	\$1,524.16	6,447	\$838.16	1.8	55%
PEABODY SCHOOL ONLY	\$112,458.79	\$51,677.56	45.95%	\$60,781.23	206,710	\$26,872.33	2.0	49%
PEABODY SCHOOL ONLY (NON ARRA)	\$550.60	\$150.00	27.24%	\$400.60	4,090	\$531.70	0.8	133%
GATELY YOUTH CENTER	\$18,412.63	\$12,700.98	68.98%	\$5,711.65	50,804	\$6,604.51	0.8	133%
KENNEDY SCHOOL L&B	\$98,204.69	\$45,713.49	46.55%	\$52,491.20	182,854	\$23,771.01	2.0	50%
KENNEDY SCHOOL L&B (NON ARRA)	\$275.30	\$75.00	27.24%	\$200.30	1,872	\$243.36	0.8	121%
KENNEDY SCHOOL NEW FIXTURES	\$252,864.05	\$45,713.49	18.08%	\$207,150.57	182,854	\$23,771.01	8.5	12%
KENNEDY SCHOOL NEW FIXTURES (NON ARRA)	\$275.30	\$75.00	27.24%	\$200.30	1,872	\$243.36	0.8	121%
BALDWIN SCHOOL	\$51,109.43	\$17,070.25	33.40%	\$34,039.18	68,281	\$8,876.53	3.5	28%
BALDWIN SCHOOL (NON ARRA)	\$1,227.90	\$75.00	6.11%	\$1,152.90	6,023	\$782.94	1.5	68%
SENIOR CENTER	\$12,740.41	\$2,317.50	18.19%	\$10,422.91	9,270	\$1,205.10	8.1	12%
AREA 4 YOUTH CENTER	\$7,831.88	\$3,830.22	48.91%	\$4,001.66	15,321	\$1,991.71	1.9	54%
AREA 4 YOUTH CENTER (NON ARRA)	\$47.63	\$0.00	0.00%	\$47.63	324	\$42.14	1.1	88%
FRANCIS FRISOLI YOUTH CENTER	\$22,153.28	\$7,798.73	35.20%	\$14,354.55	31,195	\$4,055.34	3.3	30%
ENGINE 3	\$18,696.33	\$4,012.02	21.46%	\$14,684.32	16,048	\$2,086.25	6.8	15%
ENGINE 3 (NON ARRA)	\$275.30	\$75.00	27.24%	\$200.30	1,594	\$207.22	1.0	103%
TOTAL/AVG. (W/ KENNEDY L&B)	\$400,512.59	\$159,448.53	39.81%	\$241,064.07	656,644	\$85,363.75	2.7	64%
TOTAL/AVG. (W/ KENNEDY NEW FIX.)	\$555,171.95	\$159,448.53	28.72%	\$395,723.44	656,644	\$85,363.75	3.1	61%

Note: Incentives are estimated and are subject to NSTAR approval before the lighting upgrade installation can begin.



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CITY OF CAMBRIDGE ENERGY EFFICIENCY NSTAR MUNICIPAL PROGRAM PROJECT SUMMARY (4/22/10)

BUILDING	TOTAL PROJECT COST	UTILITY INCENTIVE *	OUT-OF POCKET COSTS	TOTAL kWh SAVINGS	ELECTRICAL ANNUAL ENERGY SAVINGS	NATURAL GAS SAVINGS (THERMS)	NATURAL GAS ANNUAL ENERGY SAVINGS	TOTAL ANNUAL ENERGY SAVINGS	EFFECTIVE PAYBACK (YRS.)	ANNUAL ROI
HAGGERTY SCHOOL	\$217,754.00	\$29,550.00	\$188,204.00	267,705	\$40,156.00	11,056	\$15,479.00	\$55,635.00	3.4	30%
PEABODY SCHOOL	\$205,566.00	\$28,400.00	\$177,166.00	95,169	\$14,275.00	16,599	\$23,238.00	\$37,513.00	4.7	21%
KENNEDY SCHOOL **	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BALDWIN SCHOOL	\$68,167.00	\$5,050.00	\$63,117.00	40,228	\$6,034.00	3,954	\$5,535.00	\$11,569.00	5.5	18%
SENIOR CENTER ***	\$23,140.00	TBD	\$23,140.00	39,130	\$5,870.00	1,260	\$1,764.00	\$7,634.00	3.0	33%
AREA 4 YOUTH CENTER	\$52,135.00	\$4,500.00	\$47,635.00	21,439	\$3,216.00	4,680	\$6,552.00	\$9,768.00	4.9	21%
FRANCIS FRISOLI YOUTH CENTER	\$89,608.00	\$25,750.00	\$63,858.00	55,198	\$8,280.00	6,901	\$9,661.00	\$17,941.00	3.6	28%
ENGINE 3	\$27,348.00	\$4,500.00	\$22,848.00	605	\$91.00	2,626	\$3,676.00	\$3,767.00	6.1	16%
TOTAL/AVG.	\$683,718.00	\$97,750.00	\$585,968.00	519,474	\$77,922.00	47,076	\$65,905.00	\$143,827.00	4.4	24%

* **Note:** Incentives are estimated and are subject to NSTAR approval before the energy conservation measures can be installed.

** **Note:** There were no equipment or control drawings available for this building. To complete a proposal for this building will require a detailed scoping study.

*** **Note:** The utility incentives have not been finalized for the Senior Center project, so the overall utility incentives, out-of-pocket costs, effective payback, and annual ROI will need to be modified at a later date.

Appendix F: Energy Units and Conversion Table

BTU Conversion Chart

Fuel Energy Content of Common Fossil Fuels Per DOE/EIA

BTU Content of Common Energy Units – (1 million Btu equals 1 MMBTU)

1 barrel(42 gallons) of crude oil = 5,800,000 Btu

1 gallon of gasoline = 124,000 Btu (based on U.S. consumption, 2007)

1 gallon of diesel fuel = 139,000 Btu

1 gallon of heating oil = 139,000 Btu

1 barrel of residual fuel oil = 6,287,000 Btu

1 cubic foot of natural gas = 1,028 Btu (based on U.S. consumption, 2007)

1 gallon of propane = 91,000 Btu

1 short ton of coal = 20,169,000 Btu (based on U.S. consumption, 2007)

1 kilowatt hour of electricity = 3,412 Btu

1 therm = 100,000 Btu

CO2 Conversion

Electricity Factor – 0.905 lbs CO₂ per kWh

Natural Gas Factor – 11.71 lbs CO₂ per therm