WORCESTER POLYTECHNIC INSTITUTE

Final Report:

Town of Auburn Climate Action Plan

Sponsored by: The Town of Auburn Department of Development and Inspectional Services

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12/12/2012

Abstract

The goal of our project was to draft a Climate Action Plan (CAP) for the municipal government of Auburn, Massachusetts. We educated the residents on the effects of climate change and set a framework for drafting a CAP through the Local Governments for Sustainability (ICLEI) 5 Milestone program.

Acknowledgements

We would like to take time to thank the all of those who have assisted our project team in the past semester; the final results would not have been achievable without these people.

Our project sponsor, Adam Burney, Auburn Town Planner, was able to provide support and guidance to the project helping us to maintain a good concept of our task at hand and overcome the obstacles that we have faced. He has invited us to attend town meetings and present to the wind turbine & alternative energy committee, two activities that allowed us to interact will and understand the inner workings of the Auburn community. A big thank you for allowing us to work in a relaxed yet professional setting, a major contribution to the final product of this project.

We have also received valuable lessons from Lynne Riley, a research and instruction librarian at the WPI George C. Gordon Library. Without her assistance we would not have been able to complete in depth research that formed the foundation of our project.

Also, our project group would like to thank all of those who were able to assist in data collection and the dissemination of our informational fliers and pamphlets. Bob Fitzpatrick of MassCEC was able to provide us will the natural gas and electrical reports needed for our baseline emissions inventory. Nathan Walsh, the lead engineer for National Grid, who provided us the electric use by the Town of Auburn for 2012. As well as with the shop owners and employees who allowed us to display our fliers and pamphlets in their stores.

Lastly, we would like to thank our project advisors, Professor Corey Dehner. Without her critiques and guidance over the past semester we would not have been able to grow into the professional group we are or produce this final report. This report would not be composed or articulated so well if it were not for her weekly feedback on our writing and spoken reports.

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Executive Summary

Climate change is not a new phenomenon, but the rate at which human actions are altering global temperatures is staggering. With temperatures continuously rising, an increase in occurrence of natural disasters, and worsening weather patterns it is difficult to imagine what will occur if no action is taken.

There has been an ongoing debate, though the science is largely settled, on whether climate change is occurring. Those skeptical or opposed to the existence of manmade changes to the climate place confidence in the idea that the weather conditions are a part of a naturally occurring cycle, claiming that there is no satisfactory scientific evidence to state otherwise. However, a majority of scientific agencies have come to the conclusion that climate change is occurring and is largely due to human activities (EPA, 2011).

While the change in climate and weather patterns is the issue at hand, many of the repercussions are over looked. The financial ramification of climate change is not actively addressed, nor is the correlation between energy use reduction and financial savings. If more of the global population were to become conscious of their energy use and opportunity to save money, not only would they be able to save in individual homes, but they would also be able to gradually slow the effects of climate change.

The goal of this project was to draft the first half of a Climate Action Plan (CAP) for the Town of Auburn. To successfully accomplish this goal our project team set the following objectives:

- Establish a timeline for creation of a CAP
- Assess Auburn's needs in CAP development
- Compare the Town of Auburn with similar towns that have successfully completed CAPs

- Determine approach to creation of a CAP
- Make recommendations to the Town of Auburn for what should be included in their CAP and seek approval from the Town Planner

Methodology and Findings

Through a series of interviews, and surveys we were able to fully understand the views of the Auburn residents. From these methods we determined that our efforts must be focused towards the economic savings that would come with energy reduction, rather than environmental benefits. The majority of survey responders expressed concern with financial obligations they feared would accompany enacting a CAP. By spreading knowledge of energy saving methods we hope to not only reduce energy use throughout the town but also reduce the greenhouse gas emissions (GHG).

To garner the support of Auburn residents we began to draft informational fliers that we disseminated throughout the town. These fliers contained information regarding state incentives for investing in energy efficient appliances and technologies as well as local offers for home weatherization. We also drafted a webpage containing similarly themed information, however with more detail and additional internet sources.

We reached out to the Auburn High School (AHS) to assist in gaining community support. We believe that gaining the students support for our efforts will allow an energy reduction ethos to grow organically through the town. The idea of gaining student support evolved into creating collaborations between the AHS environmental club, the Acton-Boxborough Green Council and the WPI Green Team to aid the AHS in their efforts to be given the Green Flag Award: an award given to schools recognized for their efforts in creating a sustainable environment and spreading awareness to the greater community (National Wildlife

Federation, 2012). We were able to provide the environmental club advisor, Karen Ares, with all of the necessary contact information for the groups to collaborate efficiently moving forward.

By the use of case studies we were able to compare the CAPs of various municipalities and determine which methods would be most effective in Auburn. We sorted potential action items by analyzing population size and the urban or rural nature of the community in which they were implemented.

A less hands-on, but equally important exercise was obtaining a baseline emissions report on Auburn's energy usage. We investigated and subsequently input data sets into the Local Governments for Sustainability (ICLEI) programs, Climate and Air and Pollution Planning Assistant (CAPPA) and Clean Air and Climate Protection (CACP). These programs provided us with emissions baseline data broken down into municipal and non-municipal sections. This baseline allowed our project group and will allow future project groups and town employees to track the progress of the final CAP as well as give estimates for municipal costs and payoff period for implementing large-scale action items. Large-scale action items may include: an LED street lighting retrofit, solar panel implementation and installation of motion activated lighting in municipal buildings. Further research is needed for possible action items for the Town of Auburn to complete a CAP draft, however, we were able to come up with the following recommendations based on our findings.

Recommendations

The result of our project is the formulation of a baseline emissions inventory and the beginning stages of research for potential action items for Auburns' CAP. We have formulated these recommendations to aid in the completion of drafting and implementation of the CAP:

- Continue gathering community support by making energy reduction information readily available;
- Continue working with AHS to promote environmental awareness and sustainability;
- Review and ensure full understanding of both the CAPPA and CACP programs to maintain a consistent emissions record;
- Follow detailed methodology for data collection if it is found that additional data points are still needed; and
- Continue adding to and refining the action item summaries.

Implementing a CAP can be difficult when the community is skeptical and not fully supportive. However, all support systems and tools needed to complete this task are provided by ICLEI. With proper research and understanding of all programs involved, completing a CAP for Auburn is an achievable goal.

1.0 - Introduction

The world around us is being affected by climate change, and according to credible federal organizations such as the Environmental Protection Agency (EPA), humans are the main contributors to the problem. With temperature increase being one of the most significant consequences, the likelihood of severe environmental damage is amplified. Meaning there will be increased chances of flooding in coastal areas, and alterations to sensitive environments that will cause them to cease to exist. There will also be an increased frequency of environmental disasters such as Hurricane Katrina or Sandy, and Nor'easter Athena. These environmental catastrophes have the potential to take lives and to destroy communities as we have seen in recent news, making climate change a very high priority.

The scope of potential ramifications of climate change warrants an aggressive solution. However, the United States federal government has yet to address the manmade causes of climate change. In order to reduce climate change, local government, communities, and their residents need to take initiative. The federal government supports local governments by issuing grants and other financial rewards to municipalities that are making an effort to become a more sustainable community, but these financial resources are not well utilized. If action is not taken to reduce the effect of climate change locally, health risks will substantially increase for the elderly and the youth of heavily polluted areas. The inefficient manner in which local governments use their resources today along with a steady increase in fuel prices will also see economic issues arise at the local level.

Local Governments for Sustainability (ICLEI) provides support to local governments to combat climate change and prevent these possible ramifications. The Town of Auburn is

currently a member of ICLEI[1], and undergoing the 5 Milestone Program to achieve lower carbon dioxide emissions. Auburn is also a designated Green Community, an initiative to reduce municipal energy usage by 20% over a five year period. With the support of Auburn and ICLEI, our project team attempted to draft a CAP that successfully suited the town's emissions reduction needs, but due to unforeseen obstacles and time constraints we were only able to complete the emissions inventory and goal setting steps.

We conducted research on past CAPs, assessed the level of support in Auburn, met with town officials, educated the community on energy efficiency, and completed a baseline inventory. In order to implement beneficial action items and initiatives, towns of similar size to Auburn that have completed the 5 Milestone Program were researched and assessed based on the level of success. We also assessed the level of support that the residents of Auburn have for a CAP, a necessity to ensure efficiency and success of the project. Interviews, surveys, and in-depth interactions with town officials and residents were used to provide necessary guidance for development of a blueprint for the town's CAP.

2.0 - Background

2.1 - Introduction

Climate change is a global issue that will affect this planet unless appropriate action is taken. Scientists around the world agree that climate change is the main cause of reduction in crop yields, rise in sea level, and an increase in frequency and intensity of natural disasters. (EPA, 2011) This is common information known around the globe, yet human activity is still the main culprit of climate change through ever increasing consumption. To support this trend and

[1] ICLEI was founded in 1990 as the International Council for Local Environmental Initiatives, but has recently been rebranded as Local Governments for Sustainability.

acquire guaranteed profits, ‘developing’ countries emit high levels of CO2 through cheap industry. Although, as a country becomes ‘developed’, it is stated by respected economist, Nicholas Stern, that employing green technology becomes less costly than dealing with the negative effects that come with high emissions. The United States is a ‘developed’ country whose government has recognized climate change as a world issue (United States Policy on the Kyoto Protocol, 2001), but has previously done little work to enact a nationwide protocol or provide readily available support for local governments with Climate Action Plans (CAPs) or other emissions reduction goals.

To aid this deficiency, an organization by the name of Local Governments for Sustainability (ICLEI) effectively provides necessary tools to support local government in the implementation of sustainable development at the local level. Our project team used the popular and effective Five Milestone program that breaks the CAP development process into five easily understandable steps. We followed these guidelines to complete the first two milestones which prepared Auburn for the CAP drafting process which will reduce carbon emissions and increase the use of green energy in the Town of Auburn.

In section 2.2 we will discuss the global acknowledgement of experts on climate change, with both opposing and supporting views available. In section 2.3 we explore the ramifications of climate change. Section 2.4 will cover United States government involvement on a federal, state and local level and in section 2.5 we discuss ICLEI and their approach to CAP development. Finally, in Section 2.6 we will inform the reader about the Town of Auburn and our goals for the project.

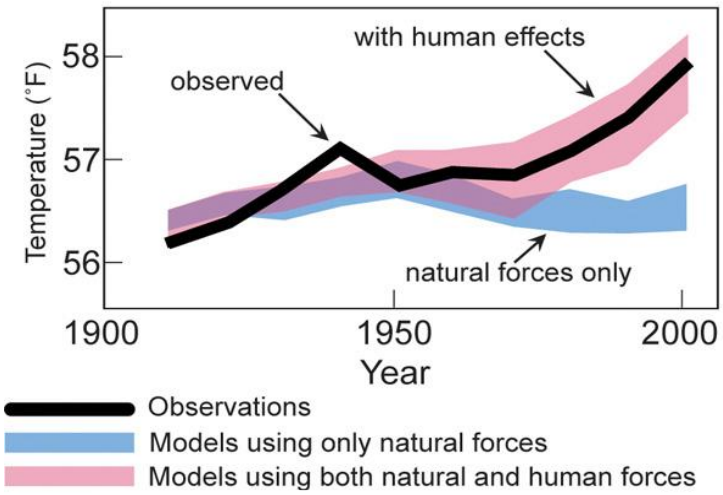
2.2 - Acknowledgement of Climate Change

2.2.1- Evidence Supporting Climate Change

The climate is changing, and there is consensus among United States[2] agencies that humans are the main contributors. The National Research Council concluded that "Climate change is occurring, is very likely caused by human activities, and poses significant risks for a broad range of human and natural systems" (2011, NRC). According to the Environmental Protection Agency (EPA), not all scientists agree on the causes of climate change, however, there is widespread agreement among US agencies that climate change is happening at an accelerated rate, and that it is primarily caused by excess greenhouse gases from human activity.

According to the National Academy of Sciences, the global average temperature has increased by more than 1.4 degrees Fahrenheit over the last century. The National Oceanic and Atmospheric Administration (NOAA) contextualizes these temperature increases and finds that 2000 to 2010 was the warmest decade on record, and that 2005 and 2010 are tied for the warmest year on record since temperatures have been recorded (2011, 2010 Tied for the Warmest Year on Record).

Figure A



http://www.epa.gov/climatechange/impacts-adaptation/

[2] U.S. Environmental Protection Agency, National Aeronautics and Space Administration and the National Oceanic and Atmosphere Administration

The argument that there is no sufficient evidence of human cause is further disproven by the National Research Council (NRC), which has released information on the activity of the sun dating back 50 years. The NRC's findings observe that recent variations have been minor and there has been no increase in solar energy over the last 50 years. On the other hand, the carbon dioxide emissions around the world have steadily increased, and the warming properties of carbon dioxide and other greenhouse gases demonstrate a clear pattern of correlation between emission increases and temperature increase. As you can see in Figure A above, our observations of the world today cannot be explained by natural forces only.

Carbon dioxide is a part of natural life[3] with plants, oceans, and soils constantly releasing and absorbing large amounts of carbon dioxide as part of the carbon cycle. While this has been satisfactory to keeping the Earth in optimal condition prior to human industrialization, the amount of carbon dioxide that human activities have added has overwhelmed this natural process. The recent research completed by United States Global Change Research Program (USGCRP), the Global Climate Change Impacts in the United States(2009) suggest that ice core measurements, which reveal the carbon dioxide levels in the atmosphere, are higher than they have been for 800,000 years.

2.2.2 - Opposition to Climate Change

There is still opposition to climate change today, with a lack of education and denial being contributing factors. According to the "Americans Knowledge of Climate Change" survey conducted by Yale University, only 10% of Americans believe that they are "very well informed" on climate change. This lack of education may lead to belief that serious consequences are hundreds of years away, but a recent report from the State of New York

[3] Necessary ingredient for plants to perform photosynthesis, as well as being a critical component of a functioning atmosphere

(Response to Climate Change in New York State, 2011) states that a major storm could submerge New York City in the next decade, providing persuasive support to climate change predictions.

Even with extensive information available, there is still opposition to the idea that climate change is occurring in the world today as a result of human activity. Only a minority of scientists worldwide[4] suggest that there is insufficient evidence that the natural cycle of warming and cooling is affected by excess greenhouse gas emissions.

2.3 – Ramifications of Climate Change

2.3.1 – World Effects

Climate change and the average temperature change that comes with it can have profound effects around the globe. According to David Nealin, of the Department of Atmospheric and Oceanic Sciences from the University of California, many places have experienced a significant increase in the amount and severity of rainfall, while other locations have experienced more frequent and intense heat waves (2009, Effects of Climate Change). Nealin further explains that the planet's oceans are warming and becoming more acidic, while ice caps are melting, resulting in a rise in sea level.

The EPA acknowledges that the Earth goes through natural cycles of warming and cooling caused by factors such as changes in the sun or volcanic activity (2012, Climate Change Facts). This data has been closely examined by the USGCRP, and they have concluded in their report titled 'Global Climate Change Impacts in the United States' that the warming seen in the past 50 years cannot be explained by natural factors alone.

[4] Willie Soon(astrophysicist at the Harvard-Smithsonian),Chris de Freitas(professor of Environmental Sciences at the University of Auckland) and John Christy(professor of Atmospheric Science at the University of Alabama)

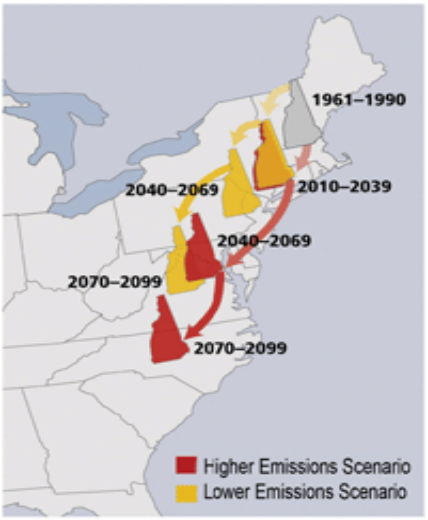
An excess of carbon dioxide in the system has consequences, including increased temperature, and increased severity of storms: the drivers of climate change. Small temperature changes can have a tremendously negative effect for this planet. According to the United States EPA, for about every 2 degrees Fahrenheit temperature increase, the world can expect to see 5-15% reduction in crop yields, 3-10% increase in flood risks, and 200-400% increase in the area burned by wildfire in the United States alone (2012, Climate Change Basics). The global average temperatures have increased by more than 1.4 degrees Fahrenheit over the last 100 years, causing significant repercussions in crop yield as well as increased flood and wildfire risk. Alarmingly, scientists from the NRC stated in their publication, 'America's Climate Choices: Final Report', that the earth's average temperatures will rise between 2 and 12 degrees Fahrenheit by 2100. While reports of possibilities for such dramatic temperature changes have not yet been published, with the observed changes from a 1.4 degree Fahrenheit increase, one can imagine the repercussions of a 12 degree Fahrenheit increase. Federal, state, and local governments, along with communities and individuals can have profound effects on the future of climate change through their actions at the local level. Reduction in greenhouse gas pollution will significantly lower the risk of continued climate change.

2.3.2 - Climate Change in the Northeastern States

According to the EPA's 'Climate Impacts in the Northeast', there has been an average annual temperature increase of 2°F since 1970 in the Northeast region. The winter season is even worse, with an average annual increase of 4°F since 1970 causing more winter precipitation to fall as rain instead of snow. By the end of the century, Boston is predicted to have an increase in the number of days experiencing 100°F from one day per year in 1990 to 24 days per year in

2100. By the turn of the century the region as a whole is expected to have an annual climate close to that of North Carolina as seen in Figure B.

Figure B



http://www.epa.gov/climatechange/impacts-adaptation/northeast.html

As the length of winter decreases dramatically, the first frost also arrives late. This causes insects such as mosquitoes to have a longer season. Mosquitoes tend to carry the West Nile Virus and Eastern Equine Encephalitis, more commonly known as EEE, which are especially prevalent in Massachusetts. This is a real issue specific to the Northeast, with a West Nile Virus breakout occurring earlier this year in Worcester County. If mosquito season were to increase, more illnesses and deaths will potentially occur every year (2012, Northeast Impacts & Adaptation).

2.3.3 - Economic Ramifications

There have been many benefits mentioned to enforcing lower carbon dioxide emissions, but countries around the world know this data, and yet still continue to be permissive of high levels of GHG emissions. In addition to environmental consequences, climate change has the potential to yield severe economic problems. Paresh Kumar Narayan, an Economics Professor of

Deakin University in Australia, convincingly asserts that developing countries[5] tend to focus on short-term income elasticity[6] which increases their profits and pulls these countries toward 'developing' or 'developed' status. As these countries become more profitable, they start to focus on the long-term income elasticity which allows them to focus on cleaner ways to become profitable (2010, Carbon Dioxide Emissions and Economic Growth: Panel Data Evidence from Developing Countries).

Narayan goes on to state: "The theoretical proposition is that during the early stage of economic development pressure on the environment is high; thus the environment deteriorates. However, over time as the economy grows, the pressure on the environment eases and thus environmental quality improves." This suggests that 'developed' nations will eventually cease to rely on carbon emission based industries.

The 'Review on the Economics of Climate Change' by Nicholas Stern, an environmental economist, supports that claim. He laments that uncontrolled climate change will be equivalent to at least 5% of the world's Gross Domestic Product (GDP), the market value of all recognized final goods and services produced within a country in a given period, each year. Stern details research on the risks of GHG releases from melting permafrost, and deduces that the potential dangers equal to 20% of the world's GDP. In fact, these risks can be avoided by the costs of action required to reduce GHG emissions: which the author estimates to be only 1-2% of global GDP each year. In other words, reducing emissions will make the world better off financially in the long run as well.

[5] Jordan, Iraq, Kuwait, Yemen, Qatar, the UAE, Argentina, Mexico, Venezuela, Algeria, Kenya, Nigeria, Congo, Ghana, and South Africa are some countries mentioned in the study.

[6] Focusing on short-term profits by any means necessary. This includes incredible amounts of carbon dioxide emissions.

2.4 - Government

2.4.1 - What the United States Federal Government has done

According to Sebastian Oberthür and Hermann E. Ott, authors of "The Kyoto Protocol: International Climate Policy for the 21st century", in December 1997, at the seventh framework convention Conference of the Parties, a landmark environmental treaty, the Kyoto Protocol, was developed. This treaty commits industrialized countries to stabilize GHG emissions. The Kyoto Protocol itself sets binding emission reduction targets for 37 industrialized countries and the European community in its first commitment period. Overall, these targets add up to an average five percent emissions reduction compared to levels recorded in 1990 (1998, Kyoto Protocol).

On March 29th, 2001, the Bush Administration withdrew the United States from the Kyoto Protocol. Soon after, the United States Embassy stated that the Kyoto Protocol is fundamentally flawed. Several of their reasons being: that the Kyoto Protocol does not provide a long-term solution, that the protocol was established by political negotiation and not by science, as well as two of the top five emitters of GHG, India and China, were exempt. The document is very clear that the United States fully acknowledges the problem that is climate change and sets ambitious goals such as: cutting greenhouse gas intensity by 18% and achieving goals comparable to the Kyoto Protocol using market-based approaches (United States Policy on the Kyoto Protocol, 2001).

Since these goals and promises were made, the EPA has been enforcing carbon dioxide emissions by enforcing restrictions on business and industry, but federal government has done little to enact a nationwide CAP or protocol. The federal government has not sanctioned climate change legislation, according to the American Association of State Highway and Transportation Officials (AASHTO) (2010, State Climate Action Plans). If the federal government were to provide more incentives for local governments, more municipalities would participate in GHG

reduction programs, leading to emissions reduction across the country. While grants and other incentives are provided, the effort made by the federal government has simply not been enough.

The U.S. Federal Government has done little to support local and state governments with CAPs (2008, U.S. Climate Action-From the Ground Up, Pg. 7). The authors go on to state that while George W. Bush was in office, the President signed "energy legislation authorizing $2 billion a year for energy efficiency block grants to local governments." The Administration then provided no funding for the program in the 2009 fiscal year. Matt Ward, Michelle Wyman, Ken Brown, and Andrea Seth, the environmental analysts that wrote the article, later stated that the Senate Appropriations Committee provided no funding, and the House Appropriations Committee provided a mere $295 million of the $2 billion promised. This article continues on to state the solution to preventing climate change nationally is to include a strong federal and local partnership, where the federal government will be assisting local governments by providing the tools and resources needed to take steps toward GHG emission reductions.

2.4.2 - What Massachusetts has done

The Regional Greenhouse Gas Initiative (RGGI) is a market-based regulatory program in the U.S. dedicated to reduction of greenhouse gas emissions. Massachusetts is one of the nine states in the Northeast that has adopted this initiative. The state has begun to initiate energy rebates and tax credits for business and homeowners that have made efforts to perform weatherization on older buildings and invest in energy efficient appliances or solar technologies in an effort to reduce state GHG emissions. Specifically, Massachusetts has made a noticeable effort of creating these incentives and many companies have been supportive (2012, Mass Save, Energy Savvy). Mass Save and Energy Savvy websites offer complete lists of private and corporate companies that have agreed to assist home and business owners develop energy

efficient methods for everyday life and business. One of the incentives put forward by Massachusetts is a tax credit of up to 15% for homeowners that have invested in green technology, this information and more like it can be found on the Energy Savvy website. Green technology is considered a continuously changing set of methods and materials including home solar panel systems, solar water heaters, and wind energy, as defined by the green technology website. Massachusetts has been able to create statewide and local incentives with the help of the companies that are willing to support sale and installation of specific energy saving technologies.

All tax credit information and rebates are easily accessible online for Massachusetts home and business owners through websites such as energysavvy.com and masssave.com that keep a detailed log of incentives that are tailored specifically to the state residents.

2.4.3 - What Local Governments have done

ICLEI provides guidance to local governments working to implement a sustainable development plan. One of the tools used by the organization is a CAP framework known as the Five Milestone Program. This program breaks the CAP development process into five easily understandable steps including: (1) collecting baseline emission inventory, (2) setting an emission target, (3) drafting a CAP, (4) implementing the CAP, and (5) analyzing the results.

In collecting baseline emission inventory, local governments are expected to compile all natural and fossil fuel use to ensure a foundation for a successful project. Target goals will then be assessed off of this information by use of software developed and provided by ICLEI, these targets will then be used in drafting of the CAP. Once the CAP has been drafted and finalized it can then be implemented and analyzed to ensure quality in the final product. This allows those involved in the process to see what actions provided desired effects and what did not, allowing reference in future efforts to create a sustainable development (2008, Five Milestone Process).

Numerous municipalities have enacted CAPs involving ICLEI's 5 Milestone program with documentation available online. This provided us with an extended background of what other governments have done, what methods were looked into during their research, and how they implemented their CAP. Of the CAPs researched (Menlo Park, California, Worcester, Massachusetts, Boulder, Colorado, Hamden, Connecticut, and Keene, New Hampshire), most are broken down into municipal, residential, industrial, and commercial operations. The municipal operation is broken down further into buildings, vehicle fleet, street lights, etc. Each sector is broken down into the fuel/energy source used. These sources include, but are not limited to, electricity, gasoline, diesel, and natural gas. Every CAP has a baseline inventory based on usage data that needs to be acquired and analyzed. This baseline inventory is used to determine long and short term goals to reduce GHG emissions. Some of the CAPs studied also had projections of what GHG emission levels would be if nothing was done to reduce them (Menlo Park, California and Hamden, Connecticut).

Aside from researching what needs to be included to implement a CAP, the community has to be supportive. Keene, New Hampshire educated their residents on what a CAP is and what methods they intended to use. Apart from informing the community of the economic benefits, the town also had to assure the residents that there would be financial benefits for the town and even personal financial gain.

2.5 - ICLEI

Local Governments for Sustainability (ICLEI) is an association of over 1220 local government members who are committed to sustainable development. With the evidence on their website, this organization effectively provides necessary tools such as technical consulting, training, and information services to support local government in the implementation of

sustainable development at the local level. This organization provides the leadership, guidance, and resources that the U.S. government has failed to provide on climate change. ICLEI has grown hand in hand with the emerging movement of local governments implementing pioneering strategies in varying fields to reduce GHG emissions. (2010, ICLEI's Support for Local Climate Action: A Selection of Tools)

2.6 – Town of Auburn

The Town of Auburn is a small bed and breakfast community slowly growing to a bustling town. Auburn is located in Worcester County and according to the 2010 census, has a population of roughly 16,188 people. The Town of Auburn is attempting to initiate a CAP to reduce their carbon footprint and reliance on CO2 emitting fuels and lower the town budget spent on these fuels.

Adam Burney, the individual representing Auburn as our official sponsor, is a head member in the Department of Development and Inspectional Services. He currently holds three positions including; Town Planner and Assistant Director of Development and Inspectional Services. Mr. Burney and the Town of Auburn have asked our group to assist in development of the first half of a CAP.

In 2011, a previous IQP group was assigned the same project; to draft the first half of a CAP for the Town of Auburn. They were able to complete a database to store and organize the required data for an accurate emissions inventory. Unfortunately, they were not able to gather the data, so the first milestone in ICLEI's program, which is to conduct a baseline emissions inventory and forecast was started by our group.

Once we assessed the baseline emission inventory, our team continued to set the target goals for the Town of Auburn. The target goals can now be used to begin drafting the CAP for the Town of Auburn.

3.0 – Methodology

The primary goal of this project was to assist the Town of Auburn in completing and enacting a Climate Action Plan (CAP). Upon the completion and analysis of preliminary research of past CAPs, the Town of Auburn's needs, as well as the resources available, our team has completed the preliminary milestones and made recommendations for the drafting of the Auburn CAP.

Our research was guided by the following objectives:

- Establish timeline for creation of a CAP;
- Compare the Town of Auburn with similar towns that have successfully completed CAPs;
- Assess Auburn's needs in CAP development;
- Determine approach to creation of a CAP;
- Work with the town planner to make recommendations for what should be included in the Town's CAP.

The rest of this chapter unfolds as follows. In the next section the research that has been completed to compare CAPs will be discussed. In section 3.2 we will assess the Town of Auburn's needs. This will include; confirmation that Auburn has a functional database to take record of fossil fuel consumption, the methods of education on CAP benefits for the Auburn community, the community's view of what issues should take priority, and assessing if there is a need to gather further funding to complete the CAP. Then, in section 3.3 our project team

explains the processes of drafting a CAP using the Local Governments for Sustainability (ICLEI) 5 Milestone program. Section 3.4 discusses recommendations for completing the CAP draft and seeking approval by required parties.

3.1 - Comparing Climate Action Plans

3.1.1 - Comparison to Other Towns that Have Completed Climate Action Plan

Our group has studied several municipalities' CAPs, both with large and small populations (see appendix F). Through these reports and comparisons we have expanded our pool of potential action items to use for Auburn's CAP. We primarily focused on towns with roughly the same population as Auburn to observe how these municipalities handled the more detailed aspect of CAP development. Keene, New Hampshire, a town with a population around 22,000 residents has not fully finished a CAP, however, they have completed the third milestone, providing our team with potential CAP development model to follow. By using ranking system to determine top priorities in the area, they were able to utilize their resources to their maximum potential towards their target for lower emissions. Menlo Park, California, another similarly sized town, did exemplary work in describing their municipal and private sector breakdown of operations, making this town an excellent example to follow in our research. Our project team has also looked into the Boulder, Colorado CAP, primarily analyzing their finance strategies and methods used to create a more sustainable community. We were able to gather ideas such as the use of home weatherization assistance programs, appliance recycling incentives, and the importance of gaining support of younger community members to achieve the most efficient and desirable outcome.

To compile the data gathered from other CAPs we studied strategies, goals, and operations breakdown, separating each element into two categories: strategies that have been

widely used through CAP development and unique strategies that are not seen as often. We then filtered the data further by determining what we believe would be useful for Auburn's CAP and what would be insufficient (see appendix G).

3.1.2 - Municipalities Data

During the process of gathering data, it became necessary to call representatives for utilities companies to gather Auburn specific data. Upon calling these representatives, and other state officials such as Bob Fitzpatrick, who were able to help us gather data, we conducted further research of the main questions or topics to ensure all team members are prepared with appropriate questions. All phone interviews were recorded and analyzed for further detail and information.

3.2 - Assessing the Town of Auburn's Needs for a Climate Action Plan

3.2.1 - Evaluating an Appropriate Database for Information Collection

Our first step was to determine an appropriate database to use for the Town of Auburn. This database should have gathered all existing information pertaining to carbon dioxide emissions that are a result of the purchase and use of natural gas and fossil fuels by the Town of Auburn. From an interview with Adam Burney (September 19, 2012), Auburn's Town Planner, it was discovered that such a database does exist on the town server, however, it was not functional. It was also found that Mr. Burney has been using the Massachusetts Energy Insight (MEI) web based database to track all necessary information. Consequently, our first action item was to identify which database format would be most beneficial to the needs of Auburn.

The database located on the town's server was assessed and our project team met with Mr. Burney (10/25/2012) regarding the use of the database to store and track the Town's utilities consumption. We then discussed the choice between correcting several deficiencies and adding

new features to create a functional database opposed to using the MEI account, updated by Mr. Burney over the last year. The benefit of the database located on the Town's server was that all employees with access to the Town's network would be able to update the database, thus making data entry efficient. On the other hand, the MEI online database held the majority of the necessary municipal utility statistics over the last 5 years which were needed to determine the goals of Auburn's CAP. The only downfall of this method moving forward is that the only employee able to access this account is Mr. Burney. A solution of granting all town employees access to the MEI account was discussed, however, this would require tremendous amounts of paperwork for each individual due to the security precautions set by Massachusetts.

After further analysis of the current state of the database, and with workload prediction exceeding several weeks to develop a functional database much like MEI, it was decided to move forward with the MEI database for Auburn so that we would be able to focus our effort on accomplishing our goal of drafting a CAP.

3.2.2 – Municipal Data Collection

The MEI website contained necessary data for the first step of the Five Milestone Program. However, MEI only housed information for the municipal sector of Auburn over the past five years, and records from 2007 only contained data for natural gas and electricity. While these two sources combined accounted for the majority of Auburn's energy usage we still had to find the vehicle fleet's fuel consumption and the town's propane consumption from 2007 to 2010 along with gathering solid waste (trash and recycling) data to have a complete emissions inventory. We spoke to Mr. Burney about retrieving any past billing information to calculate the amount of fuel consumed. He informed us that any billing information that we would need to gather would take several months to collect from the credit card company and roughly another

seven weeks to analyze. For this reason we decided this was not plausible for our time frame. After consulting with Mr. Burney we found it reasonable to reduce the fuel consumption for the vehicle fleet and propane by 1% each year. We were also able to obtain the solid waste data for 2007 and 2011 from Andrew Pelletier, Auburn's Development and Inspectional Services Director.

3.2.3 – Non-Municipal Data Collection

In order to effectively organize the emissions inventory for the non-municipal sector of Auburn, we had to determine emissions sub-sectors. After looking at the CACP program more in depth it was found that we required information from the residential, commercial, industrial, and transportation sub-sectors of Auburn. While the amount of energy consumption data that we needed for accurate projections in the non-municipal sector was not as extensive as expected, this data was more difficult to obtain.

We had to find the amount of natural gas, electricity, and vehicle miles traveled (VMT) for the entire Town of Auburn. We consulted with Mr. Burney on the best way to approach this and he directed us to NSTAR for natural gas and National Grid for electricity. Our group started making phone calls in order to get utility consumption specific to Auburn. After being told by NSTAR that they could only release address specific information individually and being transferred numerous times to different representatives of National Grid we were finally able to gather data. From NSTAR we were able to gather separate information for residential and commercial natural gas consumption for the entire state of Massachusetts. From there we found the average of each household's and business's natural gas consumption annually. We scaled this average to the number of homes in Auburn to find the consumption amount for the town.

After three weeks of persistent calling to National Grid, we received an email from the lead engineer in Worcester County, Nate Walsh, containing the electrical data for Auburn for 2007 and 2011. Unfortunately the data was in an unfamiliar format making it difficult to read (see Appendix L). We had the data converted from Megavolt amperes (MVA) to the amount of kilowatt hours (kWH) used through one year. After finding that one MVA is equal to 1000 kW, we came up with this equation; Annual kWH = (1000 kW) x (24 hours) x (365 days) x (Z MVA) where Z is equal to a years MVA.

While we were waiting to hear back from National Grid, we focused on deducting how many tonnes of CO_2 were being emitted by vehicles traveling through Auburn on a yearly basis. We found a report written by the municipality of DeWitt, New York about baseline emissions and inventory collection for their town. They utilized an equation that found the annual VMT throughout DeWitt to get an accurate emissions output from the transportation subsector. The equation is annual VMT = (AADT) x (road length in miles) x (330), where AADT stands for average annual daily traffic. This implied that we needed to get traffic counts through Auburn for each year from 2007 to 2012. Unfortunately, only a small number of counts were available for each year from the Massachusetts Department of Transportation website. We decided to combine all of the traffic counts from 2007 through 2012, and averaged them over the six year span to use as the amount of miles travelled for 2011, the year we based our projections off of.

3.2.4 - Community Outreach and Information Dissemination

Not everyone in the world recognizes global climate change as a true issue in modern times, attributing the changing weather patterns to a natural cycle in the Earth's history. With this posing to be a potential obstacle in gaining support of community members in Auburn, our project team worked to educate the community on the potential economic and health benefits of

instituting a CAP. We created an educational pamphlet explaining the development process of a CAP and the long term benefits as well as how town residents can benefit through personal health and financial gain. On the back of the pamphlet there was a website URL which lead the residents to a survey we created to gauge opinion on climate change and an Auburn CAP. (see Appendix B)

The idea of creating this pamphlet came from a proposal in Tom Tyler's "Cooperation in Groups: Procedural Justice, Social Identity, and Behavioral Engagement". This proposal states that people are concerned more with the fairness of the outcomes that they receive than direct personal gain. To do this, we were sure to incorporate information that would exemplify a variety of ways the CAP will be able to benefit the community of Auburn. (See Appendix C)

Our team also attempted to gain support of the younger members of the Auburn community in an effort to reach the adults by working with the local school to start a student Green Team. A Green Team is a group of students and faculty that come together with the intentions of allowing their community to function in a more efficient, innovative, and healthy way. The Auburn Green Team was to be a group of environmentally enthusiastic students that will be able to assist in educating the community and applying energy saving techniques in their homes. It is our belief that the residents will be more willing to support the students of their community, meaning these students will also be able to assist with our efforts of gaining community support. We have contacted an Auburn school official as well as the Green Team faculty advisor in a nearby Worcester public school for relevant information.

After hearing from the current Auburn High School Environmental Club advisor it was decided that because a club very similar to a Green Team already exists that we would move forward with assisting these student in making progress towards being presented a Green Flag

Award. The Green Flag award is a prestigious award distributed by the National Wildlife Federation (NWF) and is used to recognize schools that have made valiant efforts to improve the sustainability of the school and the greater community. Our project team was advised that the Auburn High School Environmental Club has already made great progress in moving towards being awarded a Green Flag by improving the recycling program in the school, holding a school wide assembly, and performing an environmental cleanup of a nearby stream.

We have also been able to establish communication with the WPI Green Team in an effort to maintain a guiding force for the Auburn students after the conclusion of our IQP. With the support of this already established organization on the WPI campus it is believed that the completion of achieving a Green Flag Award for Auburn High School is a feasible goal.

The assurance of the continuous movement towards this goal will be made by reaching out to the oncoming IQP team that will be working with the Town of Auburn in the future and asking if these students will be willing to attend an assembly we hope to put on with the Environmental Club of Auburn in January. The intent of this assembly would be to raise awareness of our presence in the student community and gain the support of students.

3.2.5 - Assessing Community Knowledge and Expectation of Auburn's CAP

As a student project team, we were focused on providing the Town of Auburn with a quality end product that both the residents and the town government feel comfortable with. To do this we first addressed the primary concerns of the community. We administered surveys to gather the people's knowledge on CAPs as well as what outcomes they would like to see and issues addressed in the beginning stages of our project term. This was seen as the most efficient method to gain the Auburn residents' opinions of the issues that are prevalent in the community

such as, financial feasibility of instituting a CAP in the town and specific changes residents would like to see in the town to reduce energy consumption (see Appendix D).

3.2.6 - The Financial Feasibility of Climate Action Plans

The costs associated with developing and implementing CAPs are far-reaching and strenuous on a smaller town, such as Auburn's, budget. With that being said, our project team utilized the computer program Climate and Air Pollution Planning Assistant (CAPPA) to help estimate the initial costs and eventual economic gain for the town. To cover the initial costs, and reduce financial stress, we worked with the town to identify possible funding sources to cover the costs of CAP implementation, including grants and other federal funding opportunities.

The money from these grants will also be helpful as the town begins to move towards their target goal of reducing municipal energy usage 20% by 2017, the requirement set by the state of Massachusetts for Auburn to maintain the Green Community Designation previously awarded. The Town of Auburn was awarded $165,550 for being designated a green community and has already spent most of the awarded funds on updating town buildings, in efforts to reduce their energy usage. If Auburn is able to reach the energy reduction goal by 2017 they will be eligible to reapply for the grant, however, state and federal grants Auburn qualifies for were also sought out to address immediate financial stress brought on by the CAP. We contacted the MassCEC and were redirected to Bob FitzPatrick, the Government Affairs Director at MassCEC who we interviewed regarding additional funding (see appendix E). In an effort to further educate ourselves we researched numerous grants online through Massachusetts Grantwatch. Looking through this website, we have found grants that Auburn is eligible to apply for. We looked specifically into grants such as Student & team advisors for environmental

sustainability/improvement projects and USA non-profits in eligible states for environment, health, and community development range from 5,000 dollars to approximately 300,000 dollars.

To maintain Green Community Designation Auburn must follow five main guidelines that are available on the official website of the Executive Office of Energy and Environmental Affairs for Massachusetts. These guidelines are as follows:

- Provide as-of-right siting in designated locations for renewable/alternative energy generation, research & development, or manufacturing facilities.
- Adopt an expedited application and permit process for as-of-right energy facilities.
- Establish an energy use baseline and develop a plan to reduce energy use by twenty percent (20%) within five (5) years
- Purchase only fuel-efficient vehicles.
- Set requirements to minimize life-cycle energy costs for new construction; one way to meet these requirements is to adopt the new Board of Building Regulations and Standards (BBRS) Stretch Code.

3.3 - Determining the Best Way Forward for Auburn's Climate Action Plan

3.3.1 - Overview of Process

Our project team created and disseminated educational pamphlets and fliers to inform the residents of Auburn on terms such as amount of money that could be saved and concrete health benefits. As mentioned previously, the Town of Auburn is considered to be mostly conservative and thus not necessarily supportive of a CAP. By providing concrete evidence we hope to build support for town based CAPs, and by relabeling the project as an energy savings effort instead of a movement against climate change we hoped to eliminate political bias.

The implementation of Local Governments for Sustainability (ICLEI) 5 Milestone program will allow for a well guided attempt at a successful CAP. In order to succeed with the 5 Milestone program, each step cannot be treated as a single objective. Rather, each milestone must be broken down to fully understand the objectives and achievements of each group that has worked on the Auburn CAP. This holistic analysis allowed the team to combine past teams' efforts and transition to our current objectives. The work that we put into this project and the work that will follow will mold this effort into a truly effective CAP. Analyzing the 5 Milestone process and relating it to the Town of Auburn provided priority and clear direction for a CAP.

3.3.2 - The First Milestone

The first milestone of ICLEI's program is to conduct a baseline emissions inventory and forecast for the subject town. An accurate gas emissions inventory lays a foundation for a successful project. The previous project team that looked into a CAP for the Town of Auburn gathered data and created a database to house year to year information on fuel consumption and other utility expenses. As mentioned earlier, a database that was written by a previous Auburn CAP Project team was located on the town server. However, after thorough analysis the team and our sponsor, Adam Burney, have decided to utilize the Massachusetts Energy Insight (MEI) web based database as it currently holds all of the municipal data that we needed to create our baseline.

Our team utilized Auburn's town resources and service providers as well as government officials from Massachusetts and the federal government to obtain accurate emissions data for: municipal, commercial, industrial, residential, waste management, and transportation sectors. To store this data we used the Clean Air and Climate Protection (CACP) software offered by ICLEI. The reduction goals are based off of the statistics of the current and past levels of usage of fossil

fuels by the Town of Auburn. These statistics can be obtained with the data from the MEI database and our research being entered into the CACP for analysis. This result is an accurate assessment of the current and baseline emissions which made setting a realistic goal possible, and also showed us which sectors are emitting the most. This will in turn guide the objectives and priorities of the Town of Auburn CAP, making this a critical action point.

3.3.3 - The Second Milestone

The second milestone is to set an emissions reduction target based off of the data collected during the first step. The second milestone establishes a concrete goal to a local community and drives the project forward. This emission reduction goal was made compatible with Auburn's current objective of reducing municipal energy usage by 20%, an integration encouraged by Adam Burney. ICLEI recommends setting one year, two to three year, and 10 year goals to achieve success. We set these goals based off of the baseline and current emissions in collaboration and after interviews with town officials of Auburn, particularly Adam Burney (see sample interview questions in Appendix A). These interviews helped us truly understand the emissions goals of the town.

3.3.4 - The Third Milestone

The third milestone is the task that was assigned to our project team this semester: the creation of a Climate Action Plan, unfortunately we never reached this stage of development. To complete this effectively, first it is necessary to verify that milestone steps 1 and 2 have been successfully completed. The overall aim is the reduction of greenhouse gas emissions.

To ensure that the financial aspect is feasible, a description of financial expenditure should be prepared. This expenditure report will include the cost associated with all proposed

action items in Auburn. The report will also include the current spending averages of Auburn on energy and potential savings that a CAP can introduce on an annual basis.

Educational fliers and websites were submitted for approval by the local government and staff before they were released to the community to give the public an idea of our goals and the positive effect that a CAP can have on Auburn. The goal is to create public awareness and pride in the effort to support this project in the future. ICLEI emphasizes that any and all aspects of a climate action plan should be developed with the input of the stakeholders, in this case the population of Auburn, so that the plan is carried out with majority support and contribution from the citizens of Auburn. Industries and business owners could be encouraged by possible town tax benefits and residents could be shown the long-term plan of expenditures. It is a fact that a CAP will benefit the Auburn community economically in the long run.

A timeline was also completed and was continually updated to track our progress and guide our group to success. This was to keep our team focused and driven to meet deadlines and complete quality work.

3.3.5 - Fourth Milestone

The decisions that are made in the third milestone drive the success or failure of implementation, which is the fourth milestone of the program. All of the research and decisions should be transparent for future WPI teams that may be completing their IQP with the Town of Auburn, and fully implementing the CAP.

Based on our preliminary document analysis and interviews, we advise to include in the following action items in the Auburn CAP: energy efficiency improvements in municipal buildings, encouragement of culture change in the business and residential sectors of Auburn, and more efficient waste management. Implementation of these specific action items are not

steadfast, rather Mr. Burney and Auburn are flexible as to what will eventually be implemented. We continued conducting research, on the town's database and collecting data via interviews to either cement or discard these preliminary action items for the Town of Auburn's CAP.

3.3.6 - Fifth Milestone

The fifth milestone describes accurately monitoring and analyzing the results of an implemented CAP. This step is a form of quality control for the town. It monitors positive and negative results from the plan and emphasizes the use of the techniques that work while cutting out the procedures that did not have the desired effect. This step is also used to analyze goals set in the second milestone and to set new and improved goals to further decrease CO2 emissions.

3.4 - Conclusion

The above methodology will give the next project group the necessary knowledge, tools, and support to devise and implement a CAP for the Town of Auburn.

4.0 - Findings and Analysis

After completion of various aspects of our methodology we were able to begin analysis of our findings. These findings include comparing CAPs, Auburn's needs in CAP development, and financial feasibility.

4.1 - Comparison of CAPs with the Town of Auburn

When beginning a CAP for a local municipality it is important to use other completed CAPs as references.

In comparing CAPs from various municipalities in the United States, we have been able to determine multiple action items, and if they would be useful to Auburn's CAP. These action

items ranged from being applicable to the residential sector specifically, energy use education through pamphlets and fliers and promoting the use of compact fluorescent lights (CFL), but there were also specifics to the municipal sector, LED street lighting retrofits and the installation of lighting occupancy sensors.

Our team began by studying various CAPs and compiling information, strategies, and tactics from each into lists (see Appendix F & G).

The most useful information gathered from all CAPs was the methodical breakdown of the municipal and non-municipal sectors into various sub sectors. This allowed our project team to approach gathering the baseline emissions in a well-organized and specific manner, making it so greenhouse gas (GHG) emissions and expenses of each sub sector could be analyzed efficiently.

Under municipal operations we discovered that most of the CAPs separated emission outputs into five sectors: (1) buildings, (2) waste, (3) water/storm water, (4) street lights, and (5) vehicle fleet. As stated previously this allowed for analysis of each subsector independently, enabling our group to determine which aspect of municipal operation was contributing the most GHG emissions. This in turn gave us insight as to which sub sector should take priority in the CAP draft.

Due to the fact the non-municipal sector of Auburn is not regulated and cataloged as the municipal sector, non-municipal operations breakdown is used to allow data collection to be more easily performed. We found that in the CAPs we studied emission outputs were separated into residential, commercial, and industrial sectors. From these sectors the energy use breakdown is similar to the municipals. We were able to separate electricity and natural gas consumption for each sector.

When looking at the transportation methods and GHG outputs of these methods in various CAPs it was seen that in larger municipalities there was a focus on selling the idea of public transportation through city bus routes and car share programs. Also, a lot of focus was put into making their intersections with stop lights more efficient. However, in communities like Auburn where most of the traffic through town is due to employees commuting to work or people coming to the Auburn Mall from outlying areas it was more difficult to track emissions. Due to this we were only able to track vehicle traffic by means of quantity and concentration throughout town.

An important point that was made by each CAP was the use of visuals to show the baseline inventory of the GHG emissions. Another visual commonly used was a graph showing projections of what these emissions would become if no action were to be taken as well as if efforts were made to lower the emissions with the help of a CAP.

Even though these tactics are useful for Auburn's CAP there are some that are not applicable. Some of the CAPs that we looked at included proposals for improved traffic flow through their municipalities. This would not be an effective action item because Auburn is a small town with minimal amount of busy intersections, thus we have concluded that an improved traffic flow would not decrease emissions output by a noticeable amount. There were also different fuel emitting sources discussed in the reviewed CAP's that did not exist in Auburn. Additionally, Auburn disposes of town waste outside of the town borders, meaning that while there was an expense to solid waste disposal it did not necessarily affect the emissions in Auburn. It was also discovered that the water facilities were operated by a private company, meaning that the emissions of the water treatment facility has already been taken into account through the commercial sector. By studying previous CAPs we were able to eliminate action items that

would not be effective and highlight those that have potential to be successful and warrant further research.

4.2 - Needs in CAP Development

When developing a CAP it is very important to take into account the needs of the municipality. These needs are inclusive of establishing a database functional to the needs of those drafting the CAP, developing an accurate baseline emissions figure, and gaining the support of the community members. In the following sections all of these aspects will be explored and elaborated on, specifically speaking for the Town of Auburn.

4.2.1 - Developing an Appropriate Database for Emissions Data

It is essential to compile an emissions baseline inventory as a prerequisite to the drafting of a CAP. In our project we were given the option to use an Access database constructed by the previous WPI IQP project group or use an already established MassEnergyInsight database (MEI) to accomplish this task. The MEI database had many pros, for instance, all of the needed municipal data was already entered and all of the data was organized into accessible tables and graphs. However, it was only able to be accessed by Adam Burney, Auburn Town Planner. The Access database had a single positive in that any town employee would be able to enter municipal and residential information. The negatives aspects were that this database did not have the data on it, was unable to give graphic information of the emissions data, and expenses by sector and had functionality flaws. Developing the available Access database to be as effective as the MEI database was deemed to be an inefficient use of our short project term because we would essentially be designing a replica of the MEI database. With emphasis from our project sponsor to accomplish as much of a CAP draft for Auburn as we were able we decided to move

forward with MEI and focus on completing as many of the 5 Milestones as possible, particularly the third milestone.

4.2.2 - Developing a Baseline Inventory for Emissions

When collecting the baseline inventory for Auburn we were able to discover various points of interest allowing us to begin coming to conclusions early in the project term. The first most pertinent discovery was made as we were analyzing the MEI database, the municipal electric use was higher than any other utility by at least 20%, which immediately told us that the primary focus of emissions reduction for the municipal sector would be in this area.

As the municipal information was previously gathered in the MEI database we had relatively minimal difficulties with this aspect of the project, however, because ICLEI requires municipal, residential, industrial, and commercial emissions to be gathered we had to find a way to gather this information as well. We discovered quickly that this process would not be as simple as determining the municipal emissions records. With the super storm Sandy and Nor'easter Athena preoccupying most utility companies in the Northeast with restoring services to areas that had lost power.

Once we were able to hear back from National Grid with an inventory of electrical consumption through Auburn we finalized our baseline emissions inventory. This included three separate graphs: municipal (Figure C), non-municipal (Figure D), and total emissions output (Figure E). Each graph shows increased emissions if the town was not to enact a CAP, and projections of decreased emissions if they were to enact the CAP, this gives us a visual of all possibilities. Along with the conventional CO2 emissions, we have also compiled projections of other types of emissions such as NO_x, SO_x, CO and others (see Appendix M).

Figure C

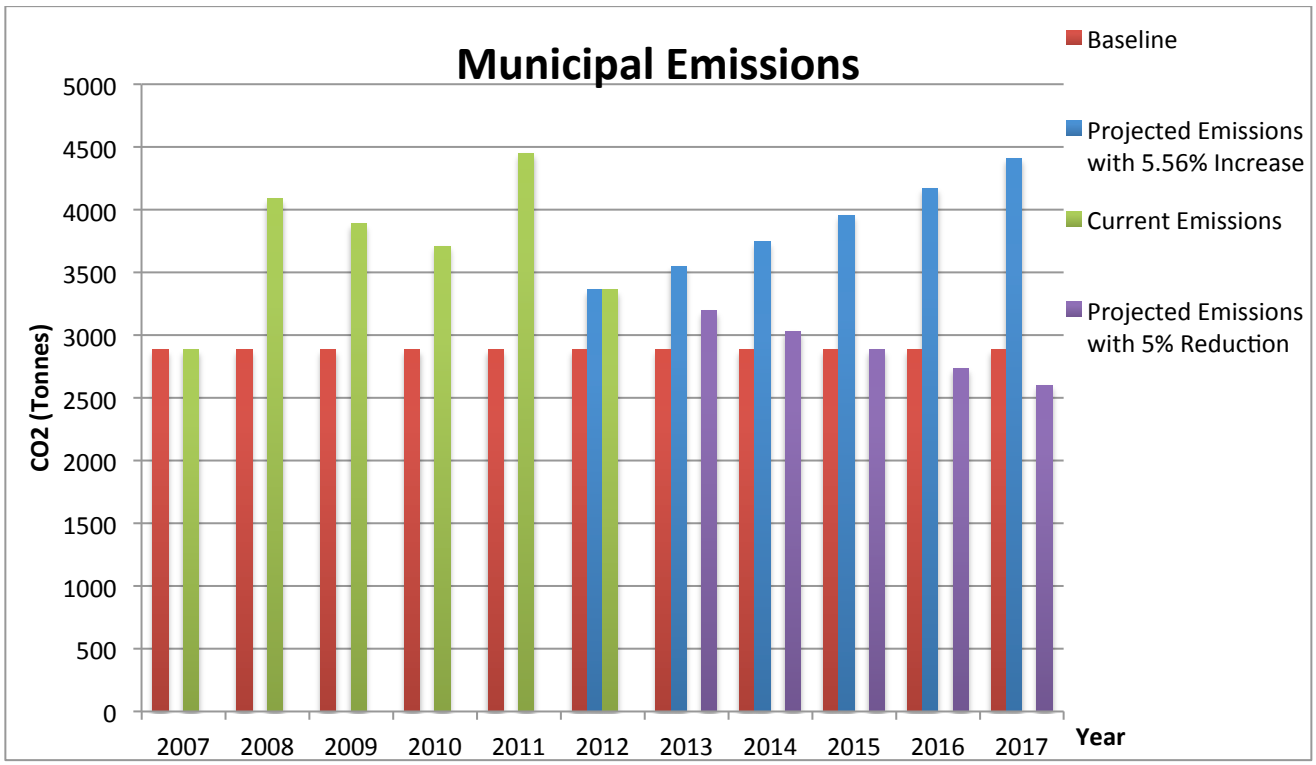


Figure D

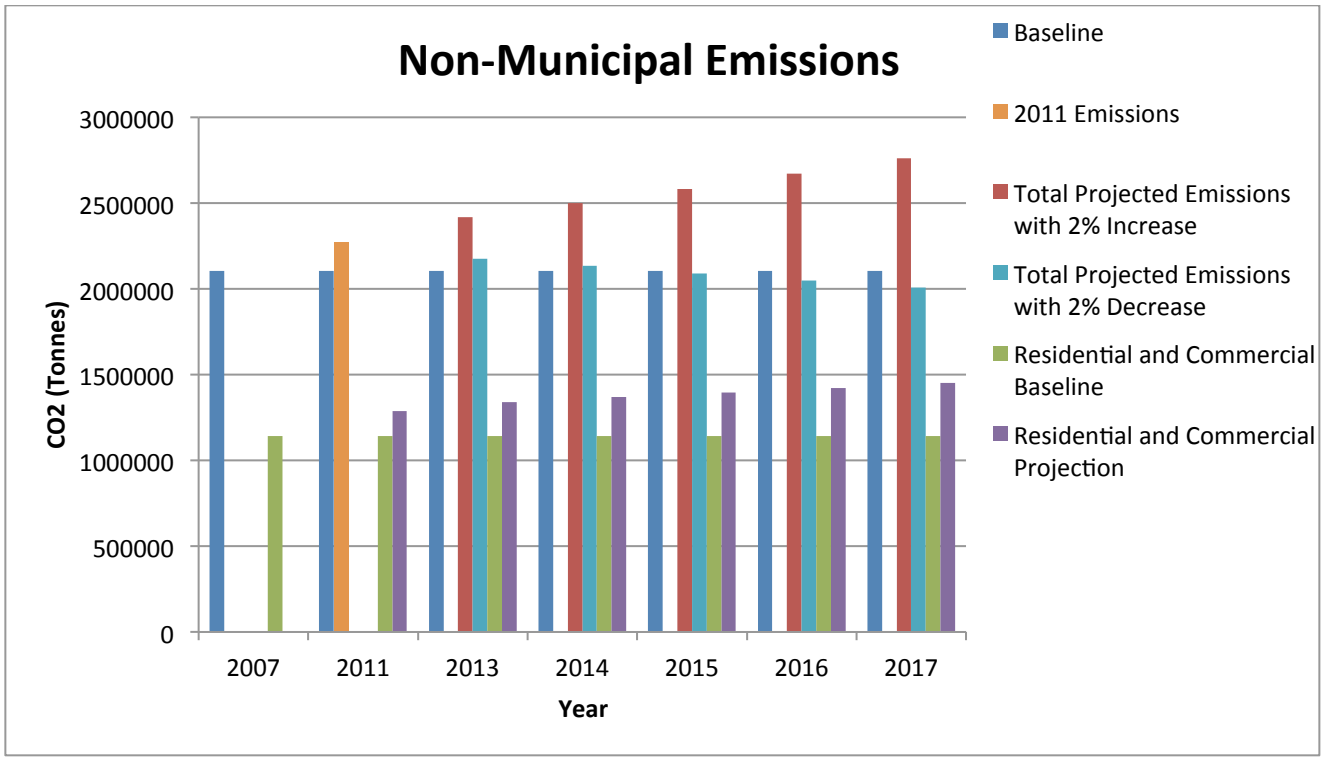
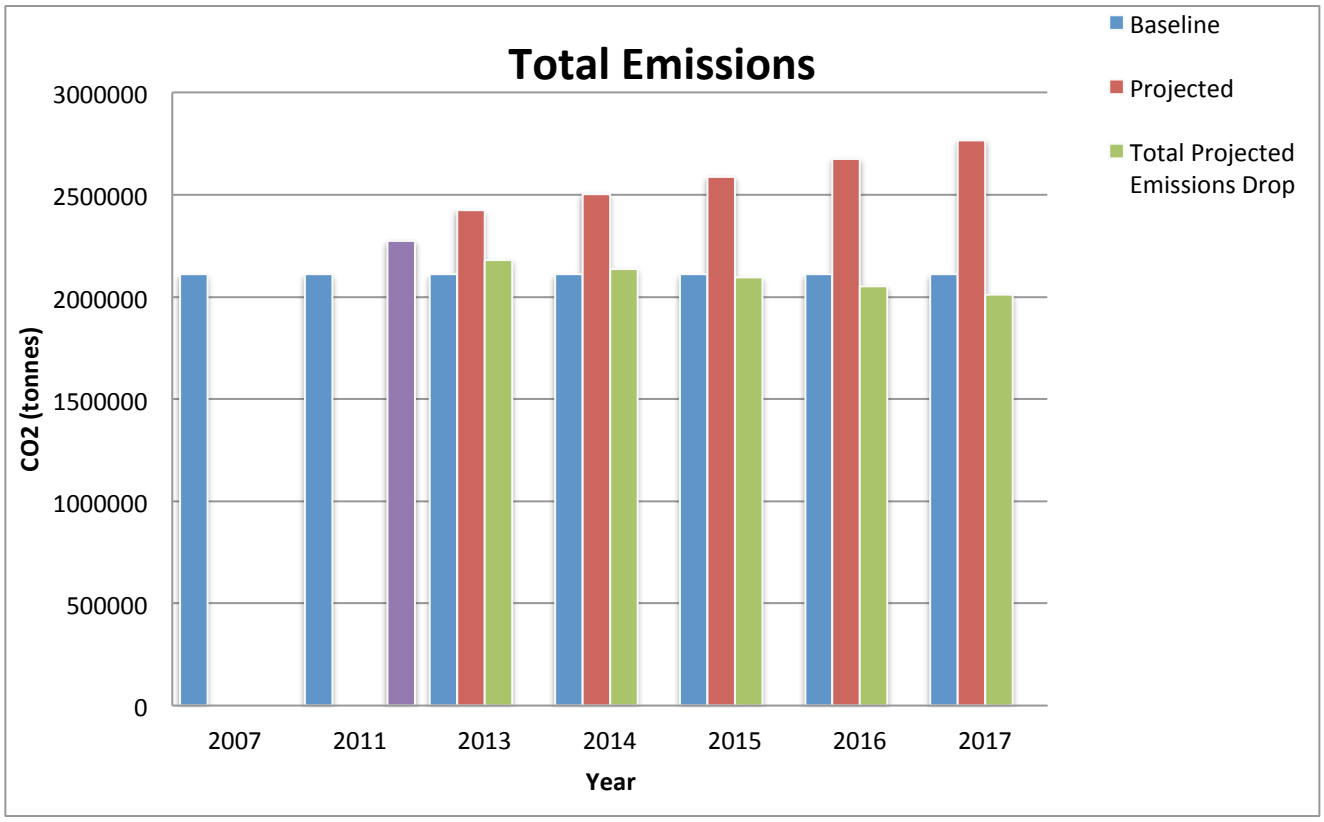


Figure E



4.2.3 - Community Support for Implementation of Climate Action Plan in Auburn

After having established a baseline inventory it was our objective to continue with recommendations that would assist the Town of Auburn in reaching the previously set CO2 emission reduction goals, a 20% reduction by 2017. In reaching these goals and implementing sustainable and energy efficient applications it is important to have the support of the stakeholders, in this case the residents of Auburn. To accomplish this, our team devised an informational pamphlet (see Appendix A) that was distributed within the first week of our project term. Attached to the pamphlet was a URL to a short survey about participants' opinions on enacting a CAP in Auburn (see Appendix B). Survey questions asked whether respondents thought that a CAP would be beneficial and what concerns they had with the CAP. We analyzed the responses and found that about half of the participating community members didn't believe

that a CAP would be beneficial for Auburn, the reasoning for this varied between a disbelief in climate change to concerns about financial feasibility. This response was not surprising to our project team as we were forewarned by our project sponsor that there was a high probability of this outcome. As half of respondents expressed the same financial feasibility concerns with a CAP in Auburn it was decided that the focus of the project would be moved towards educating the residents on energy efficiency and how it can save money. Our project team decided that we would now refer to our Climate Action Plan as an Energy Reduction Plan (ERP).

In an effort to move forward with our ERP we began to research simple energy reduction methods that could be easily applied. We compiled these facts into three informational fliers (see Appendices H, I, J) containing short explanations of how these energy reduction methods would be simple to perform and save families exceptional sums of money. Specifically, two fliers contained information pertaining to state incentives for implementing energy efficient technology and home weatherization. The third flier simply stated easily applicable energy saving facts, including the percent of energy saved by switching to compact florescent lights (CFLs). These fliers were posted on the Auburn Town website, and also distributed through various shops and stores located at the intersection of Auburn St. and Southbridge St. This location was chosen due to the high traffic density and the residential activity in this area being relatively high. At the bottom of all fliers we have placed our team email alias to allow open communication between the residents of Auburn and ourselves. In addition to distributing our fliers manually, our project team developed a webpage where all fliers, website links, and in depth information about energy reduction methods could be found in one easily accessible location. This webpage is accessible through the Town of Auburns' current website.

4.2.4 - Implementation of Student Green Team at Auburn High School

When working with a community it is important to gain morale for the cause, to do this effectively, an ERP must become an accepted entity in the area. To help achieve this goal we worked with the Auburn High School to help support the younger community members to become a sustainable aspect to Auburn and be able to spread their knowledge at the close of our project. In order to do this we have contacted Auburn High School to start a student green team or to gain the assistance of the environmental club already established in the school. We planned to educate the students on ways they can save energy and reduce their carbon footprint in the town, asking them to brainstorm ideas applicable to their school as well as their home life. These efforts will hopefully lead towards the school making efforts to receive a Green Flag Award, a prestigious award given to Eco-Schools that have shown great efforts in becoming a sustainable community and spreading their knowledge through the greater community. The reason we have placed so much emphasis on gaining support of students is because we believed that with them being active members of the community information presented by them will be better received and considered than information presented by us.

4.3 Financial Feasibility of CAP

Through surveys and document analysis, we deduced that the best method for getting Auburn residents to understand the value of an ERP is to highlight the economic benefits of its implementation. In order to garner support for an ERP in Auburn, we needed to approach the residents and town officials and speak about matters of importance to them. Our country is in the middle of an economic recession and while Auburn's residents are largely upper middle class, having an average annual home income of $81,260 according to the U.S. census, they are not immune from the fallout of the recession. Consequently this raises concerns with municipal changes that have potential to impact tax rates or increase their cost of living.

In an effort to combat these relevant issues seen by residents we have done extensive research into various money saving techniques that will also contribute to energy reduction in Auburn. These actions include installation of energy reduction products, home weatherization, and energy audits (see Appendices G, H, I).

By using the CAPPA program we are able to input all baseline information and be given an ERP outline. This outline ranks the most effective greenhouse gas (GHG) emission reduction methods and also shows what percentage of the target goal these methods will account for. While this is extremely helpful in drafting a CAP for Auburn, the most important part of this program is that it is able to give rough estimates for how long it will take to pay off the technologies and methods chosen to implement. With this information in hand, the next project team should be able to determine what emission reduction methods are most relevant to Auburn and educate the community on how long the payoff period for each method will last. For example, we were able to determine that if Auburn were to replace 100 of their current streetlights with LED streetlights it would take roughly .2 years to pay off the installation. Below, Figure F shows the projected utilities cost for the commercial and residential sectors while Figure G shows the municipal utility expenses.

Figure F

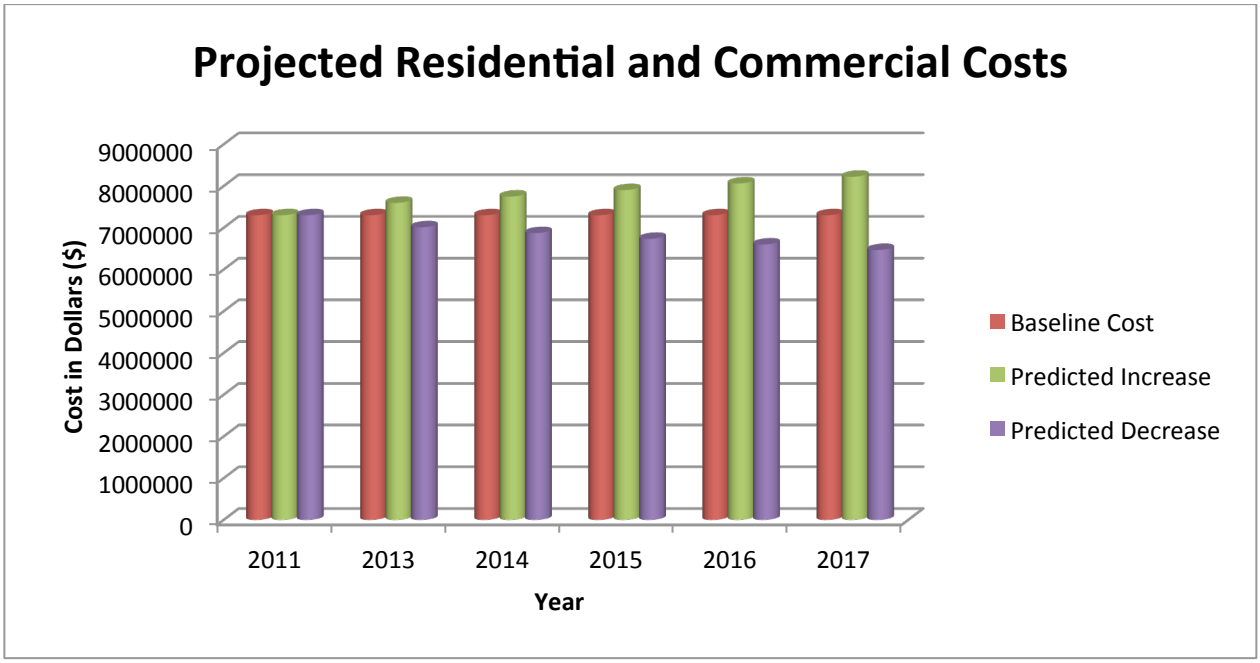
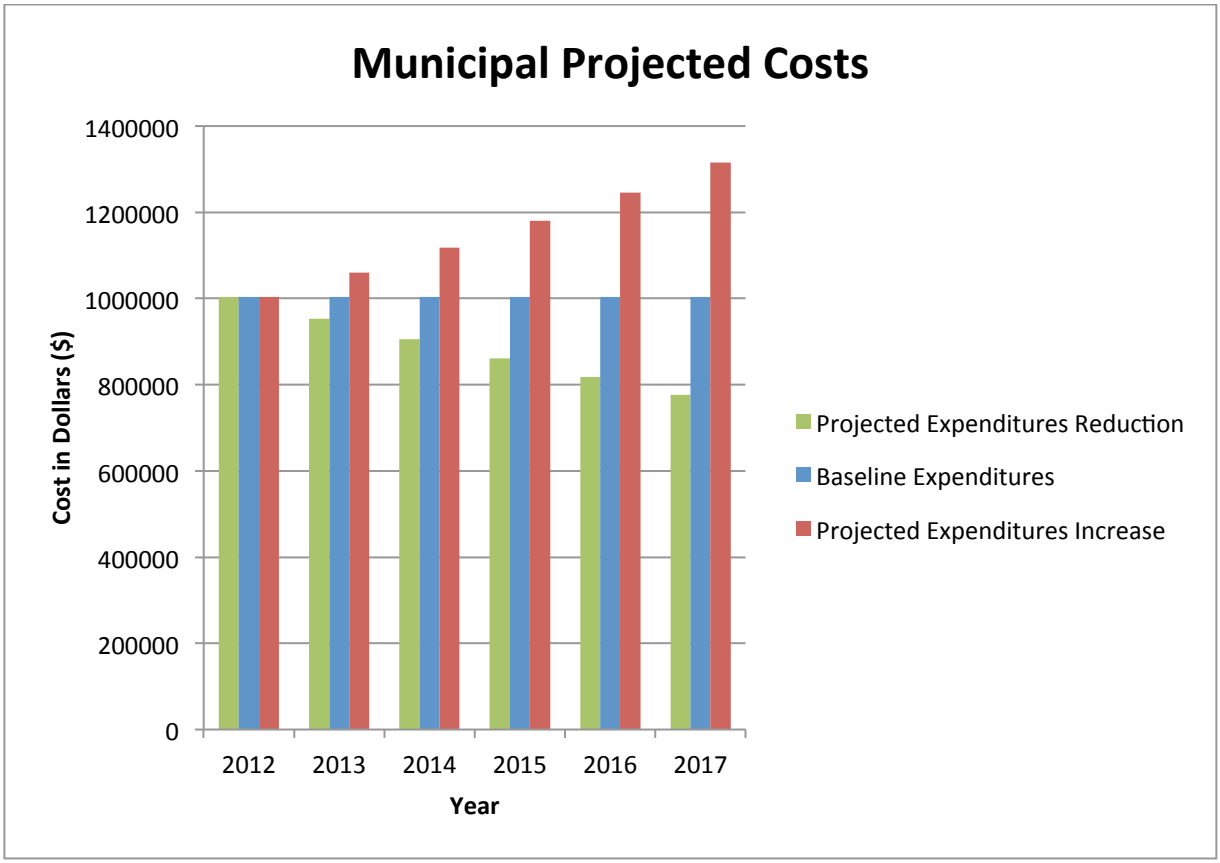


Figure G



5.0 - Conclusions and Recommendations

The end result of this project is an extremely detailed emissions inventory and a set of emissions reduction goals for the Town of Auburn. Our recommendations for the continuation for the project are listed below. We have also provided a few recommendations for action items to be included in the drafting of the Climate Action Plan (CAP).

5.1 – Project Recommendations

After completing the first two milestones in Local Governments for Sustainability's (ICLEI) Five Milestone Program we have come up with several recommendations for the successful continuation of the project.

5.1.1 – Gather Support of the Community

When working to draft a CAP it is important to have the full support of all stakeholders, in this case: the residents of Auburn. After finding that climate change was not necessarily a recognized issue for some of the community it was decided to pull focus towards energy and costs savings of smart energy use. In switching focus towards energy reduction by renaming the effort an Energy Reduction Plan (ERP), our project team still makes the drafting of a CAP possible for Auburn and effects climate change by reducing CO2 output while enjoying the support of the community. We exhibited this switch in focus in our educational pamphlets, flyers that were posted all over town, and the web page that we created to educate homeowners on residential energy savings. Our recommendation would be to continue to publicize the effort with articles in the Auburn Telegram, posting more information on the town website, and a possible pamphlet to be sent out to all residents.

We also recommend continuing support towards Auburn High School's effort for the Green Flag Award through communication with Karen Ares. This movement will only further encourage community involvement in reducing greenhouse gas emissions in Auburn.

5.1.2 – Recommendation for Analysis

Proper training is essential to being able to operate the CACP and CAPPA software effectively. There are videos that can be found online through the ICLEI USA website, and there are also manuals attached in the informational project binder with Adam Burney.

If any further data needs to be collected, it is recommended to follow the methodology that is laid out for every emissions source for consistency's sake. All of the utilized equations and calculations are also presented and explained in the informational binder as well.

5.2 – Action Item Recommendations

With community response in mind we have detailed various CAP action items with information regarding history of the technology, how the technology should be implemented, and costs associated with each. These items have then been divided into short and long-term action items based on the time frame and costs needed to accomplish each action item. The items that are relatively easy for any community member to accomplish with minimal cost have been categorized as short term action items, while those that are specifically for the municipality or items that have high upfront costs have been categorized as a long term action items.

5.3 - Short Term Action Items

5.3.1 - Composting Initiative

When most people think about town services that reduce waste, they tend to think of standard recycling programs. However, municipal composting, a form of recycling organic food

waste and yard clippings with potential to be used as organic mulch, is a way for the Town of Auburn to easily reduce the amount of waste they produce each day. On average about 1.3 billion tons of food waste is thrown out each year, all of which has potential to be recycled into compost and put back into the ground to benefit municipal and residential gardens, because compost is able to act as a substitute for chemical fertilizers and a medium for growing outdoor plants. Composting of organic waste is a natural process that takes nearly two years if not assisted by humans, however, if there was to be human intervention such as regular mixing and treatment, this process can be completed in 3 – 6 months. This allows for the efforts put forth by those who choose to compost to receive the rewards at a faster rate.

5.3.1.1 - Residential Composting

The process of developing food scraps to compost is fairly simple. All one needs is to have a designated composting container, costing between $60 - $100 if provided by the state. However, if one was to build their own composting container which can be built from brick, chicken wire, and wood, the state prices to be cut by up to half. The main ingredients needed to produce compost are food waste, yard trimmings, and moisture, however, there are many more other compostable materials including cardboard rolls, coffee grounds and filters, hair and fur, tea bags, and wool rags. The town, Hempstead, New York, has initiated a town wide composting program with promising results, this program only cost the residents the price of a town issued composting bin. The bins were available to residents interested in the program at $45/unit, this being a reduced cost due to grants awarded to the town.

5.3.1.2 - Smart Composting

Most organic materials can be returned to the environment by means of compost, though some materials including domestic pet waste, meats, and fats or grease can attract unwanted

attention from animals and should not be included in a composting pile. While maintenance methods of a personal compost pile change between seasons, if the resident responsible for the compost is educated in methods needed to properly produce compost year round, temperature and weather variation will pose no complications. The main priority in this process is maintaining adequate moisture and a consistent amount of mixing of the pile to allow breakdown of materials to occur at a rapid speed.

5.3.1.3 - Municipal Composting

If town wide composting were to be initiated by the Town of Auburn, the potential for expenses saved in trash pickup as well as profit from compost sales would be economically beneficial, through potential of job creation or extension on the waste department. The compost produced will be able to be used for garden maintenance along town buildings and roads reducing budget spent on materials needed for these activities. Many municipalities including, Greenwich and Fairfield Connecticut, as well as Berkeley and San Francisco, California, have taken on composting programs on town and city levels. In the early 1990's Greenwich and Fairfield began a town wide composting program, in doing so 30% of trash was kept from their garbage can and put back into the environment in beneficial ways. The San Francisco, CA composting program was initiated in the mid-1990s and has been proven to be the country's most successful, being used as a model for many U.S. towns and cities. San Francisco currently recycles and composts 92% of its garbage. In Berkley, CA standards have been set for residents and commercial businesses that produce large amounts of waste, 4 cubic-yards per week for multifamily homes and 5 cubic yards for commercial businesses, are made to use alternative forms of waste management such as recycling or composting programs set by the city. All of these efforts have not only been able to reduce the amount of trash being placed in landfills in

these cities and many more, but they have allowed for these communities to become better educated on taking environmental action and the importance of placing nutrient back into the soil, all actions that reduce the carbon footprint of a municipality.

5.3.2 - Energy Audit before Home Sale Initiative

Stressing the need of home energy audits and encouraging this act before sale of a home is not against any Massachusetts state laws. This idea of putting high emphasis on home energy audits has been made a requirement already in cities such as Austin, Texas. The publicly owned energy company Austin Energy has developed an Energy Conservation Audit and Disclosure Ordinance for the single-family homes that it serves. Requiring this energy audit has allowed potential homebuyers to receive in depth reports on the energy efficiency of their perspective new home. This in turn causes those who are selling to ensure they have a home that is appealing not just is aesthetics and costs, but also in energy efficiency.

5.3.2.1 - Massachusetts Incentives

While requiring or highly encouraging this activity by families looking to sell their current home may not be received well, the facts are that many companies based in Massachusetts will perform this service for free. This also leaves sellers with recommendations for areas where a home could be improved, whether it is drafty doors and windows or a lack of insulation in the attic. Mass Save is an organization in Massachusetts that offers these options for homeowners in some cases for free. They also provide residents of Massachusetts with information on rebates that they qualify for that will be able to save a single home thousands of dollars in home improvements.

5.3.2.2 - Homeowner Incentives

If a homeowner is to perform an energy audit and then continue forward with home weatherization plans, this will allow for an increase in comfort to the home as well as an increase to real estate value. For instance, if a home was to reduce energy bills by roughly $300 annually, the home value will increase up to $6,000. With rebates and money saving opportunities to perform home weatherization, this option has potential for high appeal to homeowners looking to place their property on the market. There is also an option for homeowners to complete the energy audit and present this information to the potential homebuyers. With this information if the homebuyer was to complete all of the needed improvements there would be an expected return on investment of about 16%, this is with taking into account the cost of weatherization.

5.4 - Long Term Action Items

5.4.1 - Rain Gardens Initiative

A rain garden is a form of bio-retention facility designed with storm water function and aesthetics in mind. A bio-retention facility is defined as a system containing a soil bed planted with suitable vegetation, preferably non-invasive, by the New Jersey Stormwater Best Management Practices Manual. By developing these gardens the municipality will be able to reduce storm water runoff that could potentially lead to erosion, water pollution, flooding, and diminished ground water levels. Areas that have implemented rain gardens as a method to reduce storm water runoff have seen improvement in nearby bodies of water and a reduction of water pollutants up to 30%. When a rain garden is processing storm water the plants are able to mimic the hydraulic action of a healthy forest by reducing the nitrogen, phosphorous, and overall sediment levels in the water. The implementation of rain gardens in the Town of Auburn has potential to lead to less pollution reaching the local bodies of water and a reduction in roadside erosion, saving the town maintenance and repair costs.

There are two types of basic methods for developing a rain garden, under-drained and self-contained. Both types of garden are able to improve the quality of storm water. The determining factors for which type of rain garden development method should be used include: volume of water to be treated, existing soil quality, available space, and budget.

5.4.1.1 – Under-Drained Rain Garden

The under-drain rain garden is a method where storm water is moderately filtered by the plant life then transported by an under lying drain to a conventional storm pipe system. This method is primarily used when the bottom of the garden is less than 4' from the highest seasonal level of the water table or if surrounding soil is contaminated. When designing this type of garden it is important to keep in mind that plants selected must be able to withstand extreme flooding and drought because the design is intended to drain 1" every two hours. This is the primary reason it is important to use a highly porous media, organic topsoil and mulch, and under-drains for this design.

5.4.1.2 - Self-Contained Rain Garden

The self-contained rain gardens are designed to hold moisture for long periods of time, especially in the lower areas of the garden, meaning plants chosen for this design should be able to tolerate flooding over extended time frames. Soils for this design are amended with extremely porous media, organic topsoil and mulch; at least 8" in depth, while 2' – 3' is ideal. With this type of rain garden, storm water is naturally filtered by the plant life and restored to the water table.

5.4.1.3 - General Design and Plant Selection

The general design of a rain garden is a garden planted in a depression or hole, with an expected cost of $3 - $5 for every square foot of garden developed. This cost can increase if it is

decided to work with an independent landscaping company. The garden site must be excavated, planting media must be imported, and planting liner may be used at discretion of the municipality. When developing a rain garden it is important to start with small and healthy plants so the plant life may adapt to the garden conditions as they grow, when selecting plants for the garden it is important to keep in mind that plants with deep fibrous roots, much like trees, will have the most efficient cleaning and filtration capabilities. Also, local plants are the most favorable choice in plant selection because they have already adapted to the soil and environmental conditions, herbaceous perennials, woody shrubs, and trees are the most ideal choices for the low maintenance aspect to them. Wildflowers, sedges, rushes, and ferns are also ideal choices for a rain garden. For the best cumulative effect on both volume and quality of storm water runoff filtration it is suggested to develop multiple rain gardens over a given area.

5.4.2 - LED Street Lighting Initiative

A light-emitting diode (LED) is a semiconductor device that is able to convert electricity into light by using the movement of electrons. Not only do LEDs consume less energy than the standard incandescent light bulb, they are also 300 times more efficient than a compact florescent light bulb (CFL), meaning they are roughly 1,000 times more efficient than an incandescent light bulb. LEDs also have a long life expectancy in comparison to other lighting methods, roughly 50,000 hours when run at 70% power, averaging to be about 13 hours of running time a day for 13 years.

5.4.2.1 - Advantages of LED Lighting

LED lighting technologies have proved over time to be a cost efficient lighting method, because LED lights are able to shine brightly with low maintenance cost and have a predictable life expectancy they have begun to be a widely accepted technology in U.S. municipalities.

Another advantage to converting to LED street lighting is that they possess a function where they can be dimmed when less light is needed, such as evening hours, and can be set to brighter settings as the night gets darker, always providing optimum lighting. Unlike common incandescent lighting systems if an LED street light was to suddenly lose power due to power outages they will be able to immediately resume providing light once electricity is restored because they do not need time to heat up before they will be able to put out light.

5.4.2.2 - Costs Associated with LED Lighting

While LED lights do have a higher up front cost in comparison to incandescent streetlights, $200 - $1200 for an LED opposed to $50 - $200 for incandescent streetlights, in the long run this lighting method will be able to save money for the Town of Auburn. In Seattle, WA there was a retrofit to LED street lights, reports state that they have managed to save more than $300,000 each year in electricity costs. Also, in California to assist with the upfront costs the state was awarded money by the Energy Efficient Conversion Block Grants Program (EECBG). This provided the state with millions of dollars for energy improvements, including LED street lighting retrofits.

5.4.3 - Solar Panel Initiative

Solar panels are a system used to convert solar energy into electrical energy. While the thought of this expensive technology can be deterring for some the truth is that within a year the owners of a solar panel system can begin selling unused electric energy back to the power companies as energy credits, allowing for continuous reduction in electric and heating bills. With solar panels losing efficiency with increased temperatures is a concern in warm climates, this is not necessarily and issue for the northeastern US because this reduction does not occur unless temperatures reach 115 degrees Fahrenheit. There are several types of solar panel system options

available as well, all able to meet the needs of individual homeowners or businesses, this list includes: Monocrystaline and polycrystalline silicon units, thin film, building integrated photovoltaics (BIPV), and solar hot water panels.

5.4.3.1 - Monocrystalline Silicon Solar Panels

The monocrystalline silicon units are currently the most efficient models available to buyers, however, this also means they are the most expensive. The design allows for optimal use on roofs, allowing buyers to not have to use yard space to support the system. These systems are made with a single crystal, making them the most efficient and giving buyers more energy than any other solar systems available. The monocrystalline systems also have a long life expectancy, a minimum or 25 years with potential to last past 50 years, making these panels a good long-term investment.

5.4.3.2 - Polycrystalline Silicon Solar Panels

Polycrystalline systems are a less expensive option for solar systems, however, they are also less efficient than the monocrystalline silicon panels. This system is ideal for mounting on a roof, and offer a low cost construction design, which is why they can have a slightly greater appeal than the monocrystalline option. This system also comes with a 25-year life expectancy, making this system a smart long-term investment for a household looking to reduce their home electric bills.

5.4.3.3 - Thin Film Solar Panels

Thin film solar panels are one of the least expensive solar systems to make, but this also means that they are not necessarily as efficient as the previous systems mentioned. Studies have shown that this option of solar panel only shows true efficiency when put into large-scale

application, such as a solar farm. The advantage to this system is the cost of individual units. These units are also very resistant to loss in efficiency due to increased temperatures.

5.4.3.4 - Building Integrated Photovoltaic (BIPV) Solar Panels

This option for a solar system is thought to be the most aesthetically appealing due to the fact that in many instances it is difficult to distinguish the solar cell from a home's roof shingle. The BIPV solar system is developed to blend with the already existing home design and look very similar to roofing shingles. While this is an appealing option to some, this system is less efficient than a monocrystalline or polycrystalline system. Also, because BIPV is integrated directly into the roof structure of a home the roof will need to be more frequently repaired than if a mounted solar system were to be used, but these solar cells do have a long life expectancy.

5.4.3.5 - Solar Hot Water Panels

Not all solar panels necessarily have to be strictly intended to reduce a home or business electric cost, there are also panels used to reduce gas costs used for heating home water or a heated pool. The solar hot water panels also known as solar thermal panels can provide heating and cooling for a home. A study conducted by Residential Energy Consumption Survey, posted in 2007 shows that on average a home uses up to 70% of energy costs on heating, cooling, and hot water production, making this system a smart investment for homes looking to reduce energy bills.

5.4.3.6 - Cost Associated

Solar panel systems have a large upfront cost, with price ranging between $100 and $700 for a single unit and multiple units needed for optimum efficiency. This upfront cost should not deter buyers from investing in this technology though; solar panels are able to begin paying for themselves immediately with energy savings achieved through their application in homes and

businesses. On average a solar system can pay for its self within twenty years, and adding a solar system to a home also increases the property value without increasing property tax. According to a study performed by National Renewable Energy Laboratory (NERL) homes with solar panels installed were selling 20% faster than homes without. NERL was also able to determine that for every dollar saved in energy costs annually would increase a home's value by $20. This means that if a system saves a family $1,000 in energy costs annually the value of the home will increase by $20,000.

5.5 – Conclusions

Our team was able to come up with several conclusions about the process of drafting a Climate Action Plan (CAP) for Auburn. Coming in to the project term we had a great knowledge of ICLEI and the Five Milestone Program: this guided us in hitting the ground running and starting to gather Auburn's greenhouse gas emissions from day one.

From the first weeks we were determined to complete the emissions gathering process, the goal setting based off of the emissions, and then move to draft a Climate Action Plan for Auburn. Unfortunately the seven week term was not enough time to accomplish all three goals in an effective and thorough manner.

We were able to complete the emissions inventory for the municipal and community sides. We were also able to set a five year goal based off of the current emissions and the baseline in 2007. We have started drafting a CAP in having completed write-ups, posted flyers and created a web page for recommendations to the residents on actions that they can take in their homes to reduce energy usage. We have also started working with the Auburn High School to further increase the visibility of a CAP in Auburn. Although we have started the CAP drafting process, we have not touched the biggest part of this project, which is determining action items

that require big spending or those that are controlled by the municipality to reduce greenhouse gas emissions. We hope that the next Auburn CAP team will take our information and recommendations in consideration when finishing this project for Auburn and its residents.

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Appendices

Appendix A: Interview Questions

- From previous research we have found that a town planner in responsible for many things, including organization of the Development Coordination Group, assisting in the Town's Zoning Bylaws, Master Plan and Open Space plan. Could you please elaborate more on what it is specifically you do for the Town of Auburn?

- Can you please tell us about the past IQP's that have worked with the Town of Auburn? What did they do well and poorly?

- Will past and current data from the past IQP group be available to us? Has data been gathered since?

- It is our understanding that you would like to model Auburn's climate action plan after the ICLEI model, what in particular do you like about this model? What are the major concerns for Auburn?

- CAPPA (Climate and Air Pollution Planning Assistant) program is a program that will help with determining an achievable emissions reduction target and selecting strategies to include in a climate action plan for the Town of Auburn, the 2nd and 3rd mile stones in the ICLEI program. Would the Town of Auburn be interested in looking further into this program and possibly implementing the use of the program in the development of the Climate Action Plan?

- We understand that the previous IQP group that you worked with created a database for the Town of Auburn, is there a specific issue that is keeping the town from using this database?

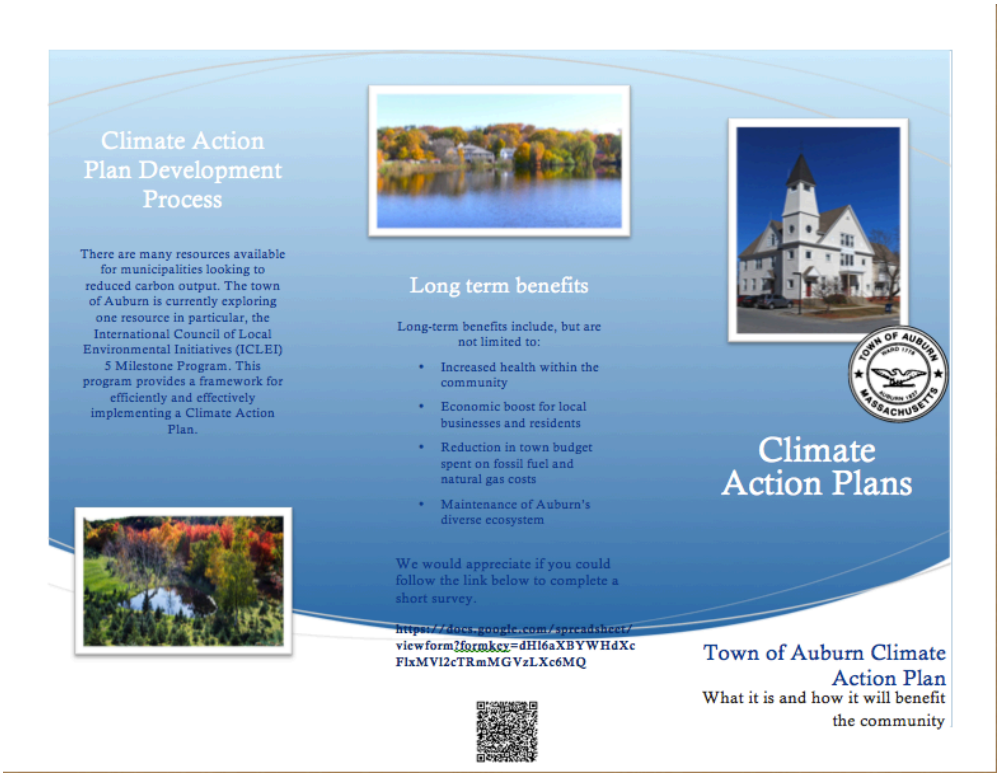
- Do you have an understanding of the town's level of support for an Auburn action plan? Do you think it would be helpful to survey residents on the matter?

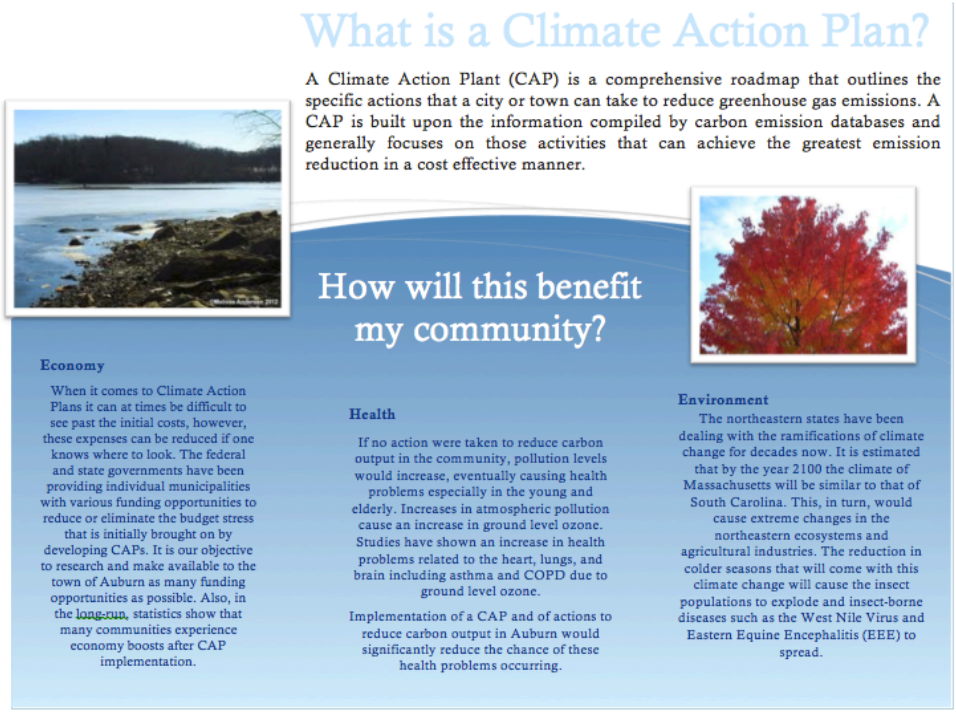
- What is the final product you would like to be attained for the Town of Auburn after our time working together? What key steps would you like to have accomplished?

- We understand the town is receiving Green Community funding, congratulations on the designation. Are there any parameters that we need to be aware of as to where/how those funds can be used and do you plan on using some of them to achieve some of the climate action plan goals?
    - They are awarded $165,550. Towns previously awarded this grant used the money for installation of solar panels on town office buildings, weatherization at schools and municipal buildings, installation of high-efficiency streetlights, and a host of energy efficiency upgrades.

- What obstacles do you think we might encounter during the IQP process?

Appendix B: Climate Action Plan Pamphlet





Appendix C: Table representing pamphlet content

Possible Topic	Possible	Benefits	of CAP
Personal Economic Gain	Savings on town taxes through green technology	Buying a High mpg car: gas savings	Home green energy production: lower monthly bill and eventually make money
Local Health Benefits	Benefits to youth and elderly	Scientific evidence backing reduction of asthma prevalence in highly polluted areas	Suggestion by Adam or other town official
Global Effects	Decrease in natural disaster frequency and power	Increase or stabilization of global crop yield	Examples of New England Disasters
Climate Action Plan	What	is	it

Appendix D: Survey Questions Conducted

"After reading the provided pamphlet please complete the attached survey"

Please select your age range

Please select your level of education

Please circle the answer which best describes your political views

On a scale of 1 to 10, can you please tell us how educated you feel about climate change?

On a scale of 1 to 10, how supportive are you of Auburn's Climate Action Plan?

On a scale of 1 to 10, how financially feasible do you think that a Climate Action Plan is for the Town of Auburn?

Do you think a Climate Action Plan will be effective for the Town of Auburn?

What specific changes to Auburn do you want see through Auburn's Climate Action Plan?

What is your biggest concern with the enactment of Auburn's Climate Action Plan?

What are some strategies you would like to see implemented in the Climate Action Plan?

Appendix E: Interview Questions (Bob Fitzpatrick)

What types of grants are available for grant applicants looking to implement green energy methods?

What are some qualifications needed for these grants?

For a town the size of Auburn, approximately 16,188 residents, what grants are available through Massachusetts and the federal government?

If so, could you please describe the application process?

Appendix F: Climate Action Plan Comparisons

Menlo Park, CA CAP (Population 30,087 (EPA) covers land area of 17.4 sq miles)

- Municipal operations break down
  - Buildings
  - Waste
  - Water / storm water
  - Street lights
  - Vehicle fleet
- Source
  - Gasoline
  - Electricity

- Natural gas
- Methane
- Diesel

· Proposed emissions reduction targets

- Option 1 (very ambitious but achievable)

§ Reduce emissions by 10% below 2005 levels by 2012

§ Reduce emissions by 26% below 2005 levels by 2020

- Option 2 (in-line with identified state priorities)

§ Reach 2005 emission levels by 2005

§ Reduce emission by 15% below 2005 levels by 2020

· Emission reduction strategies

- Roofing for city buildings
- Solar PV panels
- Replacing street lights with LED models
- Enhancements to recycling collection services
- Installation of water efficient fixtures in municipal buildings
- Green fleet policy

§ Retiring fuel inefficient vehicles

§ Using alternative fuels

§ Purchasing environmentally responsible consumables (recycled anti-freeze, tires, etc)

· Implementation of green at home program

- Audit program

- Goal was to reach at least 250 households

· Municipal operations summary for baseline inventory (2005)

- Includes percentages of everything above

· Municipal operations criteria air pollutant emissions from 2005

- Displays all above with NO_x, So_x, CO, VOC_s, (Volatile organic compounds) and PM_{10} (particular matter (no longer updated by EPA)) in lbs

· Cost of implementation with a pay back period ($90,000 with 3 years)

Worcester, MA CAP (Population 181,045 (2010 census) covers land area of 38.6 sq miles)

· Conducted efficiency graphs (electricity, light fuel oil, natural gas)

- Determined by energy output over emissions output

· Separate GHG emissions by source

- Diesel
- Electricity
- Natural gas
- Light oil fuel
- Gasoline
- Waste

· Municipal operations breakdown

- Buildings
- Street lights
- Vehicles
- Waste

- Table of GHG emissions per capita
- GHG emissions reduction target of 11% by 2010 using baseline levels of 2002
- Target deadline set in place at least 2 years before end date
- Implementation costs and benefits of “new” sources

Boulder, CO CAP (Population 98,889 covers land area of 25.4 sq miles)

- Inventory only covers predominant GHG emissions
  - CO_2 and CH_4 (methane)
  - Other GHG emissions were omitted due to the miniscule amount produced (N_20, HFC, PFC, etc)
- Forecast chart if nothing is changed with emissions target level
- Inventory profile
  - Residential
  - Commercial
  - Industrial
  - Street lighting
  - Transportation
  - Waste
- Breakdown of inventory by energy source
  - Landfill gas
  - Vehicle fuel
  - Natural gas

- Electricity
  - Reduce vehicle miles traveled
  - Purchase more efficient fuels
  - Upgrade to fuel efficient vehicles
  - Switch to low carbon fuels
  - Utilize tax incentives when possible
  - Educate the public
  - Initiate activities where benefits exceed cost
  - Making buildings more energy efficient
- Replacing windows and seals
- Energy efficient light bulbs

Hamden, CT (Population 60,960 (2010 census) covers land area of 33.3 sq miles)

- Inventory of governmental emissions
  - Buildings
  - Vehicle fleet
  - Employee commute
  - Street lights
  - Water / sewer
  - Waste
  - Community emissions sector
  - Residential

- Commercial
- Industrial
- Transportation
- Waste

· Source

- Electricity
- Gasoline
- Diesel

· More stringent building standards for homes and businesses

· Improved traffic flow

· Combined emissions trends for government and community

- Business as usual
- Baseline
- With suggested reductions
- Target (10%)

Keene, New Hampshire (Population 23,409 (2010 census) covers land area of 37.6 sq miles)

· 5 milestone program

- Conduct a Climate Resiliency Study
- Prioritize Areas for Action and Set Goals
- Develop an Adaptation Action Plan
- Implement the Action Plan

- Monitor, Evaluate, and Update the Plan
- Identified vulnerable sectors and subsectors
- Built environment
  - Buildings and development
  - Transportation infrastructure
  - Storm water infrastructure
  - Energy systems
- Natural environment
  - Wetlands
  - Agriculture
  - Groundwater
- Social environment
  - Economy
  - Public health
  - Emergency services
- Goals for each sector
- Built environment
- Natural environment
- Social environment
- Steps to take to successfully initiate a CAP
- To highlight the need for integration among mitigation and adaptation efforts
- Allow for public input about climate change and sustainability
- Come up with a financial strategy

- Create an internal team within City Government to spur departmental integration and implementation of adaptation measures.
- Prioritizing and assessing to pursue costs of implementation

Appendix G: Comparing Strategies

Common tactics

- Municipal operations break down
    - Buildings √√√√
    - Waste √√√
    - Water / storm water √√
    - Street lights √√√
    - Vehicle fleet √√
    - Residential √√
    - Commercial √√
    - Industrial √√
    - Transportation √√
- Source
    - Gasoline √√
    - Electricity √√√
    - Natural gas √√
    - Diesel √√
- Methane √√
    - Baseline inventory √√√

    - Emissions trend graph with baseline and target goal √√
    - Proposed emissions reduction targets √√√√√
    - Emissions reduction strategies
- Updating buildings √√√√
- Solar panels √√
- Replacing street lights with LED models √√√
- Enhancements to recycling collection service √√
- Greener vehicles √√

<u>Uncommon tactics</u>

- Employee commute
- Source
    - Light oil fuel
    - Vehicle fuel
- Landfill gas
- Emissions reduction strategy
    - Installation of water efficient fixtures
    - Replacing windows and seals
- Implementation of green at home program
- Air pollutant emissions
    - NO_x, SO_x, CO, VOC_s, (Volatile organic compounds) and PM_{10}
- Improved traffic flow
- Identifying vulnerable sector
    - Natural environment

- Social environment

Helpful for Auburn CAP

- Municipal operations breakdown
  - Buildings
  - Vehicle fleet
  - Street lights
  - Residential
  - Commercial
  - Industrial
  - transportation
  - Waste
  - Source
  - Electricity
  - Gas
  - Gasoline
  - Diesel
  - Oil
  - Propane
- Baseline inventory
- Emissions trend graph with baseline and target goal
- Proposed emissions reduction targets
- Air pollutant emissions

Inefficient for Auburn CAP

- Improved traffic flow
- Source
    - Light oil fuel
    - Vehicle fuel
    - Landfill gas
- Municipal operations breakdown
    - Water / stormwater

Appendix H: Informational flier

CFL LIGHTS vs. STANDARD LIGHTS

- Compact florescent light bulbs (CFLs) use 75% less energy than a standard light bulb
- Every standard light bulb replaced with a CFL can save up to $40 in electricity costs per year
- Leaving one external light on overnight uses the same amount of energy as lighting 36 living rooms with a CFL bulb for the same amount of time

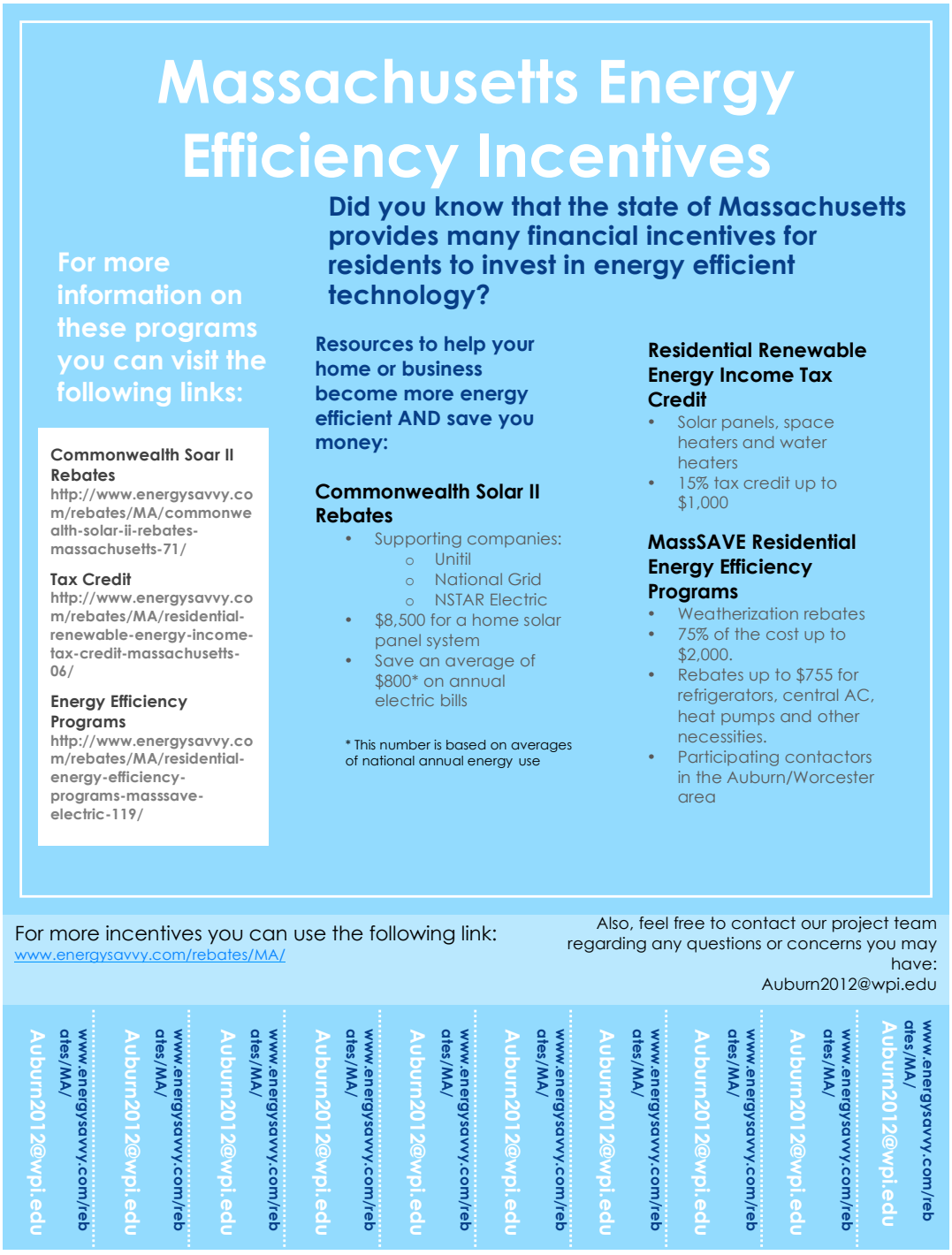
CLOSE YOUR WINDOWS AND DRIVE WITH A FRIEND

- A typical window left open over night in the winter wastes enough energy to drive a small car over 35 miles
- Short car trips are the least fuel efficient, save fuel by combining trips and carpooling with a friend.

For more information on how your annual energy costs can be reduced please visit the site shown below.
http://www.nrdc.org/air/energy/genergy.asp
Also feel free to contact our project team with any questions or concerns at, auburn2012@wpi.edu

Auburn2012@wpi.edu
http://www.nrdc.org/air/energy/genergy.asp

Appendix I: Energy incentives flier



Appendix J: MassSave flier

How Mass Save can help you save on your electric, heating, and cooling costs.

WHO:

HOME OWNERS, SMALL AND LARGE BUSINESSES
Utility companies involved with this initiative include:

- **Berkshire Gas Co.**
- **National Grid**
- **NSTAR**
- **New England Gas Co.**
- **And more**

WHAT:

Save in common energy costs associated with owning a home or business

WHY:

Prevent your hard earned money from being lost to energy inefficiencies

HOW:

Services* including:

- **Building weatherization**
- **Lighting and appliance rebates**
- **Heating and cooling rebates and incentives**

*Unless specified all services are available for home and business

HOW CAN THEY HELP MY BUSINESS?

Incentives and service for:

- **Facility upgrades**
- **Technical assistance**
- **Quality assurance & performance testing**
- **And many more**

To have access to all these offers and more, simply visit the Mass Save website: www.masssave.com

For questions regarding these incentives or additional money saving incentives contact the WPI IQP team working to reduce energy costs in Auburn
Auburn2012@wpi.edu

Appendix K: Authorship Table

Appendix L: Auburn Electrical Load

Circuit	406L1		406L2		406L4		26W1		26W2		26W3		26W4		6W1	
% feeding Auburn	10%		74%		2%		100%		74%		100%		100%		75%	
Connected kVA Total	2910		13352		990		17540		14996		14120		13330		12447	
Connected kVA Three	75		7372		345		8257		5979		8430		12500		8365	
	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load	Circuit Load	Auburn Load
Jan-2007	5.7	0.6	8.3	6.1	4.3	0.1	3.9	3.9	6.1	4.5	5.5	5.5	5.5	5.5		
Feb-2007	6.2	0.6	8.7	6.4	4.3	0.1										
Mar-2007	7.3	0.7	8.4	6.2	4.3	0.1										
Apr-2007	7	0.7	6.7	4.9	3.4	0.1										
May-2007	6.7	0.7	6.5	4.8	3.7	0.1										
Jun-2007	9.2	0.9	8	5.9	6.4	0.2	7.3	7.3	8.4	6.2	7.8	7.8	8	8.0		
Jul-2007	8.8	0.9	10.5	7.7	6.6	0.2	5.8	5.8	8.4	6.2	6.4	6.4	6.7	6.7		
Aug-2007	8.6	0.9	8.1	6.0	6.5	0.2	4.6	4.6	8	5.9	5.8	5.8	5.6	5.6	7.1	5.3
Sep-2007	7.6	0.8	7.5	5.5	5.7	0.1										
Oct-2007	6.5	0.7	6.4	4.7	5.1	0.1	6.7	6.7	7.3	5.4	7.9	7.9	5.6	5.6		
Nov-2007	7.2	0.7	6.6	4.9	5.7	0.1										
Dec-2007	9.2	0.9	8	5.9	6.5	0.2										

Appendix M: Other Projected Emissions