Development of an Energy Reduction Blueprint for the Worcester Green Low-Income Housing Coalition

An Interactive Qualifying Project Report
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Abstract

Low-income housing organizations in Worcester, Massachusetts contend with multiple challenges, as they endeavor to provide safe and comfortable homes for people in need and meet the energy demands of their facilities. The goal of our project was to work with Dismas House of Massachusetts and the Worcester Green Low-Income Housing Coalition (WGLIHC) to promote sustainability and reduce the amount of money spent on energy. We conducted a case study analysis of Dismas House in order to understand its energy reduction process, rationale, and results. Then, we created an energy reduction blueprint from our case study findings. Our blueprint includes recommendations for reducing energy usage and costs so that WGLIHC members retain more funds to improve their programs and change lives.

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Executive Summary

"Modern civilization is the product of an energy binge . . . but humankind's unappeasable appetite for energy makes the solutions ephemeral and the challenge permanent" (Crosby, 2006, p. xiv.) Today, we flip a switch to illuminate a room. We board a plane to travel thousands of miles in a few hours. We put a number into an HVAC machine to change the temperature of a room. All of this requires large amounts of energy that is usually provided by fossil fuels. Although fossil fuels like coal, oil, and natural gas adequately meet high-energy demands, the developed world continues to expand its desire for energy in ways that push fossil fuels, and the environment's capacity to endure the impact of fossil fuel extraction and use, to their limit.

As United States residents, we have grown accustomed to using lots of energy on a daily basis without thinking about the costs. According to the United States Energy Information Administration (EIA), in 2013, about 82 percent of America's energy came from fossil fuels (EIA, 2014d). Additionally, the EIA ranks the United States as the leading oil consumer in the world, consuming 20% of the world's oil with an average of 18,490 barrels a day in 2012 (EIA, 2014a; Thaler, 2012). Our reliance on fossil fuels is concerning because fossil fuels are finite resources, harmful to the environment, and increasingly expensive. As the value of fossil fuels increases due to their depletion, the energy we rely on becomes less expendable, and the cost of living increases (Heinberg, 2011). However, saving energy is costly. In particular, it requires critical decision-making, active planning, and allocated funding. Nevertheless, investing in the energy reduction process is a wise and beneficial decision.

The benefits of energy reduction efforts in low-income housing organizations are revealed through Dismas House of Massachusetts. Dismas House is a low-income housing organization that "reconciles former prisoners to society, and society to former prisoners" (Dismas House, 2014). It provides housing, programs, and services to meet the needs of its residents. However, meeting the needs of its residents includes meeting the energy demands of Dismas House's facilities. As the Massachusetts state budget has reduced funding for low-income housing organizations in recent years, paying for energy utilities took a toll on Dismas House and limited its ability to meet its residents' needs. During the recession in 2009, Dismas House had to close the doors to one of its programs. In order to alleviate the financial pressure that energy payments were exerting on the operating budget, Dismas House invested in energy reduction efforts. These efforts allowed them to allocate the saved funds to services so Dismas can better meet the needs of its residents.

Dismas House's energy reduction efforts were successful, and inspired its co-executive director, Dave McMahon, to found the Worcester Green Low-Income Housing Coalition (WGLIHC). The WGLIHC was created to recruit other low-income housing organizations to follow Dismas House's footsteps. If all WGLIHC members can reduce energy costs and use the savings to expand their services, they will contribute towards repairing the social safety net of programs and services that help low-income people, former prisoners, and other Central Massachusetts residents in need.

Goals, Objectives, & Methods

The goal of our Interactive Qualifying Project was to work with Dismas House and the WGLIHC to promote sustainability and reduce their money spent on energy. To accomplish this goal, the executive director of Dismas House and founder of the

WGLIHC, Dave McMahon, asked us to evaluate the energy reduction efforts of Dismas House, and create materials to educate other members of the Worcester Green Low Income Housing Coalition (WGLIHC) on the financial and environmental benefits of investing in energy efficiency. In order to achieve this goal, we developed four objectives.

Our first objective was to understand the process Dismas House used to reduce their energy consumption. We conducted a case study on Dismas House in order to learn "how" and "why" they successfully reduced their energy usage. In order to guide our research we proposed the theory that *Dismas House's energy reduction efforts (renovations, upgrades, implementations, etc.) ultimately improved their energy efficiency and saved them money*. We tested this theory through archival research of Dismas House's energy audits, interviews with Dismas House staff, and fieldwork consisting of enrolling members of WGLIHC in the Low-Income Multi Family Retrofit Program.

Our second objective was to identify funding options for WGLIHC members. After gaining a clear understanding of Dismas House's energy reduction efforts and the funds they utilized to implement them, we needed to determine how other organizations might emulate their success. We tracked the various funding sources Dismas House used to underwrite their energy reduction efforts in order to identify potential sources of funding for other WGLIHC members. We also sought additional funding sources for WGLIHC members.

Our third objective was to create an energy reduction blueprint for the WGLIHC using Dismas House's success as a framework. We constructed the

blueprint to serve as a step-by-step guide that teaches the members of the WGLIHC how to successfully reduce their energy usage. The blueprint was created from the information we gathered in our case study along with the sources of funding that we identified for the WGLIHC members.

Our fourth and final objective was to develop methods for sharing our project findings with members of the WGLIHC. In order to ensure that the WGLIHC benefits from our project, we needed to distribute our blueprint and recommendations to them. To do this we provided Dave McMahon with: a video highlighting the benefits of energy efficiency for low-income housing facilities, our energy reduction blueprint, and flyers and pamphlets containing some of our project findings. Dismas House staff plans to display our video onto the WGLIHC website, and distribute our blueprint, and brochures among the members of the WGLIHC.

Findings & Recommendations

Our findings and recommendations are presented through the Energy Reduction Blueprint we created for members of the WGLIHC. The Blueprint presents a series of recommendations listed in steps, and the information we discovered from the case study served as the foundation for each step. Through the archival research, fieldwork, and interviews for our case study, we confirmed that our proposed theory was true; the energy reduction efforts of Dismas House produced energy savings.

Through our case study, we found that the Low-Income Multi Family Retrofit (LIMF) Program was a huge contributor to the success of Dismas House. The LIMF Program, administered by the Low-Income Energy Affordability Network (LEAN), supports high-energy consuming low-income multi-family properties through the installation of approved energy-efficient measures (LEAN, 2014). As part of this

program, LEAN evaluates a property through an online utility tracking software known as WegoWise, develops ways for the property to become more energy efficient, and coordinates the implementation of energy reduction improvements. The LIMF Program is an advantageous resource for members of the WGLIHC to use in their energy reduction process.

Our recommendations consist of six steps for present and future WGLIHC members to consider. In order to make a housing facility more energy efficient, an organization must:

1. *Create an energy assessment baseline and identify opportunities for improvements* By enrolling in the LIMF Program, Dismas House established an energy assessment baseline at all three of their facilities with the help of LEAN, National Grid, and WegoWise in 2010. All involved organizations identified temperature control as an opportunity for improvement.
2. *Devise a plan for improvement and make initial financial projections*. In 2010, Dismas House planned to address its temperature control problems at all three locations. We found the projections for the implementations included an initial cost of $11,000 and savings of $23,000 in the next 20 years.
3. *Identify funding options.* LEAN and NSTAR funded most of Dismas House's renovations between 2010 and 2011, so Dismas House did not have to use money from their operating budget for these improvements. In June 2014, Dismas House received $120,000 from various benefactors to install solar panels at all three facilities. In addition to fully funding this installation through private gifts, they also receive credit from the state for using the solar panels.

4. *Implement improvements.* LEAN and National Grid coordinated the majority of the early improvements made at Dismas House.

5. *Evaluate success of changes.* Before and after renovations, energy data was transferred into Dismas House's WegoWise account, which calculates all energy utility usage and related costs at each of Dismas House's facilities.

6. *Repeat steps 2-5 if there are any remaining opportunities for improvement.* Dismas House continually implemented renovations since 2010. Since the initial insulation, weather-stripping and air sealing improvements in 2010, Dismas House installed Micro-Combined Heat and Power units in 2012 and solar panels in 2014.

Energy reduction is a layered and complicated process, but also a wise investment for any low-income housing organization. Between 2010 and 2013, Dismas House saved a total of 31,245 kWh, which is enough to power 3 average sized houses in the United States for one year (EIA, 2014b; US Census Bureau, 2013). They also saved an average of $164.74 per month on their energy bills, which covers approximately 24% of their average monthly grocery bills. Furthermore, these numbers do not include any of the savings produced by the recently installed solar panels. This means that the current savings of Dismas House are much greater than the numbers we calculated. Yet the energy savings should not end there; members of the WGLIHC have the opportunity to experience similar results to Dismas House. If members of the WGLIHC follow this Energy Reduction Blueprint, we are confident that they will successfully reduce their energy usage and save money spent on energy.

Authorship

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Chapter 1: Introduction

"Modern civilization is the product of an energy binge . . . but humankind's unappeasable appetite for energy makes the solutions ephemeral and the challenge permanent" (Crosby, 2006, p. xiv). Today, we flip a switch to illuminate a room. We board a plane to travel thousands of miles in a few hours. We put a number into an HVAC machine to change the temperature of a room. All of this requires large amounts of energy that is usually provided by fossil fuels. Although fossil fuels like coal, oil, and natural gas adequately meet high-energy demands, the developed world continues to expand its desire for energy in ways that push fossil fuels, and the environment's capacity to endure the impact of fossil fuel extraction and use, to their limit. Fossil fuels spurred humankind to take large strides in technological advancement, but they created many problems as well.

Fossil fuels are finite resources and increasingly expensive. They come from organic matter that has been underground and compressed for millions of years. Therefore, fossil fuels are not something that can be manufactured or renewed (California Energy Commision, 2012). Much speculation surrounds the current global supply, but exploration and production of fossil fuels are becoming more dangerous and expensive. The high demand for oil forces exploration to inhospitable regions like the Arctic and deep underwater. This decreasing accessibility points to a limited supply. Yet the demand only continues to increase. The result is higher cost for access to fossil fuels (Heinberg, 2011).

Fossil fuels are also harmful to our environment because their consumption releases pollutants like carbon dioxide, sulfuric acid, and nitrogen oxides into the atmosphere. These emissions contribute to the greenhouse gas effect, acid rain, and smog (Leonardo Academy, 2014). Unfortunately, these drawbacks are not enough to prevent our heavy reliance on fossil fuels.

The use of fossil fuels helped spark the Industrial Revolution, which drastically changed the standard way of life. Industrialization increased production capacities and affected all basic human needs, including food production, transportation, and housing (McLamb, 2011). In particular, the United States began to operate on much larger amounts of energy. Therefore, the energy the United States needed to provide food, transportation, and maintain shelter came primarily from fossil fuels. According to the United States Energy Information Administration (EIA), in 2013, about 82 percent of America's energy came from fossil fuels (EIA, 2014d). As a nation, we rely heavily on non-renewable sources to meet our energy requirements. On a smaller scale, if energy is unavailable, people in the United States will struggle to meet fundamental needs, such as food and shelter.

Meeting needs is a familiar concept for Dismas House of Massachusetts. Dismas House is a nonprofit organization striving to "reconcile former prisoners to society, and society to former prisoners, through the development of a supportive community" (Dismas House, 2014). After the recession in 2009, Dismas House struggled financially to maintain its facilities, and had to shut down one of its programs. In order to continue serving their clients, Dismas House investigated and implemented energy reduction

efforts to reduce all energy related costs. The efforts successfully decreased their energy usage and saved them money, which Dismas House used to strengthen its services. This success of these efforts led Dismas House to establish the Worcester Green Low-Income Coalition (WGLIHC) in order to help low-income housing organizations save money and consequently secure their programs and services.

As energy bills rise and the need for energy efficiency increases, Dismas House wants each of the WGLIHC partners to have a plan to reduce energy usage and energy related costs. Dave McMahon, the co-executive director of Dismas House of Massachusetts and founder of the WGLIHC, believes that reducing energy costs not only allows low-income housing organizations to retain more of their operating funds, but also helps secure the services and programs that provide for the low-income population and build up the "social safety net" (McMahon, 2014a).

In order to provide the WGLIHC with a way of reducing their energy usage, Dave McMahon reached out to Worcester Polytechnic Institute's Worcester Community Project Center. In an effort to help Dave McMahon fulfill his vision to "restore the social safety net through energy efficiency," we worked, with Dismas House and the WGLIHC to promote sustainability and reduce their money spent on energy. To accomplish this goal, we developed and accomplished four objectives. First, we gained an understanding of the process Dismas House used to successfully reduce their energy consumption. We evaluated their process through case study analysis of their energy reduction efforts, which included archival analysis, interviews, and fieldwork. Second, we identified funding options for WGLIHC members. After we identified funders, we created an energy reduction blueprint for the WGLIHC using the success of Dismas House as a

framework. Finally, we developed methods for sharing our project findings with the WGLIHC members.

This report contains five chapters: (1) this Introduction, (2) Background, (3) Methodology, (4) Findings, and Recommendations, and (5) Conclusion. In chapter two, we describe the background information on the importance of energy efficiency, examples of energy efficiency regulations and efforts, along with the effects of energy efficiency in Massachusetts. We explain the different regulations and possible funding sources along with the effectiveness of the agencies and organizations that enforce the regulations. In chapter three, we discuss the methodological approach we used to accomplish our overall goal and objectives. In chapter four we introduce our Energy Reduction Blueprint and recommendations for the WGLIHC members, in addition to findings from our case study. Lastly, in chapter five we share our project conclusions.

Chapter 2: Background

Saving energy is costly. In particular, it requires critical decision-making, active planning, and allocated funding. However, there are energy efficient programs that can help fund energy efficiency efforts and provide guidance. The purpose of this chapter is to illustrate the necessity for energy reduction, describe energy reduction efforts, explain results from energy reduction efforts, explore possible funders for energy efficiency projects, and describe our sponsor.

2.1 Need for Energy Efficiency

Energy makes life possible. It comes in many forms and conducts both organic and inorganic functions. By recognizing and seeking to understand this on a deeper level, humankind has prospered. Despite the incredible achievements and advancements humans have made by harnessing the power of energy, we have created a dependency on non-renewable resources. Most of the developed world's energy comes from fossil fuels such as oil, natural gas, and coal (EIA, 2014a). Although fossil fuels readily meet high-energy demands, their supply is limited, becoming more costly, and negatively affecting the environment. With this in mind, large energy consumers, like the United States, need to consider ways to reduce and conserve energy, as it is an essential part of its residents' everyday lives.

2.1.1 Why is Energy Important?

Energy is a fundamental part of nature. It fuels physical function, and therefore serves as the cornerstone of human and technological advancement. Human energy use has progressed from muscle power to reliance on fossil fuels, which gave us "the means

to transmit the energies we harvest…hundreds, even thousands of miles, by expressing it as electricity" (Crosby, 2006, p. xiv). With the help of fossil fuels, we use less manual labor to perform larger amounts of work, using electricity to power machines that can do much of our work for us. Before fossil fuels, humans burned other forms of biomass, like wood or plant matter, for energy. The amount of work we could do was limited to the amount of biomass and manpower we could obtain. In terms of biomass, one gallon of gasoline is equivalent to 90 tons of plant matter, which is about 40 acres of wheat (Crosby, 2006).

When people began to use fossil fuels for energy during the Industrial Revolution of the 1750s-1820s, the limits that existed before virtually disappeared. For example, industrialization replaced human labor with machines. This led to increases in overall production capacity and benefited food production, medicine, housing, clothing, and transportation (McLamb, 2011). Now, using large amounts of energy is such a huge part of our lives "that having energy flow down lines from far away and illuminate our rooms when we flip the switch is normal rather than miraculous" (Crosby, 2006, p. 162). Not having direct access to copious amounts of energy is foreign to residents of wealthier nations like the United States. In many ways, "modern civilization is the product of an energy binge" (Crosby, 2006, p. xiv). Although fossil fuels increase our productivity, such heavy usage does not come without consequences.

2.1.2 Depleting Resources

Fossil fuels are finite. They come in three main forms: coal, oil, and natural gas. All three forms developed during the Carboniferous Period, which was between 360 and 286 million years ago. During this time, plant life was abundant. As trees and other plants died, they sank to the bottom of swamps and oceans. Over many hundreds of years, sand,

clay and other minerals covered the layer of dead plants to form sedimentary rock. Then, over millions of years, more rock piled on top of the layer of dead plants, continuously squeezing the water from it. Eventually, the fossilized layer of plants became the fossil fuels (California Energy Commision, 2012; DOE, 2013).

Since fossil fuels come from fossils, which take more than a few generations to form, they are not sources that can be manufactured or renewed. Instead, they are continuously processed and supplied from reserves. This is the reason that fossil fuels are often referred to as either unsustainable or non-renewable energy. How much is left, and whether peak production has already happened is still controversial. Regardless, supplies are much less accessible than they used to be, because "exploration and production are becoming more costly, and are entailing more environmental risks, while competition for access to new prospective regions is generating increasing geopolitical tension" (Heinberg, 2011, p. 3). This is largely due to the increasing global consumption of liquid fuels, as shown below in Figure 1.

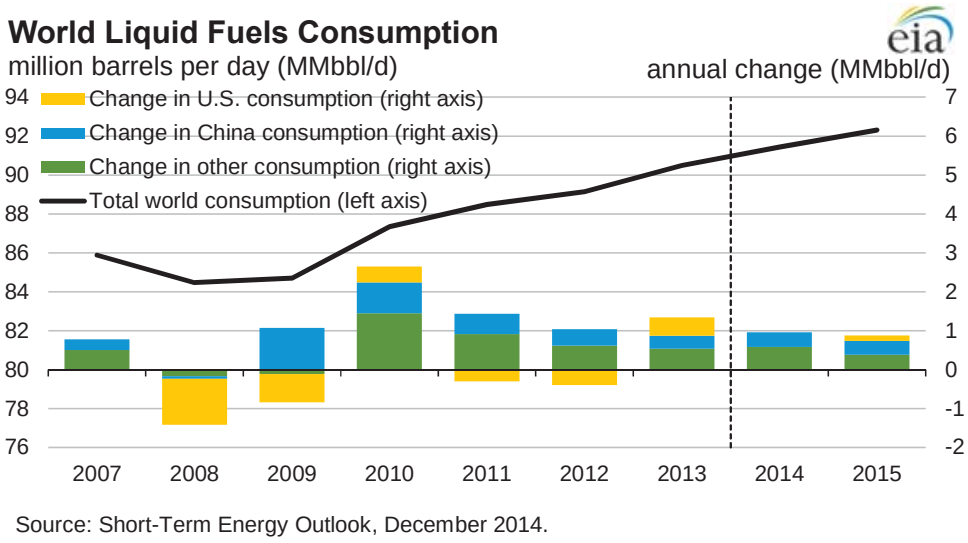


Figure 1 – World Liquid Fuels Consumption from the December 2014 Short Term Energy Outlook (EIA, 2014c)

These results testify to a concern for the supply of fossil fuels and point to an unavoidable truth: non-renewable resources will eventually run out.

2.1.3 Rising Prices

In accordance with the law of supply and demand, the steady depletion of non-renewable resources without much change in the demand for these resources forces the prices to rise. Fossil fuel providers are fully aware of depleting reserves, and adjust their prices accordingly (Harris, 2013). As the price of production for non-renewable energy goes up, naturally, the price for consumption goes up as well. According to the Energy Information Administration (EIA), in 2008, the United States spent around $1 trillion on fossil fuels. As illustrated by Figure 2 below, this is more than the U.S. spent on education, military, or household food expenditures in the previous year (Payne et al., 2009).

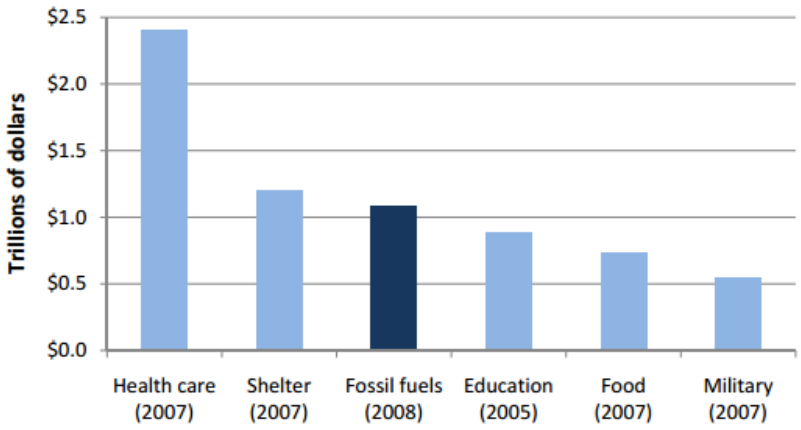


Figure 2: U.S Annual Expenditure by Category (Payne, Dutzik, & Figdor, 2009)

If prices continue to rise, the United States government will have no choice but to spend more on fossil fuels, which would put a significant strain on our economy and national security. According to the Environment America Research and Policy Center, a

$10 per barrel increase in the price of oil would increase Air Force spending by $600 million annually (Payne et al., 2009). In 2009, the EIA made projections for annual fossil fuel expenditures. The first projection was a reference case projection. This projected the annual fossil fuel expenditures while assuming that a variety of new or unconventional sources of fossil fuels would be discovered in the next 20 years. The second projection was a high case projection. This projected the annual fossil fuel expenditures without accounting for any new fossil fuel discoveries.

In the reference case, shown in Figure 3a, EIA predicted that the U.S. would spend over $1 trillion dollars annually by 2030, and in the high case, shown in Figure 3b, EIA predicted that the U.S. would spend more than $1.5 trillion annually by 2020 (Payne et al., 2009).

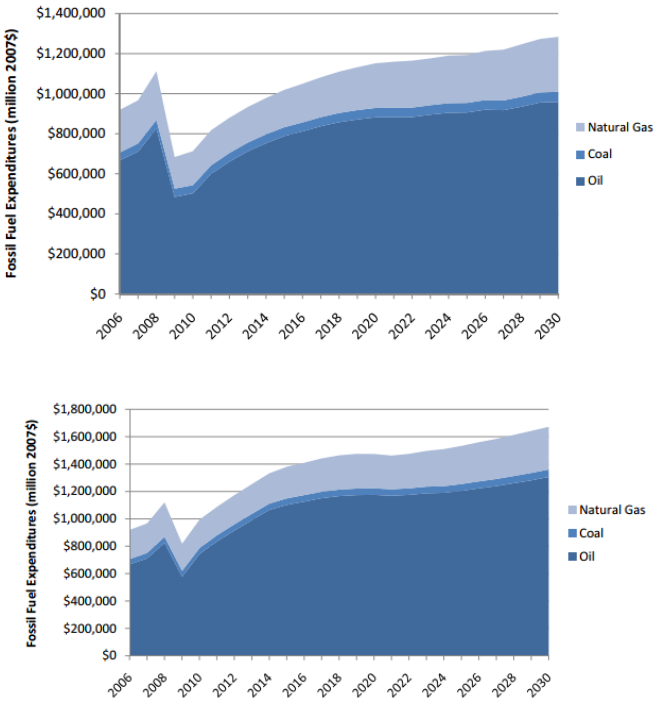


Figure 3: (a) Top: Projected U.S. Expenditures on Fossil Fuels, Reference Case using 2007 dollars (Payne et al., 2009)

(b) Bottom: Projected U.S. Expenditures on Fossil Fuels, High Price Case using 2007 dollars (Payne et al., 2009)

Former U.S. Army Captain, Iraq veteran, founder of the War Kids Relief program, and 2008 New York Congress candidate Jonathan Powers claims:

> *"It is critical for our national security that we break America's dependence on fossil fuels, which puts our troops' lives at risk, empties our nation's treasury, funds our enemies, and fuels global warming" (Aurillo & Sargent, 2014).*

Because of our heavy reliance on foreign fossil fuels in particular, many of the United States' strategic decisions were partially motivated by the need to protect access to energy for our allies and ourselves (Payne et al., 2009). In other words, the more the United States Government spends on fossil fuels, the more they are hurting the U.S. economy and the U.S. residents. Additionally, fossil fuels endanger much more than national security and the economy.

2.1.4 Health and Environmental Impacts

Fossil fuel consumption harms the environment by contributing to air pollution and water contamination. This increased pollution affects our atmosphere, impairs marine life, and causes health problems. Fossil fuels are usually burned in order to access the energy stored inside, which releases large amounts of carbon dioxide in the process. Carbon dioxide is a greenhouse gas, which influences the amount of heat retained by the earth. It serves as the primary greenhouse gas that contributes to the greenhouse gas effect, illustrated in figure 4, below, which causes an increase of the earth's average temperature (Rojas-Avellaneda, 2007).

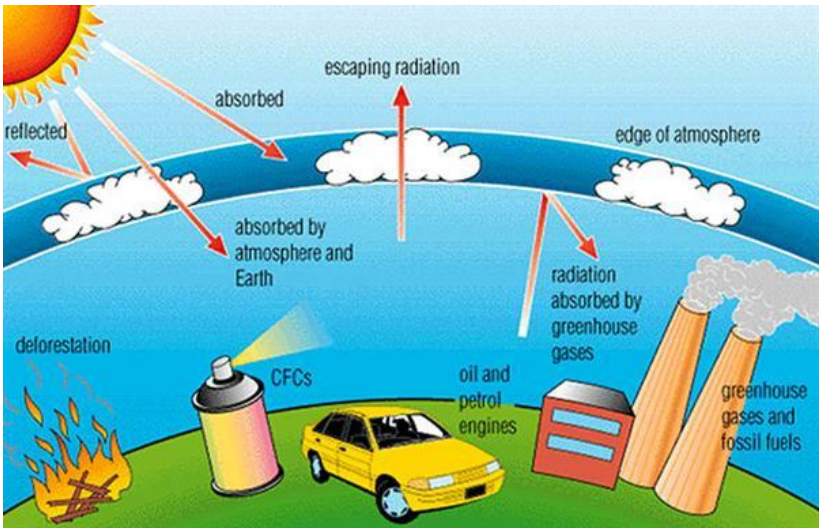


Figure 4 – Greenhouse Gas Effect (Clean Air Foundation, 2014)

Carbon dioxide is absorbed and emitted naturally as part of the carbon cycle, but "human activities currently release over 30 billion tons of CO_2 into the atmosphere every year. This build-up in the atmosphere is like a tub filling with water, where more water flows from the faucet than the drain can take away" (US EPA, 2014). Since 2010, the carbon dioxide levels are the highest they've been in 800,000 years (US EPA, 2014). These recent abnormal levels of carbon in the atmosphere are linked to the currently large consumption of fossil fuels (Crosby, 2006; Leonardo Academy, 2014; US EPA, 2014). Working backwards, since the high levels of carbon in the atmosphere explain the rise in average global temperature, the high consumption of fossil fuels is one of the main contributors to climate change.

The environmental effects of fossil fuels are not limited to the atmosphere. Oceans absorb around 22 million tons of carbon dioxide every day. This affects the acidity of the seawater, which interferes with various marine animals' ability to make shells and skeletons through calcification. In turn, this affects lobsters, clams, starfish,

oysters, clams, and various species of phytoplankton, which all occupy vital spots in the global ocean food web. If oceans absorb excess carbon dioxide, the "impacts would reverberate through economies everywhere; various industries, including tourism and fisheries, would likely suffer if the ecology of our oceans were to be altered" (Bradshaw, 2007). In other words, economies would decline because they depend on the delicate balance within aquatic ecosystems, and excess levels of carbon dioxide threaten this balance. Additionally, fish in lakes and waterways near electrical power plants are no longer safe to eat because the fossil fuel combustion that takes place in the power plants contaminates the water with heavy metals like lead and mercury (Leonardo Academy, 2014).

In addition to carbon dioxide, burning coal and oil releases pollutants like sulfur dioxide and nitrogen oxides into the atmosphere. When sulfur dioxide and nitrogen oxides enter the atmosphere, they combine with water and form acid rain, which can deteriorate buildings and damage vegetation (Crosby, 2006; Leonardo Academy, 2014). Sulfur dioxide is also linked to the development of respiratory illnesses, including asthma, bronchitis, emphysema, and lung cancer (Crosby, 2006; Leonardo Academy, 2014). In many urban areas, pollutants in the atmosphere experience chemical changes underneath intense sunlight, resulting in photochemical smog (Rojas-Avellaneda, 2007). In the past, smog has displayed a wide range of negative effects; from forcing continuous coughing for the people in Los Angeles, California during the 1940's, to causing over 4000 fatalities in London, England during the winter of 1952 (Crosby, 2006). There is clearly a price associated with the high-energy demands met by fossil fuels. Whether directly, or indirectly, fossil fuels are ultimately destructive toward human well-being.

2.1.5 U.S. Fossil Fuel Consumption

The most alarming thing about non-renewable resources is our dependency on them. In particular, the United States is heavily reliant on fossil fuels, consuming 20 percent of the world's oil (Thaler, 2012). According to the Energy Information Administration (EIA), in 2013, about 82 percent of America's energy came from fossil fuels, leaving a mere 18 percent coming from Nuclear (~8.5%) and Renewable (~9.5%) Energy sources (EIA, 2014d). The EIA also ranks the United States as the leading oil consumer in the world, consuming an average of 18,490 barrels a day in 2012 (EIA, 2014a).

This means that: the United States is especially sensitive to spikes in oil prices; is a large contributor to the contamination of the world's atmosphere; and would take the hardest hit should the fossil fuel supply run out. The United States needs to consider ways to be more efficient with its energy usage and consumption.

2.2 Energy Reduction Efforts

The large dependence on non-renewable resources is concerning and calls many to action. Municipalities, government agencies, non-profit organizations and private companies may all contribute to the breadth of energy reduction mechanisms available. In this section we detail many of these efforts, as well as how and why they originated. Efforts may consist of Energy Reduction Plans, Climate Action Plans, and new technologies.

2.2.1 Oil Crisis Sparks Nationwide Energy Efficiency Efforts (1973 - 1974)

The United States has suffered for its dependency on foreign oil. During the 1973 Arab-Israeli war, the United States offered military supplies to the Israeli military. In retaliation, Arab members of the Organization of Petroleum Exporting Countries (OPEC)

imposed an embargo against the United States. The embargo banned oil exports and introduced cuts in oil production. The price of oil in the U.S. skyrocketed and value of the dollar dropped drastically. The embargo foretold an imminent recession (Office of the Historian, 2013).

In April of 1973, President Richard Nixon introduced a new energy strategy to boost domestic production and ease the strain of nationwide fuel shortages. Then, Arab members of the OPEC decided only to lift the embargo if the U.S. brought peace between Israel and its Arab neighbors. In response to this, Nixon announced Project Independence, which ultimately promoted domestic energy independence. Then, in March 1974, the negotiation between Israel and Syria persuaded the relevant parties to lift the embargo (Office of the Historian, 2013). With the immediate threat alleviated, America planned for the road ahead.

Throughout the course of the 1973-1974 crisis, the United States was able to see beyond the problem set forth by the oil embargo. There was a greater need to conserve energy and domestic energy sources. The Federal government responded with a series of efforts to address these needs (ASE, 2013; Office of the Historian, 2013). Policy initiatives before the 1980's tended to emphasize educational efforts, financial incentives, and national energy efficiency standards. In 1977, the Department of Energy (DOE) formed, and "consolidated the Federal Energy Administration, the Energy Research and Development Administration, the Federal Power Commission, and other government programs into one cabinet-level department to provide the framework for a comprehensive national energy plan" (ASE, 2013, p. 6). After 1980, major strides toward energy efficiency included the National Appliance Energy

Conservation Amendment of 1988, the Energy Policy Act of 1992, the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009[1].

Of course, the efforts did not stop at a national, or even a statewide, scale. Many local governments followed the path paved by statewide and national policies, by making their own strides toward energy efficiency.

2.2.2 ERPs and CAPs

In 1990, more than 200 local governments from 43 different nations met at the United Nations headquarters in New York to attend the World Congress of Local Governments for a Sustainable Future (ICLEI, 2014). The purpose of the conference was to establish the International Council for Local Environmental Initiatives (ICLEI), which is now known as ICLEI – Local Governments for Sustainability. In 1995, a handful of municipal governments launched ICLEI USA, an independent organization that helps guide local governments within the United States in their journey toward energy efficiency. Today, ICLEI USA is the domestic leader on climate protection and sustainable development at the local government level, and consists of more than 600 cities, towns, and counties (ICLEI USA, 2014b). In order to help local areas improve their energy efficiency, ICLEI developed a process known as the Five Milestones for Climate Mitigation. This process is aimed to help local governments reduce energy usage and greenhouse gas emission.

The Five Milestones in order are: (1) conduct a baseline emissions inventory and forecast, (2) adopt an emissions reduction target for the forecast year, (3) develop a local

[1] ASE, A. t. S. E. (2013). The History of Energy Efficiency.

action plan, (4) implement policies and measures, and (5) monitor and verify results. This process has already been used to help hundreds of towns and cities across the nation reduce their energy usage and greenhouse gas emissions (ICLEI USA, 2014a).

In particular, the Five Milestone process helps cities and towns generate successful Energy Reduction Plans (ERPs) and Climate Action Plans (CAPs). An ERP is any sort of comprehensive approach to reduce energy consumption, while a CAP is a unique approach to reduce greenhouse gas emissions. Despite the two plans' different incentives, each plan is "tailor made" to meet the wants and needs of a particular town or city (Gorniesiewcz, Lukowski, Richardson, & Torrente, 2013).

Of the many tailor made plans adopted in the last decade, we limited our analysis to ERPs in Massachusetts because they operate under the same climate conditions and available programs as our sponsor, the Dismas House of Massachusetts. In particular, we looked at the ERPs of Framingham, which was drafted in 2013, and Milton which was drafted in 2010.

Both Framingham and Milton implemented energy reduction efforts two years before they developed their ERPs, so both used the year they began their energy reduction efforts as their baseline year. In other words, Framingham used 2011 as its baseline year, while Milton used 2008 as its baseline year. Both Energy Reduction Plans emphasized improving the energy use of their municipal buildings. Buildings accounted for 67.10% of the Town of Framingham's energy use in 2011, and 80.60% of the Town of Milton's energy use in 2008. However, they took very different approaches to reducing energy consumption and increasing energy efficiency in their municipal buildings (Town of Framingham, 2013; Town of Milton, 2010). Since a majority of

Framingham's buildings are outdated, equipment replacement, renovation, and reconstruction of municipal buildings provided the best solution (Town of Framingham, 2013). On the other hand, Milton's buildings were recently renovated so they installed solar panels on the roof of their town hall and high school. Additionally, they made plans to install a wind turbine (Town of Milton, 2010). In order to create an effective ERP, energy efficient technologies are often included in order to help make communities more environmentally friendly. Please see Table 1 below for a brief overview of Milton and Framingham's ERPs. (Table 1)

ERP	Framingham, MA	Milton, MA
Baseline Year	2011	2008
MMBtu used in baseline year	198,392	82,237
Percent Use of Baseline MMBtu		
Buildings	67.10%	80.60%
Vehicles	23.60%	13.90%
Street & Traffic Lights	3.10%	4.70%
Water/Sewer	5.70%	0.80%
Implementation		
Buildings (Municipal)	Replaced outdated HVAC equipment	Hired licensed HVAC Technician for all district schools
	Replaced and continue replacing school lightning with LEDs	All 32watt light bulbs in schools replaced with 25watt ones
	Plan to reconstruct Fuller Middle School and McAuliffe Library	Installed Solar Panels on Town Hall and High School
Buildings (Residential)		
Vehicles	Plan to reduce fuel use and fuel consumption; replace end of life municipal vehicles	
Street & Traffic Lights	Plan to convert all street lights from high pressure Sodium to LED	
Water/Sewer	Plan to put Variable Frequency Drives (VFDs) and upgrade heating in water systems	
Miscellaneous		Plan to install a 1.8 MW Wind Turbine
Additional Support	Amerisco, Inc	ICLEI
Notables	From 2011 to 2013 energy use in municipal buildings declined by over 11%	Predicted 57.2% reduction in fossil fuel energy from 2008 to 2013

Table 1 - Energy Reduction Plan Table

2.2.3 Technological Efforts

Technology impacts society with its ability to reduce energy and make our communities more environmentally friendly. Modern technology makes possible the use of natural renewable energy sources such as solar energy, hydropower, and wind power. It also helps to decrease energy loss; for example, implementing insulation on housing can reduce average home heating and cooling costs by around 20% (NAIMA, 2014).

Renewable Energy

Today, solar power is widely used around the world as a substitute for fossil fuels. According to the data from the European Photovoltaic Industry Association's (EPIA) annual Global Market outlook, Germany, Italy, China, United States and Japan have 71,763 MW of solar photovoltaic power installed in total (EWEA, 2012). Solar energy can meet various types of electricity demands.

It provides support for the electricity grid by building large solar power stations to generate more electricity by sunlight, and also helps homeowners provide daily lighting through solar panel installations. Solar water heating is "a combination of collector array, an energy transfer system, and a thermal storage system," which provides a reasonable alternative to using gas and electricity to provide hot water (Gordon, 2001). In addition to energy from the sun, the wind is also a viable source of energy. Technology to harness the power of wind is used primarily by European and Asian governments. In 2012, installed wind power capacity in the European Union totaled 105 GW (EWEA, 2012), and the installed wind power capacity in China totaled 76 GW (Bloomberg New Energy Finance, 2013). In Japan, the Wind Lens, developed by Yuji Ohya, intensifies air flow and creates two to three times the output of a normal wind turbine (Ohya, 2012).

Insulation

Insulation is to houses as the atmosphere is to the earth; both the insulation and the atmosphere help maintain a desirable temperature within the house and earth respectively. Insulation is the most efficient way to reduce energy usage and greenhouse gas emissions. It can help residential houses reduce energy used for cooling in the summer and heating in the winter by around 20% (NAIMA, 2014). By implementing weather-stripping and caulking, renters and homeowners can prevent the indoor and outdoor thermal transmission and consequently reduce the energy used by an HVAC (Heating, Ventilating, and Air Conditioning) system (NAIMA, 2014). Insulation is also one of the many effective energy reduction measures that protects people against harsh environmental conditions.

2.3 Energy Reduction Efforts in Massachusetts

Massachusetts is the first state in the nation to combine energy and environmental agencies under one cabinet secretary. The Executive Office of Energy and Environmental affairs oversees the Commonwealth's six environmental, natural resource, and energy regulatory agencies (EEA, 2014a). As a result, many types of organizations take the initiative to help communities implement energy efficiency measures. In this section, we describe the breadth of private programs, not for profit organizations, and government programs focused on energy reduction in Massachusetts.

2.3.1 Private Programs Efforts

Private programs are not funded by the government, but offer their goods and services for a cost; this money is in turn used in the operation of the company. These programs provide services, equipment, guidance, and funding for startup organizations or home projects related to energy efficiency. One particular program that helps homes

become more energy efficient is the MassSave Home Energy Assessment (MassSave) Program.

The MassSave Program is partnered with Next Step Living, a home energy – efficient company, to provide free home energy audits, financial incentives, and technical assistance to industrial, residential, and commercial customers. Even though this program only helps three sectors, they work in close collaboration with the Massachusetts Department of Energy Resources (DOER), to provide a wide range of services, incentives, trainings, and information promoting energy efficiency. These services are intended to help residents and businesses manage energy usage and related costs (MassSave, 2014).

2.3.2 Not for Profit Organizations Efforts

Not for profit organizations receive funding from government grants or private donations, which primarily go to the organization's operations and services. Therefore, not for profits focus on services and activities that benefit the well-being of the community instead of those that generate revenue. In this section, we offer examples of not for profit organizations focused on helping communities and organizations become more energy efficient.

Leadership in Energy and Environmental Design

Leadership in Energy and Environmental Design (LEED) is a green building certification program that recognizes best-in-class building strategies and practices. Their certifications are well known around the country as they provide guidance and strategies towards energy efficiency. After submitting an application, the building is reviewed and rated. The LEED rating system is made up of a combination of 12+ credit categories, which the project must satisfy to earn points. The more points the higher the certification

level. These certifications have four different levels: Certified, Silver, Gold, and Platinum; certified being the lowest and Platinum being the highest. These levels help categorize the project according to a degree of energy efficiency achievements. All these requirements and steps ensure that every aspect of the project is fully covered and understood (LEED, 2014).

Northeast Energy Efficiency Partnership

The Northeast Energy Efficiency Partnership (NEEP) serves the Northeast and Mid-Atlantic areas by educating the public on the importance of energy efficiency. NEEP's mission is to guide buildings toward energy efficiency through public policy, program strategies, and education. NEEP envisions regions that fully embrace energy efficiency as a cornerstone of any sustainable energy policy. A society that is aware of living green to help achieve a cleaner environment creates a more reliable and affordable energy system (NEEP, 2014). Through education, NEEP hopes that residents can adopt high efficiency products, reduce their energy usage in buildings, and promote the knowledge they have acquired. NEEP wants to make energy efficiency desirable in Northeast and Mid-Atlantic regions. (NEEP, 2014).

Local Environments for Sustainability

Another not for profit organization is the Local Environments for Sustainability (ICLEI). ICLEI is one of the world's leading associations dedicated to sustainable development. Their mission is to promote local action for global sustainability and support cities in becoming sustainable to create a green urban economy. From contributing to 12 mega-cities, 100 super-cities and urban regions, 450 medium-sized cities and towns, and 450 large cities in 86 countries in the world, they have developed a wide presence. This worldwide presence was initiated by contacting leaders at the

national, regional and international levels to create a strategic alliance to help prepare cites for a future in sustainability (ICLEI USA, 2014b). ICLEI focuses on strengthening its networks to identify and implement radical solutions, and act rapidly in promoting the wide spread message of its mission (ICLEI USA, 2014b).

Worcester Energy Barnraisers

Lastly, the Worcester Energy Barnraisers is a not for profit organization that contributes to energy reduction through community participation. Their mission is to promote environmental sustainability, along with social and economic justice, while collaborating with home energy efficiency projects (Barnraisers, 2014). This organization manages an energy barn-raising event to bring communities together. The community spends the day working to create an energy efficient home. This process consists of three hours of learning and working, and ends with a fun celebration. The purpose of this event is to bring communities together, and to promote environmental justice and energy efficiency awareness through labor and education. The organization believes in establishing an inclusive community solution to climate change (Barnraisers, 2014).

2.3.3 Massachusetts State Efforts:

Massachusetts is a national leader in helping individuals, businesses, organizations, and governments make smarter choices about energy (EEA, 2014a). The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) is the umbrella agency that houses Massachusetts's six environmental and energy regulatory agencies. Therefore the EEA agencies influence many Massachusetts state programs and policies. Examples include the Green Communities Act, the Massachusetts Clean Energy Center, The Massachusetts Renewable Energy Trust, and the Green Affordable Housing Initiative.

The Massachusetts Green Communities Act, passed in 2008, is a law that introduces renewable energy and energy efficiency regulations to the Commonwealth of Massachusetts. According to the Green Communities Act, Worcester, Massachusetts is designated as a Green Community. In order to be considered, the cities/towns must create a plan to reduce the city's energy usage by 20% within 5 years. Through the help of The Green Communities Division, the city or town that is considered a Green Community provides support and technical assistance to improve energy efficiency and increase the use of renewable energy in public buildings, facilities and schools (GCA, 2014; MLEP, 2013).

The Massachusetts Clean Energy Center (MassCEC), created by the Green Jobs Act of 2008, generates jobs and accelerates the success of clean energy technologies. They support clean energy projects and invest in residential and commercial renewable energy installations by providing guidance and rebates for innovative energy efficient technologies (MassCEC, 2014c).

In 1988, the Massachusetts Legislature created the Massachusetts Renewable Energy Trust (MRET) "as part of the deregulation of the electric utility market" (MassCEC, 2014c). The MRET is funded by a "systems benefit charge" paid by electric ratepayers of investor-owned utilities in Massachusetts. These electric ratepayers pay an average of $0.30 per month (MassCEC, 2014c). This trust helps inform the public of the benefits and providers of renewable energy.

2.4 Funding Options in Massachusetts

Massachusetts is a national leader in energy savings, and receives financial support from the United States Department of Energy (USDOE). As part of the American Reinvestment and Recovery Act, in 2011 the Massachusetts Department of Energy

Resources (DOER) received over $14 million from the USDOE through the Energy Efficiency and Conservation Block Grant Program (Block Grant Program).

Starting energy reduction efforts is a positive step to reduce our carbon footprint. However, these efforts require time and money. In this section, we list the funding options in Massachusetts available for reducing energy usage.

2.4.1 Grant Programs in Massachusetts

Massachusetts has grant programs available for municipalities interested in implementing energy saving measures. Unlike government loans, recipients do not need to repay grants. DOER and MassCEC provide the majority of the energy efficient grant programs.

Grant Name	Donor Agency	Amount
Commonwealth Hydropower Program	Massachusetts Renewable Energy Trust	**Amount: Design & Construction:** 50% of costs or $1.00 per incremental kWh per year Feasibility study: 80% of costs **Maximum Incentive:** Design & Construction: $600,000 Feasibility study: $40,000
Commonwealth Organics-to-Energy Program	Massachusetts Clean Energy Center (MassCEC)	**Amount:** Technical Assistance: $60,000 **Feasibility:** $40,000 **Construction:** 25% project cost **Pilot:** 50% project cost
Commonwealth Wind Commercial Wind Program	Massachusetts Renewable Energy Trust	**Amount:** Varies depending on applicant type (public vs. non-public) and grant type (site assessment, feasibility study, onsite wind monitoring, acoustic studies, business planning, and development) **Maximum Incentive:** Public Entities: $100,000 Non-Public Entities: $317,000
Commonwealth Wind Community-Scale Initiative	Massachusetts Clean Energy Center (MassCEC)	**Public Entities:** $500,000 **Non-Public Entities:** $327,000
Green Communities Grant Program	Regional Greenhouse Gas Initiative (RGGI)	Custom incentive, amount will vary

Table 2 - State Grant Program for Renewable Energy and Energy Efficiency[2]

[2] Database of State Incentives for Renewables & Efficiency website: http://dsireusa.org

The DOER aims to help energy efficiency project applicants find funders. In return, DOER will take the applicants' project as a case study. A good example is the partnership of DOER with the Arlington House project. DOER helped the Arlington House Zero Net Energy Building obtain a $40,000 grant from NSTAR along with monitoring instruments from Visitank. (DOER, 2008)

MassCEC financially supports the Commonwealth Hydropower Program to provide both feasibility studies and construction of hydroelectric facilities. Applicants that apply for the Commonwealth Hydropower Program, use a technology that transforms kinetic energy from flowing water into electricity through a hydropower engine. In order for MassCEC to fund the project, the project must strive to achieve Massachusetts Renewable Portfolio Standards. The results of the whole project must generate 200,000kWh/year for non-conduit feasibility granted projects, and 50,000 kWh/year for design and construction granted projects. (See table 2 above)

2.4.2 Rebate Programs in Massachusetts

In addition to grant programs, Massachusetts has rebate programs offered for energy reduction measures. Rebate programs offer partial paybacks to people or organizations that purchase a product within certain specified requirements. In particular, energy efficient rebate programs subsidize energy reduction measures that meet special criteria, after implementation has already taken place. For example, the Commonwealth Woodstove Change-Out Pilot Program is a rebate program supported by MassCEC that provides rebates to applicants who replace outdated stoves. The applicant is only eligible for a rebate if their new stove was professionally installed and United States Environmental Protection Agency certified. If all the criteria are met, the applicant will receive a rebate of up to $2,000 (MassCEC, 2014a).

State Rebate Program For Renewable Energy and Energy Efficiency		
Grant Name	**Donor Agency**	**Amount**
Massachusetts New Homes with ENERGY STAR	Energy Efficiency Fund (Public Benefits Fund)	**Amount:** Varies depending on type of housing (single or multi-family) and measures taken/tier achieved **Maximum Incentive:** $7,000
Residential Air-Source Heat Pump Program	Massachusetts Renewable Energy Trust Fund	**Amount:** Ductless Systems: $750-$2,250 Central or Multi-Head Systems: $750-$3,750 **Maximum Incentive:** Ductless systems: $2,250 Central or Multi-Head Systems: $3,750
Commonwealth Small Pellet Boiler Grant Program	Massachusetts Renewable Energy Trust Fund	**Amount:** Base Grant: $7,000 Automated Conveyance of Fuel Adder: $3,000 Thermal Storage Adder: $2,000 Solar Thermal Hybrid System Adder: $1,000 Moderate Income Adder or Moderate Home Value Adder: $2,000 **Maximum Grant:** $15,000
Commonwealth Solar Hot Water Commercial Program	Massachusetts Renewable Energy Trust Fund	**Amount:** Feasibility study: $5,000; Construction grants: $75*number of collectors*SRCC Rating (Private); $150*number of collectors*SRCC Rating (Public/Non-Profit) Massachusetts Manufactured adder: $200 Metering adder: Up to $1,500 PV adder: $500 **Maximum Incentive:** Feasibility study: $5,000 Construction Rebates: 40% system costs or $100,000 (Private); 65% system costs or $100,000 (Public/Non-Profit)
Commonwealth Solar Hot Water Residential Program	Massachusetts Renewable Energy Trust Fund	**Amount:** Base rebate: $75 X number of collectors X SRCC rating (Category D, Mildly Cloudy Day) Additional $200/system for systems with parts manufactured in Massachusetts Additional $500/system for metering installation Additional $500/system for participants that have also installed solar PV on the same facility Adder for moderate home value/moderate income of twice the base rebate. Adder for natural disaster relief of twice the base rebate. **Maximum Incentive:** $4,500 per building or 40% of total installed costs (whichever is less)
Commonwealth Solar II Rebates	Massachusetts Clean Energy Center (MassCEC)	**Amount:** Residential: $0.25 (base) - $1.70/W DC (varies by rebate adders) Commercial: $0.25 (base) - $1.30/W DC (varies by rebate adders) **Maximum Incentive:** Residential: $3,500; Commercial: $1,500 (per host customer and excluding natural disaster relief adder)
Commonwealth Wind Incentive Program – Micro Wind Initiative	Massachusetts Renewable Energy Trust Fund	**Amount:** Capacity-based Rebate = Rated Capacity (kW) * 460 +3200 Estimated Performance Rebate = Expected Production * 2.8 * (Rated Capacity^-0.29) **Maximum Incentive:** Public Projects: up to $5.20/W with maximum of $130,000 Non-Public Projects: up to $4/W with a maximum of $100,000

Table 3 - State Rebate Program for Renewable Energy and Energy Efficiency[3]

Massachusetts also has rebate programs for solar water heating, which is mentioned in section 2.2.3(above). Applicants are required to purchase a 10-year warranty on the solar hot water collector. In order to receive a rebate on a solar water

[3] Database of State Incentives for Renewables & Efficiency website: http://dsireusa.org

heating unit, the new equipment must have a sunlight collector certification of OG-100, have a heating system certification of OG-300, and it must be installed where the collector can receive sunlight up to 5 hours per day (MassCEC, 2014b). Rebates for solar water heating systems are offered to cover 25% of the cost of construction, up to $50,000 (MassCEC, 2014b).

In addition to renewable energy technology, rebates for housing insulation improvements are also available. MassSAVE provides 75%, up to $2,000, towards the installation of approved insulation improvements (MassSave, 2014). In general, rebates may not cover all costs for energy efficient installations, but they are helpful when combined with other funding sources. (See Table 3 above)

2.5 Results of Energy Efficiency Efforts

The energy reduction efforts within Massachusetts have produced positive environmental and financial results. This section describes the environmental impact of Massachusetts compared to California, another progressively green state, along with the money Massachusetts saved through energy reduction efforts in 2010-2012.

2.5.1 Environmental Impact

According to The State Energy Efficiency Scorecard, Massachusetts and California are the most energy-efficient states in the United States (ASE, 2013). However, the environmental impact caused by energy savings in Massachusetts is more noticeable than in California.

Due to the various energy reduction and efficiency policies implemented in Massachusetts, greenhouse gas emissions have decreased. According to the Summary of Massachusetts Green House Gas Emissions (GHG), as of July 2014, the annual GHG Gross Emissions have gone down by an average of roughly 0.69 Million Metric Tons

(MMT) of CO_2 per year since 1990 (EEA, 2014b). However, California, ranked second behind Massachusetts in energy efficiency (ASE, 2013), and still has an increasing annual GHG Gross Emission. According to the California Air Resources Board, annual GHG Gross Emissions have increased by an average of 1.3MMT per year from 1990 to 2012 (NEXT 10, 2014). The recognition Massachusetts receives as the most energy efficient state in the country comes from the results produced by its strong energy efficient programs, efforts, and communities.

2.5.2 Money Spent vs. Money Saved

Guided by the Energy Efficiency Advisory Council (EEAC) from 2010 to 2012, the MassSave energy efficiency programs invested $1.2 billion and delivered $5.4 billion in benefits to industries, homeowners, businesses and multi-family buildings (MassSave, 2014). In 2011, the Massachusetts' government spent $161 million on residential energy saving programs, and saved 227 GWh of electricity. They also spent $61 million on low-income housing organizations, and as a result, saved 20 GWh of electricity (MEEAC, 2011). Massachusetts put large amounts of money into its programs; however, Massachusetts's energy consumption substantially decreased, and more money accumulated in the long run. Due to the State's investment, programs that operate within the Commonwealth of Massachusetts produce successful results. In the same way, programs willing to assist an organization in its energy reduction process, ultimately contribute to the organization's savings and long-term success.

2.6 Dismas House of Massachusetts

Dismas House of Massachusetts is an organization that took advantage of the support Massachusetts offers for energy efficiency. Through these energy efficient programs, Dismas House produced energy savings that bolstered their own low-income

housing programs and services. In addition to strengthening their own programs, Dismas House wants to reach more people in need by extending these opportunities to other low-income housing organizations. This led to the foundation of a coalition for low-income housing organizations that seeks to help vulnerable citizens through the benefits of energy efficiency, the Worcester Green Low-Income Housing Organization.

2.6.1 Dismas House History

What distinguishes Dismas House of Massachusetts from other organizations is the effort and dedication that they put into helping people rehabilitate from prison before they go out into the world (Dismas House, 2014). In 1974, Reverend Jack Hickey founded Dismas House in Nashville, Tennessee. Then, in 1988, concerned citizens in Massachusetts worked with Dismas House director, Terry Horgan to open a Dismas House of Massachusetts in Worcester, Massachusetts. After 19 years in Worcester, Dimas House opened The Father John Brooks House to help support the graduates of Dismas and their families, as they grew closer to societal integration. Father Brooks House ensures the financial stability of Dismas House's clients, so they can build a life for themselves and their families. In 2010, Dismas House opened a 35-acre residential farm in Oakham, Massachusetts known as the Dismas Family Farm. The farm provided a rehabilitative work environment while residents developed vocational skills (Dismas House, 2014).

After the financial crisis of the 2009 recession, Dismas House had to close the doors to one of their programs due to loss of funding (McMahon, 2014b). This compelled Dismas House to investigate and implement energy reduction measures to decrease expenses. Their energy reduction efforts successfully reduced Dismas House's energy expenses, and they wanted to inform other organizations to do the same. As a result, the

co-Executive Director of Dismas House, Dave McMahon, created the Worcester Green Low-Income Housing Coalition (WGLIHC) so that other low-income housing organizations would not have to shut down any of their own services due to financial losses.

2.6.2 Worcester Green Low-Income Housing Coalition (WGLIHC)

The Worcester Green Low-Income Housing Coalition is a partnership-based association. Each partner in the WGLIHC provides services to the low-income population of Central Massachusetts. The mission of WGLIHC is twofold: (1) implement a comprehensive energy reduction strategy by reducing the carbon footprint and energy costs associated with the buildings through an array of funds; and (2) aim to broadcast the long term reduction of energy costs as a measure to sustain "social safety nets" in similar communities (WGLIHC, 2014). The "social safety net" that the WGLIHC works to sustain refers to the programs and services that support the most vulnerable citizens during times of need. In particular, the WGLIHC works to strengthen the housing programs that support the low-income population.

2.6.3 Foundation for the WGLIHC: Dismas House Success Story

As Dismas House was the first pioneer for energy efficiency in the WGLIHC, they set an example for others to follow. Dismas House implemented air sealing and complete attic insulation in the fall of 2010, along with a Micro-Combined Heat and Power (MCHP) unit at their 30 Richards Street location. According to Dave McMahon, these changes saved Dismas House approximately 19 percent on the 2013 heating bill for this location. McMahon projected approximately $11,000 savings, in gas for the next 20 years. After experiencing the financial benefits of their energy reduction efforts,

McMahon wants to increase the WGLIHC partners' efficiency and further reduce their energy costs (McMahon, 2014b).

2.7 Conclusion

For our Interactive Qualifying Project, we hoped to address the importance of energy and how precious it is to our society. Massachusetts expresses the need to educate and inform the public about using energy wisely through the support and opportunities its programs provide for energy reduction efforts. Dave McMahon took advantage of these opportunities, and applied them to Dismas House in order to increase its funding through energy savings. From the success that energy savings brought to Dismas House, Dave McMahon founded the WGLIHC to strengthen the low-income housing organizations in Central Massachusetts. If the members of the WGLIHC can effectively enhance their programs and services, they will help establish a more secure social safety net. However, in order to enhance their programs through the benefits of energy reduction, members of the WGLIHC must first implement successful energy reduction measures. So Dave McMahon reached out to Worcester Polytechnic Institute's Worcester Community Project Center, to research methods for reducing energy consumption and create an achievable energy reduction plan for members of the WGLIHC.

Chapter 3: Methodology

Dismas House of Massachusetts requested that we evaluate their energy reduction efforts and educate other members of the Worcester Green Low Income Housing Coalition (WGLIHC) on the financial and environmental benefits of following in their footsteps. More specifically, Dismas House requested that we: create a blueprint for energy reduction using Dismas House's energy efficiency efforts as a framework, find possible funders for energy reduction measures in low-income housing, create informational brochures, and create a video for the WGLIHC highlighting the benefits of energy reduction. Consequently, the goal of our project was to work with Dismas House and the WGLIHC to promote sustainability and reduce the amount of money spent on energy. To accomplish this goal, we developed four objectives:

1. Understand the process Dismas House used to successfully reduce their energy usage.
2. Identify funding options for WGLIHC members.
3. Create an energy reduction blueprint for the WGLIHC using Dismas House's success as a framework.
4. Develop methods for sharing project findings with members of the WGLIHC.

We also identified the stakeholders of our project. We defined our stakeholders as any person, or group of people, who might be interested in improving their energy efficiency, or might benefit from the results of our research. Here is a list of the stakeholders involved in the project:

1. Members of the WGLIHC. This includes Abby's House, Our Father's House, The Bridge of Central Massachusetts, Interfaith Hospitality Network, Evergreen House, Jeremiah's Inn and Latin American Health Alliance
2. Other low-income housing organizations in Massachusetts
3. Low-Income Energy Affordability Network (LEAN)

4. WegoWise
5. National Grid
6. NSTAR
7. Potential funders willing to contribute towards improving energy efficiency

We identified stakeholder groups 1 and 2 as parties interested in improving their energy efficiency, and accounted for all organizations listed on the WGLIHC website. The WGLIHC was founded in the interest of energy reduction, so any member of the WGLIHC is naturally a stakeholder for our project. We also accounted for all other low-income housing organizations in Massachusetts because energy reduction provides opportunities for any organization to save money. We identified stakeholders 3 through 7 as parties who could benefit from the results of our project. Stakeholders 3 through 6 include parties directly involved with the energy reduction process of Dismas House, found through the documentation we analyzed in our first objective. Stakeholder 7 account for parties with the desire to contribute to future energy reduction projects, as our project results may influence these parties' commitment to that desire. In the sections that follow we describe the methods used to achieve each objective.

Objective 1:
Understand the process Dismas House used to successfully reduce their energy usage.

In order to fully understand the process Dismas House used to reduce their energy usage, we conducted a case study. A case study is an investigation of a "contemporary phenomenon in its real world context" (Yin, 1994). Through our case study, we answered the "how" and "why" of the particular situation surrounding our case. According to renowned social scientist and author, Robert Yin, case studies require a case, a theory,

and a research plan. Therefore, we designed our research plan by determining our case, and a theory surrounding our case to prove or disprove.

Dismas House served as our case, and the phenomena we investigated were the reasons behind their energy reduction. Dave McMahon shared his belief that the financial savings Dismas House amassed after the recession of 2009, were a result of the energy reduction efforts made by Dismas House beginning in 2010. In order to guide our research, we proposed the theory that: *The energy reduction efforts of Dismas House (renovations, upgrades, implementations, etc.) ultimately improved their energy efficiency and saved them money.* After we determined our case, and developed a theory, we designed a plan using different research methods to conduct our case study.

During our case study, we used archival research, fieldwork, and interviews to test the theory that we proposed. We gathered a variety of information about the energy reduction efforts of Dismas House by reviewing and interpreting Dismas House's: energy audits, collecting records of their building renovations, and analyzing information from the utility accounts of Dismas House contained in WegoWise. WegoWise is "an online tool that tracks, monitors and analyzes water and energy use for single buildings and entire portfolios." It is a useful tool for comparing energy usage before and after significant renovations (WegoWise, 2014b). We received two audits for two of the Dismas House buildings, and the Dismas House WegoWise account information from Dave McMahon. Dave Mahon also provided us with contracts and summaries of Appliance Upgrades for two fellow coalition members, Hector Reyes House and Jeremiah's Inn, as Dismas House did not have any documentation of their appliance upgrades. In order to gather more information we called and emailed the auditor of the

Dismas House buildings, Mark Lapan, and the contractor of the appliance upgrades at Hector Reyes buildings, Mark Lapan, and the contractor of the appliance upgrades at Hector Reyes House and Jeremiah's Inn, Larry Weir.

While using archival research as a method to gather information from the outside, we conducted fieldwork to understand the efforts of Dismas House from the inside. In addition to learning about the process that Dismas House used to reduce their energy consumption, fieldwork allowed us to experience it for ourselves. More specifically, we learned about how Dismas House helped members of WGLIHC enroll in the Low-Income Multi-Family Retrofit (LIMF) Program. For a few weeks, we became the main contacts of Dismas House for the WGLIHC members, and guided the Worcester based low-income housing organizations, Abby's House, The Bridge, and Our Father's House through the LIMF Program's application process. This entailed reaching out to a representative from each organization, through email or over the phone, and gathering the necessary information for their applications. We emailed and/or called Stephanie Page, the Executive Director at Abby's House; Ron Hayes, from The Bridge; and Judith Pasierb, the Executive Director at Our Father's House. We also prepared a presentation on the LIMF Program and its role in the successful energy reduction process of Dismas House for Tess Sneesby, the Housing Coordinator of Abby's House, and Doug Clough, the Maintenance Manager of Abby's House, in order to strengthen our cooperation with their organization during our fieldwork.

In order to properly assist these organizations, we sought help from Billierae Engelman, who is the Program Assistant of the LIMF Program, along with Tessa Sanchez, who works in Client Services at WegoWise. Through email, we kept them up to

date with our fieldwork progress, and conducted informal interviews as we had questions about the LIMF process. In addition to assisting the WGLIHC members toward energy efficiency, our involvement in this process helped us identify the source and meaning behind the WegoWise compilations and the energy audits we were analyzing for the project. A description of both the LIMF Program and WegoWise process can be viewed in Chapter 4: Findings and Recommendations.

Along with analyzing, collecting, and interpreting data provided by Dismas House, we conducted both semi-formal interviews and continuous informal interviews with the Dismas House staff, specifically, Dave McMahon and Bill Wahrer. We communicated with them on a regular basis through face-to-face interactions or emails. These interviews helped us triangulate our data and develop a deeper understanding of the improvements made at Dismas House. Please see Appendix A for all inquiries and informal interview questions we asked while completing this objective.

Objective 2:

Identify funding options for WGLIHC members.

In order to successfully reduce energy consumption and associated costs, Dismas House used a variety of funding sources. With the results of the archival research we conducted in Objective 1, we identified the funders that Dismas House used to implement their energy reduction efforts. We also researched additional funding resources that WGLIHC members can use for their energy efficiency renovations. Due to the scope of the energy reduction measures completed at Dismas House, the funding options they explored is useful to the WGLIHC members during their energy efficient journey.

In addition to the funding Dismas House used for their renovations, we researched additional funding options for members of the WGLIHC. State government agencies and private organizations offer free equipment in exchange for tax credits or rebates. Specifically, we analyzed the United States Department of Energy American Recovery and Reinvestment Act Plan (DOE ARRA) from which Dismas House got the DOE ARRA Solar Renewable Energy Credit Grant to install the Micro-Combined Heat and Power (MCHP) Unit, at their 30 Richards Street location (DOE, 2014). Dismas House was also granted a MassHousing Award, which provided a $65,000 grant for installing solar panels at three of the Dismas House locations (MassHousing, 2014). Another source we investigated was The Greater Worcester Foundation, which is a tax-exempt public charity providing support and funds to any sector that benefits the well-being of the community. Therefore, we conducted an informal interview via email with Kelly A. Stimson, Director of Donor Services at The Greater Worcester Foundation, to gather additional information about the funding options they offer. Through our data collection, we acquired the essential ingredients for creating our energy reduction blueprint.

Objective 3:

Create an energy reduction blueprint for the WGLIHC using Dismas House's success as a framework.

Using the information gathered from objectives 1 and 2, we created a blueprint for members of the WGLIHC. A blueprint is a guide detailing a step-by-step process to achieve something. During our case study analysis of Dismas House, we discovered how Dismas reduced their energy spending, why they chose specific energy reduction efforts, and why their efforts were successful. We compiled an energy assessment summary, an improvement overview, and a spreadsheet of raw utility data from the information

dispersed throughout the audits, reports, and WegoWise account of Dismas House. We developed a robust understanding of Dismas House's energy reduction process and organized this process into phases.

From each phase, we established a recommendation for other low-income housing organizations to follow. Then, we organized the recommendations into steps, which formed the outline of our blueprint. With each step, we provide in-action examples from the energy reduction process of Dismas House. Additionally, the blueprint reveals *what* measures the WGLIHC must take to reduce energy consumption, and *how* the WGLIHC can take those measures.

Objective 4:

Develop methods for sharing project findings with members of the WGLIHC.

In order to ensure that the WGLIHC members would benefit from our project, we developed methods for sharing our project findings with them. This included creating an informational video and brochures. We created a video highlighting the benefits of energy reduction for low-income housing organizations using the information gathered through our previous objectives. For the purpose of our project, a video was essential to promote the work done at Dismas House. Since our blueprint details how WGLIHC members might reduce their energy costs, we had to give them an incentive to follow it. So our video was created with the intention of informing the WGLIHC *why* investing in energy efficiency is important and beneficial.

The content of our video includes a brief overview of Dismas House and their energy reduction process, a brief overview of the WGLIHC, findings from our case study, the recommendations from our blueprint, and testimonies from the executive

directors of low-income housing organizations that are part of the WGLIHC. For the testimonies part of our video, we received signed consent forms in order to conduct filmed interviews with: our sponsor and Co-Executive Director of Dismas House, Dave McMahon; the Executive Director of Hector Reyes House, Dr. Matilde Castiel, and the Executive Director of the Interfaith Hospitality Network, Joanne Alley. The testimony section touches on the current state of the social safety net in Central Massachusetts, and the potential improvements energy reduction may have on increasing the financial stability of the social safety net. For the purpose of our video, we defined the social safety net as the housing programs and services that are provided for low-income citizens. See Appendix B for the questions we used during our filmed interviews.

In addition to the video, we created two types of brochures to serve as visual aids in promoting energy efficiency for the WGLIHC. These brochures were created to address the important aspects of the blueprint, success of Dismas House, and defined terms and resources organizations can use. This led to creating two types of brochures, which contains guidelines, resources, and figures of savings to promote energy efficiency. The first brochure provides quick and easy to read overview of the steps contained in our blueprint, and defines the key terms involved throughout (See Appendix C1). The other brochure advertises benefits and savings involved with energy efficiency (See Appendix C2). After completing our video and brochures, we shared them with Dave McMahon to distribute among the members of the WGLIHC.

Chapter 4: Findings and Recommendations

From our case study on the successful energy reduction efforts made by Dismas House, we created an Energy Reduction Blueprint, came up with findings and developed recommendations for the Worcester Green Low-Income Housing Coalition (WGLIHC). In this chapter we provide the six steps of the Energy Reduction Blueprint. With each step we provide an explanation of key concepts and include an example of how Dismas House completed the step. Then we present additional findings from our case study on Dismas House. Lastly, we offer our recommendations for the WGLIHC to promote energy efficiency awareness.

4.1 Energy Reduction Blueprint

In order to accomplish our goal of promoting sustainability and helping members of the WGLIHC reduce the amount of money spent on energy, we produced an Energy Reduction Blueprint (Blueprint). The Blueprint presents a series of recommendations for low-incoming housing organizations, detailing how they can employ a similar process as Dismas House and reduce their energy consumption in order to save money. Within each step of the Blueprint, we explain key action items that WGLIHC members can take, and we provide examples using Dismas House's own energy reduction efforts. In order to understand the process that Dismas House used to successfully reduce their energy usage and energy related costs, and to allow other low-income housing organizations to benefit from such energy cost savings, we conducted a case study on Dismas House. We operated under the theory that: *The energy reduction efforts of Dismas House (renovations, upgrades, implementations, etc.) ultimately improved their energy efficiency and saved them money*. Through archival research, fieldwork, and interviews

(described in Chapter 3), we confirmed this theory, and subsequently, developed this Blueprint using the Dismas House case study as the model.

In order to improve energy efficiency in a building, a low-income housing organization must follow these steps:

Step 1: Create an energy assessment baseline and identify weaknesses.

All journeys start somewhere. To reduce energy consumption, the first step is to create an energy assessment baseline. An energy assessment baseline, or starting point, will provide a clear picture of the current state of energy use for a particular facility. From this baseline, an owner will be able to identify points of weaknesses and pinpoint areas or systems in the building that need improvement.

An energy assessment baseline includes information on the building's structure, enclosure, which is the part of the building that is controlled within the envelope of the building structure, heating and ventilation systems, appliances, and utility consumption history. Through our case study, we discovered that Dismas House was able to develop an energy assessment baseline with the help of the Low-Income Multi-Family Retrofit Program and WegoWise.

The Low-Income Multi Family Retrofit Program (LIMF Program) is a quasi-governmental program, meaning that the program is financially sponsored by the government but managed privately. The LIMF Program supports low-income multi-family properties to reduce their energy consumption through the installation of approved energy-efficient measures (LEAN, 2014). This program is part of MassSave, an energy savings program for Massachusetts homeowners and renters, and receives funding from Columbia Gas of Massachusetts, Berkshire Gas, Cape Light Compact, National Grid,

Western Massachusetts Electric, New England Gas Company, NSTAR, and Unitil. As recognition for these organizations' funding efforts, the LIMF Program acknowledges them as Massachusetts Energy Efficiency Program (MEE) administrators. The MEE Program administrators, along with the Low-Income Energy Affordability Network (LEAN), jointly manage the LIMF Program. LEAN administers the LIMF Program applications, coordination of auditors, and project approvals, while the MEE program administrators handle the funding decisions.

Low-income multi-family properties owned by any public, not-for-profit, or for-profit organization are eligible to apply to the LIMF Program. This program consists of four main steps: (1) the applicant completes an online application, which is accessible here: http://leanmultifamily.org/user/register; (2) the applicant works with LEAN to create a WegoWise account by entering basic utility meter and building data; (3) LEAN reviews the application and requests any additional information from the applicant necessary for developing a complete understanding of the building; and finally, (4) LEAN informs the organization if their building is selected for assessment (see Figure 5 for an illustration of the flow of steps 1-4). Once a project is selected, LEAN and the MEE Program administrators assign an auditor to conduct the assessment.

Based on the building assessments, LEAN identifies a set of potential cost-effective improvements through a cost-effective analysis. The cost-effective analysis measures improvements by a benefit-cost ratio (BCR). Potential improvements include renovations, installations, or any other measures that modify the property itself. LEAN then presents these measures to the applicant and a contractor through a Cost-Effectiveness Report to finalize the scope of the work. After the applicant and contractor

agree on the improvement measures, LEAN coordinates the improvements and provides the funds needed in order to implement them. The whole program process is detailed in Figure 5 below.

As part of the Low-Income Multi Family Retrofit Program, the applicant must create an account with WegoWise. WegoWise is an online utility benchmarking software that provides expert utility analysis and tracking. The mission of WegoWise is to help building owners save money through energy reduction and assemble "powerful evidence of the financial and environmental benefits of energy efficiency" (WegoWise, 2014a). In order to create a WegoWise account, an organization must provide pertinent building information along with certain utility account information, depending on the utility provider. Usually, LEAN gathers this information from an organization's LIMF Program application and is able to complete the enrollment on behalf of the organization that is applying. A detailed list of the requirements for a WegoWise account can be viewed here: http://support.wegowise.com/customer/portal/topics/168036-getting-started?b_id=962. Once a WegoWise account is initiated, the user can continuously monitor their utility consumption and all utility related costs. The reports generated through WegoWise, along with the audits performed through LEAN, establish a firm foundation for an energy assessment baseline.

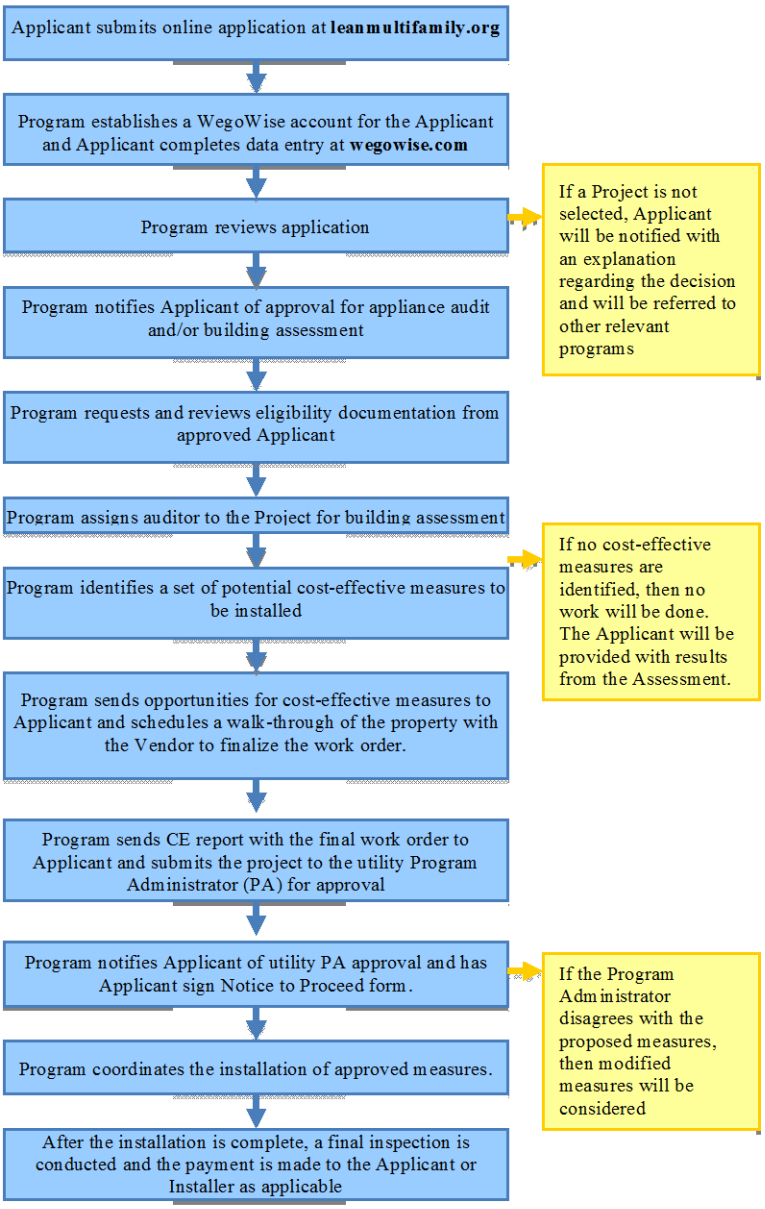


Figure 5 - Low-Income Multi Family Retrofit Program Flowchart (LEAN, 2010)

Legend
Program = LIMF Program
CE report = Cost-Effectiveness Report
PA = MEE Program administrator

Energy Assessment Baseline of Dismas House

Dismas House completed step 1 in 2010 and developed an energy assessment baseline for all three of their housing facilities using the Low-Income Multi Family

Retrofit Program. The three Dismas House facilities are located at 30 Richards St in Worcester, 50 Arthur St in Worcester, and 687 Lincoln Rd in Oakham, Massachusetts. Dave McMahon provided LEAN's Level I audit results for the 30 Richards St and 50 Arthur St properties, a Cost-Effective Report of 687 Lincoln St sponsored by National Grid, and access to the Dismas House WegoWise account.

The Level I LEAN audits occurred in May of 2010, while National Grid's Cost-Effective Report of 687 Lincoln Rd dated back to January 3, 2011. Since a Cost-Effective Report follows the energy assessment step in the LIMF Program process, we concluded that National Grid conducted an energy assessment around the same time as the 30 Richard St and 50 Arthur St locations. The LEAN audits assessed the 30 Richards St and 50 Arthur St locations' heating systems, domestic hot water systems & fixtures, floor assemblies over basements, ceilings & roofs, lighting & appliances, and ventilation. The Cost-Effective Report provided Dismas House with a brief overview of the property's traits and characteristics and a series of suggested conservation measures that would help reduce the energy spending at the 687 Lincoln St location.

The Dismas House WegoWise account contains utility information for all three locations through present day. However, the data from the 30 Richards St and 50 Arthur St locations date back to 2007, while the data from the 687 Lincoln St location only dates back to 2010. Regardless of how far back WegoWise tracks, the Dismas House WegoWise account contains a complete collection of each location's utility usage in 2010. Collectively, the information from the Level I LEAN audits, the brief overview included in the National Grid's Cost-Effective Report, and the utility information

contained in Dismas House's WegoWise account established a thorough energy assessment baseline for Dismas House.

The purpose of an energy assessment baseline is to evaluate a property in order to identify weaknesses in the facility's energy distribution. Weaknesses may exist in areas such as temperature control or appliance efficiency, and may be identified through excessive consumption of a particular utility. Since early renovations at all three locations included some sort of insulation upgrade and air sealing, we concluded that Dismas House identified temperature control as a weakness. From Dismas House's audits, we observed that the condition of the walls, windows, and doors; the presence and potency of insulation; and effectiveness of the facility's heating system are all components of temperature control. Since most of the comments made by the auditor emphasized the weaknesses or need for the improvement in these areas, we confirmed that overall temperature control was a major area of inefficiency for Dismas House's buildings. For example, between the two Level I LEAN audits, there were nine separate comments that suggested installing or improving insulation. See Appendix D for a Table containing all of the data we gathered from the Level I LEAN audits and the Cost-Effective Report.

Additionally, from the utility records in Dismas House's WegoWise account, we observed a high consumption of electricity in 2010, as well as a steady decrease in electricity use over the past 4 years. As seen in Table 4 below, the annual electricity usage at 30 Richards St in 2013 decreased by 3,730.2 kWh compared to 2010, while the annual electricity usage at 50 Arthur St in 2013 decreased by 14,630.11 kWh compared to 2010. Between the two facilities, in 2013, Dismas House saved a total of $3245.53 on their annual electric bill compared to 2010. Considering the implementations of solar

panels at all three locations in June of 2014, Dismas House will save significantly more on electricity in 2014 compared to 2010.

Annual Electricity Usage (kWh)		
Year	**30 Richards St**	**50 Arthur St**
2010	23580.8	54005.15
2011	22526	50228.8
2012	18885.1	36389.25
2013	19750.6	39375.04

Annual Electricity Cost ($)		
Year	**30 Richards St**	**50 Arthur St**
2010	3410.24	7418.51
2011	3151.38	7074.07
2012	2702.29	5124.70
2013	2621.89	4961.33

Table 4 – Annual Electricity Usage and Costs at Dismas House Properties at 30 Richards St and 50 Arthur St, Worcester, MA

This confirmed that Dismas House identified their heavy electricity usage as a weakness, and implemented effective measures to address this weakness. Of course, implementing these measures takes careful planning and will be discussed further in the next step.

Step 2: Devise a plan for improvements and make initial financial projections.

After determining an energy assessment baseline and identifying weaknesses, an organization must devise a plan with the LIMF Program to make improvements and financial projections. With LEAN's guidance, organizations must consider the housing and building restrictions, and then determine what efforts take first priority. Without a thorough plan, a building's condition, structure, or location, may undermine the improvement process by further extending the implementation phase and increasing

costs. Therefore, conducting a thorough examination of the building's condition avoids unexpected costs throughout the implementation process.

A common restriction with low-income housing facilities is the condition of the housing units. Low-income housing started to emerge around the mid 1800's. In 1854, the New York Association for Improving the Condition of the Poor created a building to serve as the first low-income housing model. However, it was quickly demolished a little over a decade later, as it became part of one of the worst slums in the city (Husock, 2009). Public housing aimed to limit the profit motive in housing, and resulted in weak incentive to maintain or improve the structure. This struggle is still evident today as facilities are not usually up to date with energy efficient methods (McMahon, 2014a).

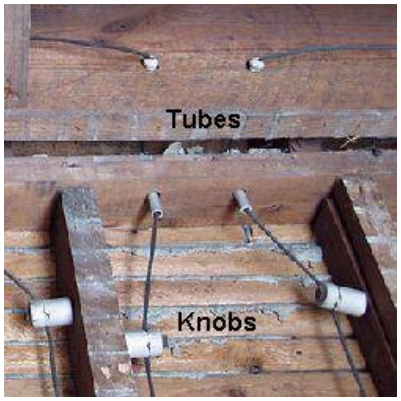


Figure 6- Knob and Tube Wiring

Due to the deterioration and outdating of certain facilities, implementing improvement measures can entail large projects such as changing the whole electrical wiring of the house, replacing the windows and doors, or changing the heating system in order to make the facility compatible with any further renovations. In many older facilities, simple measures become large projects, which require more time and money. Time frames usually range from a day to months depending on the effort required for the renovation. In order to ensure successful improvements, an organization must properly prioritize and plan renovations. Prioritizing is an essential component to a successful improvement plan.

Dismas House Makes a Plan for Improvements: Temperature Control

In 2010, Dismas House planned to address the temperature control problem at their 50 Arthur Street location by implementing extensive air sealing and insulation. However the electrical system, which consisted of knob and tube wiring, was outdated and dangerous (As seen in Figure 6 – Knob and Tube Wiring). This type of wiring is a fire hazard, especially when insulation is placed on top of the wires. Therefore, replacing these wires took priority over air sealing and insulation. LEAN worked with NSTAR to fund this temperature control project, which projected to save Dismas House $12,000 on heating over the course of 20 years. NSTAR projected a cost of $10,000 to replace the knob and tube wiring, and install insulation and air sealing.

Dismas House also planned to address the temperature control problem at the 687 Lincoln Street location. The repairs described in the 2011 Dismas House Cost-Effective Report included plans to replace the pump room door and the exposed insulation above the building's wool sorting room in order to keep the wool sorting room between 68 F and 55 F and to prevent the pipes from freezing. Since National Grid sponsored the energy assessment for this location, they provided Dismas House with financial projections of the suggested renovations' costs and savings. National Grid projected that replacing the exposed insulation would cost $784, and would save 850 kWh, and $122, annually. Replacing the pump room door would cost $108 and was projected to save 332 kWh, and $48, annually. Together, both projects were predicted to cost $892 and save Dismas House 1182kWh, and $169, annually. With these savings, National Grid calculated a payback period of 5.3 years for Dismas House (refer to Appendix F – Dismas House of Massachusetts Renovations from 2010 – 2014 for a list of renovations done at Dismas House)

Devising a plan to make improvements, with the help of financial projections, establishes a clear picture of the costs and benefits of the project for the applicant. There are always opportunities for improving energy efficiency. Therefore, this step is essential in order for the implementation of improvements to run smoothly. In addition to the planning phase, looking for funders to cover the cost is crucial.

Step 3: Identify and secure funding options.

Renovations are expensive. However, there are private and public funding options that low-income housing organizations can utilize. Before making any changes, an organization should identify available funding options to cover the expenses of the improvements. There are three ways to approach a funding search:

1. Seek topic-relative funding,
2. Seek general use funding
3. Use existing operating budget to fund projects.

Topic-Relative Funding

Topic-relative funding is a type of funding that is restricted and can only be used for a specific topic. In this case, that topic is energy efficient renovations. Topic-relative funds are mainly offered through programs funded by the government or utility companies. Key characteristics of these programs are: (1) the application process is long, (2) they can provide large amounts of funding, (3) they have restrictions as to how the funds can be spent, and (4) it only serves a specific topic, any funds that remain unspent after the implementation is completed must be returned.

Topic-Relative Funding at Dismas House

The solar panel project of Dismas House offers a good example of topic relative funding. The solar panel project was supported by multiple funding options. Among the $120,000 that Dismas House accumulated through funding, MassHousing provided a

$65,000 grant, through the 2014 Mass Housing Awards for Affordable Sober Housing. This grant came from the Center for Community Recovery Innovations, Inc. (CCRI), a nonprofit subsidiary corporation of MassHousing that supports not-for-profits that create or preserve affordable sober housing in Massachusetts for recovering substance abusers. They provided the grant to Dismas House in the interest of improving the facilities of an organization that provides rehabilitative services to former prisoners.

General Use Funding

In contrast to topic-relative funding options, general use funding options provide financial support without restrictions. These funds play an important role when an organization is unable to gather the necessary funding from a topic-relative source. The application process for general use funding tends to be shorter, but the amount of funding provided is relatively small. Local or other small-scale foundations are the main source of general use funding. For example, The Mini-grant and Discretionary Grant, provided by The Greater Worcester Foundation, target not-for profit organizations for general usage and only offer up to $3000 and $25,000 respectively (GWCF, 2014).

After identifying funding options, an organization must match its funders with the priorities established in the plan for improvements. Ideally, the largest funding option should be used to cover the cost of the most important renovation, or the largest project. However, if the combination of topic-relative and general-use funding cannot meet the financial needs of improvements, the last place an organization could go for funding would be their own operating budget. Ideally, organizations allocate a certain amount of their budget for capital improvements, such as property renovations or appliance upgrades. In this way, existing operating budget for capital improvements could be the most convenient funding option for the organization. However, some energy reduction

improvements require large amount of money to implement, such as Dismas House's solar panel project, and the budget of low-income housing organizations are limited. Therefore, an organization should avoid exhausting its operating budget to fund large energy reduction projects.

General Use Funding at Dismas House

In 2010, the LIMF Program, which offers topic relative funding options, provided extensive air sealing, complete attic insulation, and weather stripping to the 30 Richards St facility free of charge. To support their recent installation of solar panels at all three of their facilities, Dismas House used funding from a mixture of private and public sources: Mass Housing, the City of Worcester, Saint Gobain Corporation of North America, Massachusetts Department of Agriculture, Unibank and United Bank. See Figure 7 for pictures of solar panels installed at all three locations, and see Figure 8 for a pie chart of each funder's contribution to the installment.

Figure 7- Solar Panels: 30 Richards St (left), 687 Lincoln St (middle), 50 Arthur St (right)

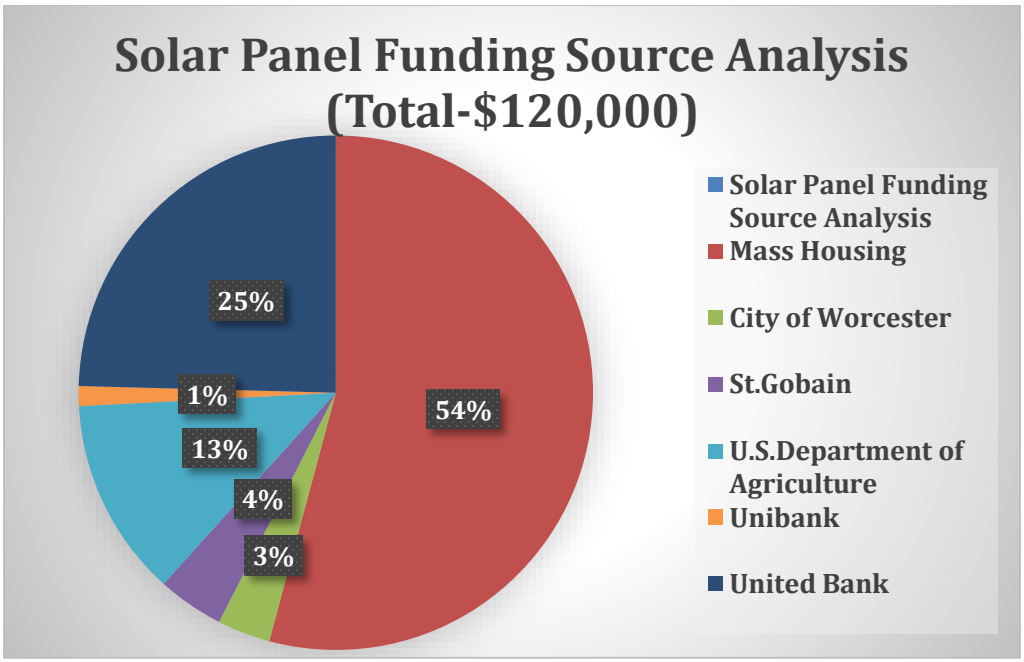


Figure 8- Solar Panel Funding Source Analysis

Step 4: Implement Improvements.

After an organization creates a plan and secures funding to support it, the next step is to start implementing improvements. Sometimes, unexpected obstacles that were not considered in the improvement plan occur and render the implementation plan unachievable. If this happens, the organization should revisit their plan and attempt to address the problem or restriction.

Step 5: Evaluate Success of Changes

After completing steps 1-4, evaluating the success of changes is the next. In this step, success is evaluated through reduced energy usage and cost savings. An easy way to track the utility usage before and after the improvements made in step 4 is through the WegoWise account provided by the LIMF Program. WegoWise calculates any type of energy consumption, from all units of usage, to cost. It provides visual data, which an organization can easily interpret to see if their implementations saved them money and energy. Through our archival research we determined that WegoWise does not determine

the success of a program. However, it collects the raw data that organizations need to extrapolate energy and cost savings. The raw data generated by WegoWise gives low-income housing organizations the ability to calculate their own savings and projection comparisons.

Success of Improvements at Dismas House

In order to calculate savings for Dismas House, we were given documentation of the Dismas House Operating Budget so we could conduct comparisons to the raw data from WegoWise. The Dismas House Operating Budget contained income and expenses generated from all three locations. This was a projected amount for the upcoming 2015 year. As WegoWise generates raw data, it reflects visual aids according to certain time frames and energy consumption units. The graph in figure 9 describes the electricity use in kiloWatt hours (kWh) at 30 Richards Street location. The graph reflects both monthly and yearly time frames expressed in certain colors.

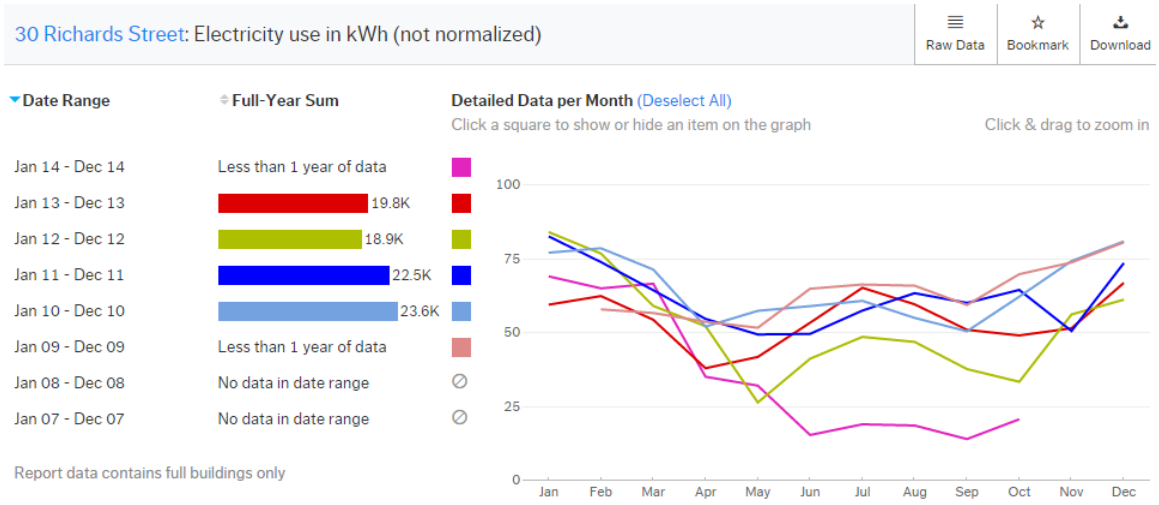


Figure 9 - Electricity use in kWh (not normalized) at Dismas House facility at 30 Richards Street, Worcester, MA

WegoWise also generated a table containing the numbers reflected in the graphs. We used WegoWise's raw data and created total energy costs at each of the locations at Dismas House (Appendix E – All Dismas Location Energy Costs). With that information we were able to create categories, from average to annual energy usage, from 2010 to 2013. From there, we subtracted the 2013, 2012, and 2011 figures from the figures in 2010 for each category to calculate their savings (Table 5 -Annual & Monthly Usage and Costs Savings).

Annual & Monthly Usage and Costs Savings (from 2010 to 2013)	
Electricity Savings Cost ($)	
Total Annual Electricity Savings since 2010 ($)	$5,930.56
Average amount saved per month on electricity bill since 2010 ($)	$164.74
Electricity Usage Savings (kWh)	
Amount of Electricity reduced per month since 2010 (kWh)	867.92kWh
Annual Electricity Savings since 2010 (kWh)	31,245.06 kWh

Table 5 – Annual & Monthly Electricity Usage and Cost Savings

With our calculated savings, we used the Dismas House Operating Budget to determine what percentage of savings could cover other expenses. We concluded that Dismas House saved 31,245 kWh in electricity, which is enough to power about 3 average sized homes in the United States for one year (2,392 sqft homes) (EIA, 2014b; US Census Bureau, 2013). Dismas House also saved a total of $5,930.56 in 2013 from their electricity bills since 2010, which means that Dismas House saved an average of $164.74 per month since 2010. The average monthly electricity savings amount to approximately 24% of the average monthly grocery bill at Dismas House. After calculating savings with

usage and costs for each improvement, Dismas House focused on other opportunities for savings.

Step 6: Repeat steps 2-5 if there are any remaining weaknesses or opportunities for improvement.

Even with changes made and success confirmed, productive energy reduction calls for continuous strides toward energy efficiency. Energy savings increase flexibility within an organization's operating budget, which allows that organization to allocate funds for additional improvements. This last step requires an organization to determine any remaining weaknesses or opportunities for improvement, and to go through the whole process again from step 2. There is no need to repeat Step 1 once the process is initiated because repeating steps 2-5 addresses any remaining weaknesses from Step 1 that were not initially considered.

Dismas House Continues Making Renovations

After completing the initial extensive attic insulation project at the 30 Richards location, Dismas House continued making improvements in waves. From 2010 to 2014, Dismas House continuously upgraded, renovated, and improved all three of its properties.

In 2010, Dismas House implemented extensive air sealing and insulation at both the 50 Arthur Street and 30 Richards Street locations. This included upgrading the wiring as mentioned in step 2 at 50 Arthur Street. In 2011-2012, Dismas House installed a Micro-Combined Heat and Power (MCHP) unit at 30 Richards Street (Appendix F – Dismas House Renovations from 2010-2014). This unit reduces energy consumption by simultaneously producing electricity and heat. The MCHP is very efficient by heating water or space and providing electricity to power other appliances in the household (Home Renovation Research Labs, 2014). In June of 2014, Dismas House installed solar

panels at all three of their locations as mentioned in step 3. For their 2015 project, Dismas House plans to implement a solar wind turbine at the 687 Lincoln St location, which is estimated to account for 70% of their electricity usage (MyEnergySolution.com, 2014).

4.2 Other Findings

The Low-Income Multi Family Retrofit Program (LIMF) was a huge contributor to the successful energy reduction efforts of Dismas House.

The LIMF Program played a critical role in the successful energy reduction efforts implemented by Dismas House. As discussed in section 4.1, the LIMF Program, administered by the Low-Income Energy Affordability Network (LEAN), supports low-income multi-family properties to reduce their energy consumption through the installation of approved energy-efficient measures (LEAN, 2014). Not only is the LIMF Program useful for replacing old appliances with newer ones, but also, it helps organizations to develop a comprehensive, step-by-step plan to achieve energy reduction. This plan requires: creating an energy assessment baseline of the organizations buildings' enclosure, heating and ventilation systems, appliances, and utility consumption; and identifying energy inefficiencies or opportunities for improvement.

LIMF helped Dismas House throughout the renovation process and guided them through the steps to implement energy reduction renovations. The LIMF Program is a key program highlighted in our Energy Reduction Blueprint.

From our fieldwork we found that members of the WGLIHC have varying levels of commitment to energy efficiency.

The members of the WGLIHC have some understanding of the benefits of energy efficiency, but as with most strapped, under resourced not for profit organizations; there are competing priorities. These members recognize the potential opportunity to save

money, but they have mission-driven organizations to run. Managing these organizations is task heavy, as the services and programs offered by these organizations impact the lives of people in Central Massachusetts. Therefore, the organizations' directors have difficulty finding time to sit down and determine if energy reduction is worth their time; meaning they have even less time to actually sit down and develop an effective plan for energy reduction.

In addition to providing women and children with a place to live, Abby's House is concerned with the costs of maintaining its facilities. With regards to energy reduction, Abby's House is concerned with the cost of implementation and does not have much time to consider the benefits in more depth. After speaking with Tess Sneesby, the Housing Coordinator at Abby's House, and Doug Clough, the Maintenance Manager at Abby's House, about the LIMF Program, the benefits of energy reduction, and the investment required for both, they expressed greater interest in investing time into energy efficiency. Since the LIMF Program does a majority of the work, it takes weight off the staff, allowing them to focus on their organization and clients.

Through our interviews with the executive directors of Hector Reyes House and Interfaith Hospitality Network, Dr. Matilde Castiel and Joanne Alley respectively, we found that both organizations are aware of the benefits of energy efficiency; however, neither organization expresses urgency to implement energy efficient measures. This may be due to a lack of understanding of the breadth of financial benefits of energy efficiency. Therefore, different promoting tactics need to be considered so future and current members of the WGLIHC can take advantage of the cost saving benefits that energy efficiency offers.

4.3 Other Recommendations

Promote awareness about the benefits of energy efficiency.

Our first recommendation is to promote awareness about energy reduction efforts among the residents of low-income housing facilities. One thing we observed from our case study is that the residents are generally not aware of the importance of energy savings. This leads to wasteful practices such as leaving the windows open while the heat is on, and leaving the television and lights on while no one is in the room, resulting in larger utility bills.

We recommend having an "Energy Efficiency Organization Champion Award" that will be given to an organization that takes steps to increase energy efficiency. We also recommend having an "Energy Efficiency Personnel Champion Award" that will be given to a person or group of persons that embody energy saving consciousness. The awards could be heavily promoted among other organizations to reinforce awareness about energy efficiency, and to enhance public acknowledgment and best practices in this area.

Our final recommendation is that the organization set up a tracking and evaluation mechanism to help energy audit engineers create and modify the housing energy usage baselines. This mechanism can also be used to analyze the amount of energy saved and the amount of money saved due to a specific improvement. This will provide a convincing numerical view of the importance of energy efficiency.

Chapter 5: Conclusion

Energy efficiency is a wise investment and can help low-income housing organizations decrease energy costs. Prior to installing solar panels, Dismas House saved 31,245 kWh of electricity by implementing smaller scale energy reduction measures. This amount of electricity could power three average (~2500sq. ft) size homes for one year. Dismas House also saved a total of $5,930.56 on their electricity bills from January of 2011 to December of 2013. Over the 36 months that these savings accumulated, Dismas House saved an average of $164.74 per month, which covers approximately 24% of their current monthly grocery bill.

Other members of the Worcester Green Low-Income Housing Coalition (WGLIHC) can achieve the same success with the guidance of the Energy Reduction Blueprint. Government funding, not-for-profit programs, and local foundations currently offer various funding opportunities for low-income housing organizations to increase their energy efficiency. These programs provide an opportunity for low-income housing organizations to implement energy efficient systems and practices. The cost savings generated by these efforts could be applied to mission-related activities. Through energy efficiency, members of the WGLIHC could strengthen their programs and services that serve the low-income population.

We believe that introducing energy efficient methods to low-income housing will not only impact the Worcester community but also the Commonwealth of Massachusetts. We hope that this project and Blueprint will help catalyze other organizations to follow what Dismas House initiated.

Appendix

Appendix A: Informal Interview Questions and Inquiries:

We are a **group of students** from Worcester Polytechnic Institute, working with Dismas House of Massachusetts to promote sustainability and help members of the Worcester Green Low-Income Housing Coalition reduce money spent on energy. As part of our project, we are conducting a case study on the energy reduction efforts of Dismas House in order to create an energy reduction blueprint. We are contacting you with the hope that you will be able to provide us with information or insight that might help us to create an effective blueprint.

Questions about Dismas House Renovations:

Mark Lapan, Energy Auditor, Worcester Community Action Council

- Do you have any more audits or information on Dismas House that we could use for an energy reduction blueprint?

Larry Weir, RISE Engineering, Thielsch Engineering, Inc.

- Would you be able to send us the energy audits performed on Dismas House or any of the other low-income housing organizations in the WGLIHC?

Bill Wahrer, Fellow with Dismas House of Massachusetts

- What is HERS rating used for? Is this report used for solar panels or only window renovations?
- Could you tell us what energy saving renovations were done on the Dismas Farm?
- Did Dismas House join the National Grid Multifamily Retrofit Efficiency Program and have any similar documentation to provide more information about the electric appliances?

Dave McMahon, Co-Executive Director, Dismas House of Massachusetts

- Would it be okay for you to send us the solar app account info for us (myenlighten)?
- We are working on our findings process and digging deeper in the data we have recently. Can we have the specific end dates of these renovations?
    - Micro-Combined Heat and Power (MCHP): End Date
    - Re-wiring and insulations for 50 Arthur St.: End Date

  We were also wondering who funded the "Extensive air sealing along with complete attic insulation"
- We were wondering if you had any plan for seeking funding? Did you seek potential funding depending on the specific category of funding source?

Questions gathering information for LIMF Program enrollment:

Judith Pasierb, Executive Director, Our Father's House

- What year was the building built?
- What are the gross square feet of the building?
- Is it public housing?

- Is there a basement? If so, what is it finished and what is the squire feet of the basement?
- Is the heating system a boiler or a furnace?
- What is the hot water fuel type?
- Is there any type of cooling system for the building?
- Is there a common laundry facility? If so, what is the fuel for the dryers?
- How many meters are there for water, electricity and gas?
- Could you tell us if all your residents are of low-income?

Billierae Engelmen, Program Assistant, Low-Income Energy Affordability Network

- Do you still need their utility account information or low-income eligibility from <insert WGLIHC member name here>

Kelley A. Stimson, Director of Donor, Greater Worcester Community Foundation

- Is there any funding for Energy Saving/Energy Efficiency Housing Projects or for Low-Income Housing?

Questions about LIMF Program & Wegowise:

Billierae Engelmen, Program Assistant, Low-Income Energy Affordability Network

- What kind of information does the applicant need to submit during the LIMF application?
- Is there a checklist of all the documents needed for the 4 steps on the LIMF website?
- What is the application process timeline?

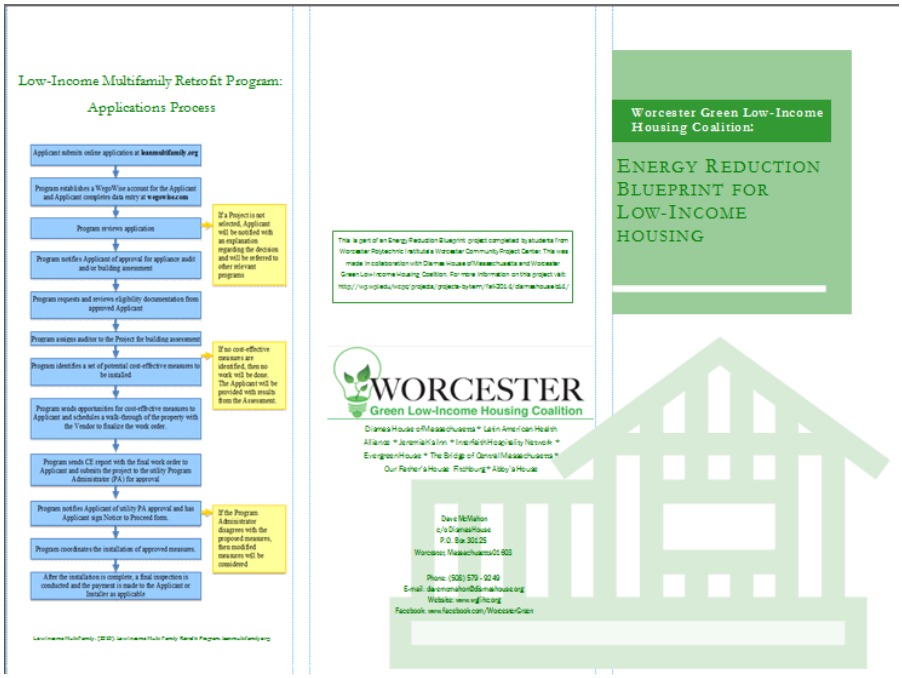
Appendix B: Filmed Interview Questions

We are a group of student researchers from the Worcester Polytechnic Institute. We are working collaboratively with Dismas House to promote sustainability and help members of the Worcester Green Low-Income Housing Coalition save money on energy. A requirement for the academic portion of our research is a video documenting the benefits of energy reduction. Your participation in this media production would be greatly appreciated and is entirely voluntary.

We will be videotaping interviews to capture attitudes, opinions, beliefs, claims and responses. Thank you for your time and consideration.

- How would you describe the current state of the social safety net in Central Massachusetts?
- How do you think energy reduction in low-income housing organizations can help repair the social safety net?
- What opportunities do you think energy savings could bring to your organization? What do you think the far-reaching significance of energy saving is?

Appendix C1: Informational Brochure



Low-Income Multifamily Retrofit Program:

Applications Process

Applicant submits online application at lowmultifamily.org

Program establishes a WegoWise account for the Applicant and Applicant completes data entry at wegowise.com

Program reviews application

If a Project is not selected, Applicant will be notified with an explanation regarding the decision and will be referred to other relevant programs

Program notifies Applicant of approval for appliance audit and or building assessment

Program requests and reviews eligibility documentation from approved Applicant

Program assigns auditor to the Project for building assessment

Program identifies a set of potential cost-effective measures to be installed

If no cost-effective measures are identified, then no work will be done. The Applicant will be provided with results from the Assessment.

Program sends opportunities for cost-effective measures to Applicant and schedules a walk-through of the property with the Vendor to finalize the work order.

Program sends CE report with the final work order to Applicant and submits the project to the utility Program Administrator (PA) for approval

Program notifies Applicant of utility PA approval and has Applicant sign Notice to Proceed form.

If the Program Administrator disagrees with the proposed measures, then modified measures will be considered

Program coordinates the installation of approved measures.

After the installation is complete, a final inspection is conducted and the payment is made to the Applicant or Installer as applicable

Low-Income Multi-Family. (2010). Low-Income Multi-Family Retrofit Program. lowmultifamily.org

This is part of an Energy Reduction Blueprint project completed by students from Worcester Polytechnic Institute's Worcester Community Project Center. This was made in collaboration with Dismas House of Massachusetts and Worcester Green Low-Income Housing Coalition. For more information on this project visit: http://wp.wpi.edu/wcpc/projects/projects-by-term/fall-2014-2/dismashouse-bld-/

Worcester Green Low-Income Housing Coalition:

Energy Reduction Blueprint for Low-Income Housing

WORCESTER

Green Low-Income Housing Coalition

Dismas House of Massachusetts * Latin American Health Alliance * Jeremiah Kalmi * Interfaith Hospitality Network * Evergreen House * The Bridge of Central Massachusetts * Our Father's House Fitchburg * Abby's House

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E-mail: davemcmahon@dismashouse.org
Website: www.wgllhc.org
Facebook: www.facebook.com/WorcesterGreen

A Proposal to Over Save 10 % on Electricity and Natural Gas Bills

Steps Towards Energy Efficiency

In order to create a more energy efficient low-income housing facility an organization must:

Step 1: Create an energy assessment baseline & identify opportunities for improvement.

⇒ The Low-Income Multifamily Retrofit Program will provide auditors to assess the buildings energy efficient status to determine what needs to be fixed.

Step 2: Devise a plan for improvements & make initial financial projections.

⇒ The Low-Income Multifamily Retrofit Program will assist you in creating a plan for making renovations and financial projections.

Step 3: Research funding options.

⇒ While creating a plan, grants will used to make this renovations possible.

Step 4: Implement renovations.

⇒ The Low-Income Multifamily Retrofit Program will provide financial and implementation guidance to start renovations changes.

Step 5: Evaluate success of changes.

⇒ Success is determined by reduced energy usage and costs during a certain time frame. A WegoWise account will help in providing a visual aid of savings made.

Step 6: Repeat steps 2-5 if there are any remaining opportunities toward savings.

⇒ The renovation process does not end with one project. If there are still any more opportunities to reduce costs, then steps 2-5 may be repeated for a new renovation.

Useful Links:

Worcester Green Low-Income Housing Coalition:

www.wgllhc.org

Low-Income Multifamily Retrofit Program:

www.lowmultifamily.org

WegoWise:

http://support.wegowise.com/customer/portal/topics/188038-getting-started?b_id=982

Useful Energy Efficiency Programs

Worcester Green Low-Income Housing Coalition

The Worcester Green Low-Income Housing Coalition is a partnership-based association. Each partner in the Coalition provides services to homeless residents of central Massachusetts cities and towns. The mission of WGLIHC is twofold: (1) implement a comprehensive energy reduction strategy by reducing the carbon footprint and energy costs associated with the buildings through an array of funds; and (2) aim to broadcast the long term reduction of energy costs as a measure to sustain social safety nets in similar communities.

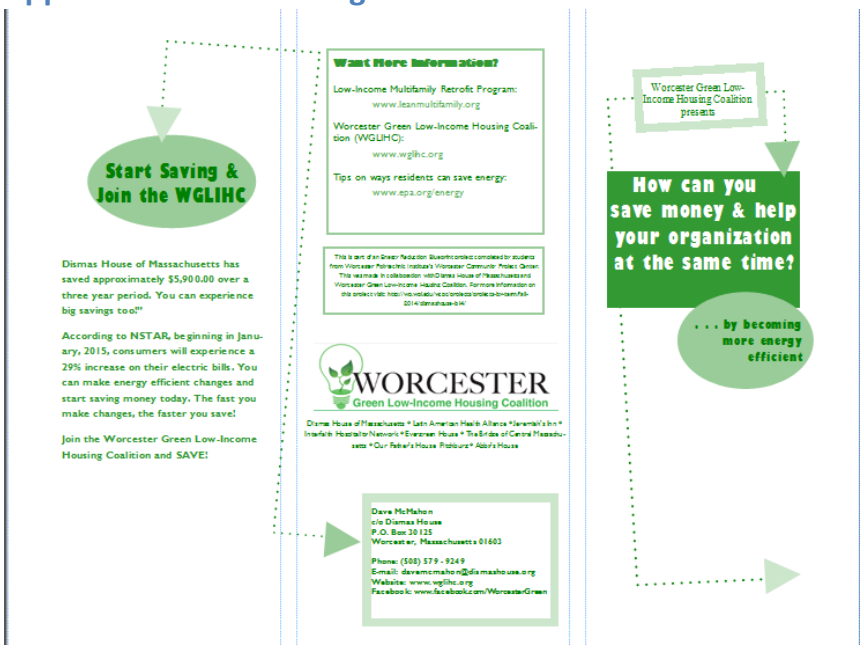
Low-Income Multifamily Retrofit Program

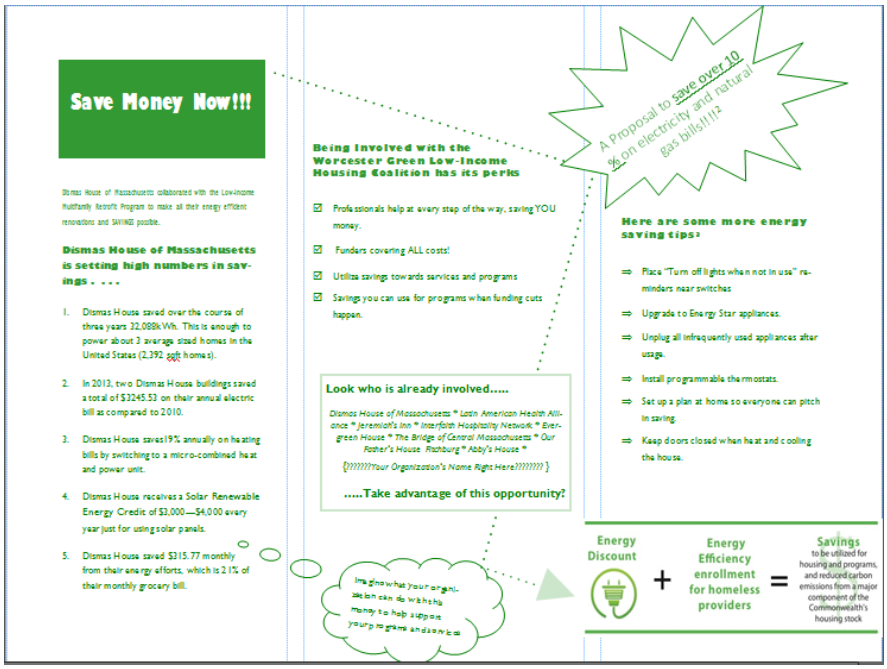
This is a quasi-governmental program, meaning that the program is supported by the government but managed privately. The Low-Income Multifamily Retrofit program. This program supports high-energy consuming low-income multi-family properties through the installation of approved energy-efficient measures. They provide professional auditors to assess the buildings and are present to devise an energy reduction plan.

WegoWise

WegoWise is an online utility benchmarking software that provides expert utility analysis and tracking. It provides powerful evidence of the financial and environmental benefits of energy efficiency, through visual graphs at different time frames. The mission of WegoWise is to help building owners understand energy usage.

Appendix C2: Advertising Brochure





Appendix D: Summary of Level I LEAN audits and National Grid Cost-Effective Report

Energy Audit Assessment Summary
Dismas Father Brooks House May 13, 2010

Appliances & Building Enclourse	Comments	Improve
Heating System (Basement)	(1)Uses natural gas (2)digital thermostat (3)not energy efficent (4) space heating only	(1) pipes need insulation
Domestic Hot Water (DHW) System & Fixtures	(1)hot water system:fired storage (2)uses natural gas (3)80.9% energy efficent (4)have a shower aerator	(1) bathroom erator needed (2)kitchen aerator needed
Floor Assemblies over Basement/crawlspace	(1) proper fireblocking (2) no floor insulation needed	(1)need insulation for band joist and sills
Ceiling/Roof	(1)roof type: gable (2) mineral wood insultation (3)good condition	(1)air sealing fireblocking needed (2) access door hatch need insultation (3)
Walls	(1)wall type: wood stud (2)ALL doulble hung: double pane windows are in good condition	(1)front and side entrance doors need replacement (3) ALL decorative single pane need storms
Lighting	(1)n/a	(1) hallway lighting needs replacement (2) ALL apt#2 lightings needed replacment, replace ceiling fan/light with estar fans (3) apt#3 bathroom lamp needs replacement, bath1&bedroom1 lighting need replacment (4)apt#4 bath1 lighting and lamp replacement
Improve clothes dryer		(1)replace 2 vinyl vent house with mental
Ventilation	(1)exhaust for bath only with windows for kitchen ventilation	(1) need a system for outdoor air suplly

Energy Audit Assessment Summary
Dismas House May 13, 2010

Appliances & Building Enclourse	Comments	Improve
Heating System	(1)Uses Hot water boiler (2)Uses natural gas (3)analog thermostat (4)82% energy efficent (5) space heating only (6)Forced hot water dirstribution system	(1) n/a
Domestic Hot Water (DHW) System & Fixtures	(1)hot water system:fired storage (2)uses natural gas (3)79% energy efficent (4)have a shower aerator (5)heat wrap present	(1) Pipes need insulation (2)kitchen aerator needed (3)Bathroom aerator needed
Main Basement Old Section: Floor Assemblies over Basement/Crawlspace	(1) wall below grade insulated (2) band joist and sills insulated (3)Apt. #8 is located in basement (4) rockwoll used to pack thermal bypasses	(1)proper fireblocking (2)perimeter air sealing needed for rim joist (3)pentration air sealing needed for crawlspace & basement (4)floor insulated needs fiberglass batts (5)need to airseal and wax, and sweep door to basement
Crawlspace: Floor Assembiles over Basement/Crawlspace	(1)proper fireblocking (2)perimeter air sealing (3)insulated wall below grade and band joist and sills	(1)penetration air sealing needed at plumbing pipes (2)floor insulation needed with fiberglass batts, needs to repair some fallen down bays (3) need to reinstall fallen batts (4)should insulate box sills (5) access hatch needs wax (6) heating pipes run through the area and need insulation
Ceiling/Roof	(1)gable roof type (2)fiberglass batts & mineral wool insulations (poor quality) (4)access door and hatch insulated and not weatherstripped	(1)need thermadome (2) thermal bypasses not present (3) air sealing and fireblocking needed in chimney/vent pipe, elctrical penetrations, plumbing penetrations, wall plates, and electrical boxes areas
Ceiling/Roof: Addition	(1)gable roof type (2)air sealing/fireblocking insulated (3) access door and hatch insulated	(1) accessdoor or hatch weatherstripped (2) thermal bypasses not present
Wall: 1st Floor Old Section	(1) Wall type: wood stud (2)mineral wool insulation (3) front &side entry, good insulated thermal (4) all windows, double pane good condition	(1)thermal bypass not present (2) air sealing and fireblocking needed; need to patch laster in supply closet and insulate
Wall: 2nd Floor Old Section	(1) Wall type: wood stud (2)mineral wool insulation (3)All window, double pane,	(1)Air sealing and fireblocking needed for patch paster in suppy closet
Wall: Addition	(1)Wall type: wood stud (2)fiberglass batts insulation; good quality (3)All windows, double pane & side and rear door insulated thermal	(1)thermal bypass not present
Lighting (Common Areas and Exterior)	(1) n/a	(1)Lamp in office needs replacement (2)Hallway lights needs replacement (3)Lamp in meeting rooms needs replacements
Lighting (Apartments)	(1)All bedrooms utizlize ceiling fans w/ lights (2) recommend replacing them energy star ceiling fans	(1)All bedrooms needs light replacements (2)Kitchen, basement, and supply closet lamp needs replacement
Ventilation	(1)Bath only exhaust (with windows for kitchen ventilation)	(1)There is no system for outdoor air supply

Energy Assessment Summary (Cost-Effective Report)
Dismas Family Farm January 3, 2011

Appliances & Building Enclourse	Comments	Improve
Wool Sorting Room	(1)Floor insulated with fiberglass batts in wool sorting room (2)60sq. Ft. is plank covered (good condition) however has some animal damage	(1)Replace exposed insulation above the wool sorting room
Pump Room	(1)All walls and ceiling are insulated (2) floor is dirt (3)houses well pump and hot water heater (4)	(1)replace pump room door (2)infiltration must be considered if basebaord unit conanot maintain a modest load
Other Considerations	(1)have a switch put on the anicondensate heater for refrigerator when area starts to "sweat"	(1)insulate the stock waterer (2)look for the best insulated chicken waterer

Appendix E: All Dismas House Locations Energy Costs

Dismas House: 30 Richards Street

Average Monthly Usage (kWh)	Average Electricity (kWh)	Year
6747.53	1067.35	2014
7735.608333	1645.883333	2013
7499.85	1573.758333	2012
8130.791667	1877.166667	2011
8976.516667	1965.066667	2010
9151.316667	1927.236364	2009
7525.658333		2008
5313.377778		2007

Annual Energy Usage (kWh)	Annual Electricity (kWh)	Year
67475.3	10673.5	2014
92827.3	19750.6	2013
89998.2	18885.1	2012
97569.5	22526	2011
107718.2	23580.8	2010
109815.8	21199.6	2009
90307.9		2008
47820.4		2007

Father Brooks House: 50 Arthur Street

Average Monthly Usage (kWh)	Average Electricity (kWh)	Year
5784.78	1956.047	2014
7723.05	3281.253333	2013
7292.15	3032.4375	2012
10180.24167	4185.733333	2011
10692.20833	4500.429167	2010
7980.958333	3318.71625	2009
5564.516667		2008
3705		2007

Annual Energy Usage (kWh)	Annual Electricity (kWh)	Year
57847.8	19560.47	2014
92676.6	39375.04	2013
87505.8	36389.25	2012
122162.9	50228.8	2011
128306.5	54005.15	2010

Dismas Family Farm: 289 Lincoln Street

Average Monthly Usage (kWh)	Average Electricity (kWh)	Year
3550.51	3550.51	2014
7241.441667	3595.966667	2013
7736.658333	2462.25	2012
7686.708333	2127.733333	2011
3598.05	2329.816667	2010

Annual Energy Usage (kWh)	Annual Electricity (kWh)	Year
35505.1	35505.1	2014
86897.3	43151.6	2013
92839.9	29547	2012
92240.5	25532.8	2011
43176.6	27957.8	2010

All Locations

Totals for Dismas		
Average Monthly Use (kWh)	Average Electricity (kWh)	Year
16082.82	6573.907	2014
22700.1	8523.103333	2013
22528.65833	7068.445833	2012
25997.74167	8190.633333	2011
23266.775	8795.3125	2010
Annual Usage (kWh)	Annual Electricity (kWh)	Year
160828.2	65739.07	2014
272401.2	102277.24	2013
270343.9	84821.35	2012
311972.9	98287.6	2011
279201.3	105543.75	2010

Appendix F: Dismas House of Massachusetts Renovations from 2010 - 2014

Dismas House of Massachusetts Renovations from 2010 - 2014		
30 Richards Street Location		
Renovation Item	Cost	$ (or kWh) Savings (2010-2013)
Extensive air sealing along with complete Attic Insulation and Weather-stripping	n/a	This work alone, while only a few thousand dollars, saved 19% on the annual heating bill for this facility (confirmed through actual bill analysis, adjusted for degree-days), which calculates, to approximately $11,000 in gas savings over the next 20 years (this work was funded through the NSTAR Low Income Multi Family Program). Electricity: Sep 11 - Aug 12: 20.7K kWh Sep 10 - Aug 11: 23.1K kWh Present Saving: 11.58%
Micro – Combined and Power (MCHP)	$10,000 - $20,000	Gas: Jan 12 - Dec 12: 71.1K kWh Jan 11 - Dec 11: 75K kWh Present Saving: 5.2%
Solar Panels (Done at all three locations)	$120,000	Expected to get somewhere between 7,000 to 8,000 in electrical savings from the solar panels and 3,000 to 4,000 dollars in SREC credits
50 Arthur Street		
Electrical Rewiring Insulation Repairs: (1)Air Sealing (Sidewall, Attic, basement, and piping) (2) Weather-stripping Repairs (3) Ventilation and Water Measures	$10, 000	This work resulted in documented 24% savings on the heating bill, which for this property will save about $12,000 over the next 20 years Electricity: Jan 11 - Dec 12: 50.2K kWh Jan 10 - Dec 11: 54K kWh Present Saving: 7.57%
287 Lincoln Street		
Replace the Exposed Insulation Above The Wool Sorting Room	n/a	Projections made in Jan, 2011: kWh saved annually: 850 kWh Annual Savings: $122 Payback: 6.42 years
Replace the Pump Room Door		kWh saved Annually: 1175 kWh Annual Savings: $169 Payback: 5.3 years Payback with National Grid: 2.9 years

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