Greenfield Energy Audit

Energy: Use, Climate Change Emissions, and Cost

FY2001 & FY2008

Future Goals & Next Steps

Greenfield, MA Town Report

ICLEI Cities for Climate Protection Program

June 2009

Table of Contents **Greenfield Energy Audit, 2009**

Appendix

Credits and Acknowledgements

This report was prepared for Christine Forgey, Mayor, Town of Greenfield. We are grateful for her leadership.

This report was prepared with the assistance of numerous people and organizations.

Project leaders:
Sandy Shields, Director, Department of Public Works (DPW)
Nancy Hazard, WorldSustain & Co-chair Greening Greenfield

ICLEI Support:
Missy Stults, ICLEI, Local Governments for Sustainability

Data Collection:
Natalie Walker, Smith College Intern

Data Analysis:
Nancy Hazard, WorldSustain & Co-chair Greening Greenfield

Data Acquisition and Advice
Greening Greenfield Energy Committee
Utility companies: Berkshire Gas, WMECO, Constellation Energy, Rice Oil
Maureen Mullaney, Franklin Regional Council of Governments and her staff
Catherine Miller and Rana Al-Jammal, PhD, Pioneer Valley Planning Commission
Tina Cote and Jake Toomey, Franklin Regional Transit Association
Greenfield Assessors Office
Registry of Motor Vehicles
US Department of Energy Information Administration (EIA)
US Census Bureau

Review:
Sandy Shields, DPW Director, Members of the Greening Greenfield Energy Committee and residents of the Town of Greenfield, with a special thanks to Daria Fiske formerly with the Franklin County Energy Task Force, Carol Letson, Becca King, Pam Kelly, and Tom Hutcheson.

Photo Credits:
Dan Brown, Peter Letson, Martha Rullman, Paul Newell, Alan Twarog

REFERENCES:
Franklin County Energy Project & Task Force publications including the **Franklin County Energy Study: A Renewable Energy Study,** 1977, University of Massachusetts at Amherst, sponsored by the U.S Department of Energy
Pioneer Valley Clean Energy Plan (PVCEP), 2008, Pioneer Valley Planning Commission, Franklin Regional Council of Governments and the Pioneer Valley Renewable Energy Collaborative. www.pvpc.org/activities/Landuse/landuse-cleanenrgy.shtml

A. Our Vision

In 2007, the citizen group, the Greening Greenfield Energy Committee approached Mayor Christine Forgey and together they launched the Greening Greenfield campaign.

The campaign aims to keep Greenfield a great place to live, and to revitalize it using "greening" as the economic and inspirational engine to build a sustainable Greenfield so that current and future generations can sustain and enjoy life in this beautiful, abundant valley.

The campaign was in response to the fact that on a global level, climate change is happening faster than anticipated, oil supplies are shrinking while demand is growing, and population is exploding. Locally, regionally and nationally we are experiencing economic stresses due to job loss, and higher energy and food costs.

The Greening Greenfield brochures states that our strategy to address these issues is to:

- **Reduce our carbon emissions** by working with ICLEI's Cities for Climate Protection program and writing and implement a sustainability plan. Our ultimate goal is zero emissions and waste, as well as clean air, water, and food.
- **Collaborate** with individuals, groups, businesses and town government. Use cooperative learning, public relations and advocacy. Bring financial and human resources to the table.
- **Use existing technologies** to reduce our need for costly and polluting fossil fuels. We will also help build new sources of energy that do not emit toxic or climate change emissions.
- **Foster sustainable:** land use and agriculture; transportation: local economies, green businesses, jobs and manufacturing; healthy and equitable lifestyles; and quality education, health care, arts, entertainment, parks and recreation.
- **Advocate** for local, regional, state and federal policies that support our sustainable vision.

Greening Greenfield adopted the definition of sustainability as stated by the 1987 Bruntland Commission as follows:

> **"Sustainability is a system of thinking that strives to meet the present economic, social and environmental needs without compromising future generation's ability to meet their own needs."**

By extrapolation, sustainable energy is energy that is made from sources that support the local economy forever, are not depleted when used (are renewable), and do not poison our environment, or emit climate change emissions. This type of energy will be secure and have a stabile price, and support the local economy.

B. Executive Summary

The Greenfield Energy Audit addresses Greening Greenfield's first strategy as noted above in the Vision section. It builds on the work of many people and organizations that have looked at energy use in Franklin County and the Pioneer Valley over the past 60 years. It is our hope that that this Audit and the Greening Greenfield campaign can help mobilize people in Greenfield by providing a collaborative focal point for residents and businesses and a window to the many active groups in the region; by keeping an eye on our goals and time line; by shining a light on successes and documenting practical steps that can move toward sustainability; by putting Greenfield's successes in the context of larger plans; and by fostering town pride in our collective efforts and successes.

What We Did

In February 2008, Mayor Christine Forgey signed a resolution for Greenfield to join the Climate Protection Program offered by the international organization ICLEI – Local Governments for Sustainability. ICLEI's Climate Protection Program (CPP) is built on the premise that "if you cannot measure it you cannot control it." This report documents several of the CPP steps as follows:

- Completion of two energy use inventories: one for Town government operations, and one for community-wide energy use. We used ICLEI software to analyze our energy use, climate change emissions and cost of energy used.
- Announcement of aspirational goals for 2050.
- Starting the assessment process that will lead to setting milestones and creating an Action Plan.

We selected FY2001 as our base year, to tie into the existing Pioneer Valley Clean Energy Plan (PVCEP) and the Town's budget. We also collected energy use data for FY2008 so that we could assess trends over the past 7 years, and have an accurate assessment of where we are now. We entered the energy use data into ICLEI's software to convert energy use into a common unit (millions of BTUs, MMBtu), and to determine climate change emissions. We also calculated the cost of the energy we used.

After discovering that the Town government sector by sector climate change emissions pie graph FY01 looked virtually identical to the sector by sector cost of energy pie graph, we chose to focus primarily on money, instead of climate change emissions. We did this because a Greenfield Community College study confirmed that for most people, saving money is a greater motivator than cutting climate change emissions. Additionally, for many citizens in Greenfield, "greening" is perceived as being an action that only the wealthy can do, and that the people who use this phrase do not appreciate and respect the economic challenges that most people face.

What We Discovered

Following are the two most interesting findings of the Town government inventory were that:

- Between FY01 and FY08, the cost of energy rose 38% or $645,367 to from $1.7 million to $2.357 million, and the energy portion of the budget rose form 4.4% in FY01 to 5.8% in FY08, in spite of the fact that between FY2001 and FY2008, energy use and climate change emissions of the Town decreased about 3% each. Our schools and other Town services are being severely stressed by these increased fuel costs.

- There is great potential to save energy dollars by improving the energy efficiency of our most energy inefficient buildings. We found that the most energy inefficient Town buildings used five times as much energy as the efficient buildings.

For the community-wide inventory, the most startling discovery is that in FY08, the residents of Greenfield spent over $85.8 million on energy and, because of that expenditure, $67.1 million went out of our community. Given our population of 18,666, that means that $4,638 was spent on energy by each person either directly or indirectly, and for each household that figure grows to over $10,000.

Goals set for 2050
In response to these challenges, on January 17, 2009 Mayor Christine Forgey set two long-term aspirational goals for 2050:

1) ZERO energy dollars spent by Greenfield residents will leave the region by 2050.
2) Cut climate change emissions by 80% by 2050.

Strategies We Will Use to Develop a Plan
We will use the following three strategies when seeking out and analyzing opportunities to reduce our energy use and cost, and climate change emissions as follows:

1) Does it reduce our energy use? Are we doing more with less?
2) Does this new source of energy produce zero carbon emissions, zero toxic waste,, build the local economy, and avoid any unintended consequences??
3) Is this a game-changing technology, behavior, or idea that opens new doors to doing things better?

We will apply these three strategies when assessing the five Town government sectors: buildings, vehicles, waste, water/sewer and lighting, and to the three community-wide sectors: residents, commercial/industrial, and transportation. When applying these strategies we will not only look at who uses energy, but also keep in mind the three major types of energy we use - electricity, heat, and transportation fuels. Additionally, we will keep in mind the characteristics of each type of fuel - electricity, fuel oil, natural gas, gasoline, wood, solar etc - in terms of its climate change emissions, cost per unit of energy delivered, and how much of what we pay for that energy stays in our region or leaves.

Additionally, the correlation between lowering costs and lowering climate change emissions provides a unique opportunity to build community and solidarity between advocates for “greening” the community, and the advocates for economic development, equity, and good jobs.

Recommendations on Next Steps Needed to Create an Action Plan:
The next step outlined by ICLEI is for Greenfield to draft an Action Plan. To accomplish this step, we recommend the following actions.

1. We recommend that Town government continue to take a leadership role as follows:
    a. The Mayor work with staff responsive for Town government energy use to assess opportunities and set 1 to 5 year milestones for energy reductions and local renewable energy generation on Town-owned buildings and land.

b. The Mayor set up a 'green teams' made up of staff and citizen stakeholder groups responsible for energy use to set 1 to 5 year milestones for energy reductions and local renewable energy generation. This process will feed into the Master Planning process.

c. The Mayor and Town Council make a commitment to start updating the Master Plan next year, using sustainability as the overarching goal; integrate sustainability principals such as smart growth, strict building codes etc. into the plan; and use what we learned from the *Greenfield Energy Audit* to inform the plan wherever appropriate. The Master Plan will double as an Action Plan, as defined by ICLEI's new sustainability program.

d. Apply for Massachusetts *Green Communities* designation, which will make us eligible for future funding.

e. The Town consider adopting the new Massachusetts Stretch code for buildings, which will make Greenfield eligible for additional state funds.

f. The Town continue to work closely with the Greening Greenfield Energy Committee (GGEC) as an advisory committee.

g. The Town support GGEC in its efforts to engage all 18,666 residents by continuing to meet with GGEC leaders on a regular basis; offering accounting support for grants aimed at supporting GGEC efforts; host ICLEI software; and support GGEC programs on an as requested / appropriate basis.

2. The Greening Greenfield Energy Committee (GGEC) continue to create programs that give the public the motivation and tools they need to take action in reducing their personal energy use and, if feasible, generate renewable energy on their homes.

The Challenges

We recognize that the task to change how we make and use energy is daunting, but it is necessary. Change is never easy. In Greenfield, a community of 18,666 people with 7,905 households, we have an additional challenge because Greenfield's average household income is $40,800/year, which is below the below the state and national average. Additionally, many elders live on fixed incomes of less than $14,000/year. Over the study period, the cost of energy rose 38%, and is likely to continue to rise as demand outstrips supply as population grows and fossil fuel resources diminish. On the plus side, there are numerous, highly motivated and talented individuals working in local government, government agencies, non-profits, and businesses that are already actively engaged in working toward our common goals. Additionally, recent state legislation has positioned Massachusetts as one of the most progressive states in the country when it comes to growing the green economy and moving toward sustainability. Finally, on a national level, President Barak Obama's election and initiatives to date also raise hope.

In Summary

We see this report as one step in many that will help Greenfield, the nation, and the world, move toward a more sustainable future. As emphasized by ICLEI, this is an iterative process that involves creating a plan with both long term goals and short-term milestones; constant measurement of progress toward our goals; and then adjusting our plans to achieve our goals. The good news is that our end goal is clear, we have made a commitment to that goal, and we are working on a plan to establish near-term milestones that will enable us to achieve our long term goals.

1. Introduction

This report, *The Greenfield Energy Audit*, builds on the work of many people and organizations that have looked at energy use in Franklin County and the Pioneer Valley over the past 60 years. It is our hope that this Audit (also referred to as an inventory) and the Greening Greenfield campaign can help mobilize people in Greenfield by providing incentives and motivational information; a collaborative focal point for residents and businesses; a window to the many active groups in the region; timely reports on progress toward our common goals; visibility for Greenfield heroes and successes; offer a regional to global context for Greenfield's efforts and successes; and a PR campaign that will foster town pride in our collective efforts and successes.

In February 2008, Mayor Christine Forgey signed a resolution for Greenfield to join the Climate Protection Program offered by the international organization ICLEI – Local Governments for Sustainability (ICLEI was formerly known as the International Council for Local Environmental Initiatives). Through this resolution, the Town of Greenfield recognized the "profound effect" that greenhouse gases emitted by human activity are having on the Earth's climate, as well as Greenfield's opportunity to reduce these emissions, both through its government operations and by inspiring change throughout the community. (See Appendix 1 for a copy of the resolution).

This document, *The Greenfield Energy Audit*, is the completion of the fourth milestone in Greenfield's ICLEI-supported 10-step process: conducting an inventory of our energy use and greenhouse gas emissions. Presented here is the inventory of the energy use, costs, and climate change emissions resulting from Greenfield's government operations as well as estimates of community-wide energy use, costs, and climate change emissions. We have chosen FY2001 as our baseline against which we will be able to compare future performance, in order to tie in with the Pioneer Valley Clean Energy Plan (PVCEP)'s time line, and Greenfield's budget. This base line will also enable us to measure our progress toward our goals. We have also collected data from FY2008, so that we are already able to look at trends to date and draw some conclusions. This document is Greenfield/ICLEI Step # 5: Setting goals for 2050. It also sets the stage for starting Greenfield/ICLEI Step #6: Assessing what can be done and setting near-term milestones.

We recognize this effort of reducing our carbon emissions from energy use as a key step toward achieving our ultimate goal of "building a sustainable Greenfield so that current and future generations can enjoy life in this beautiful abundant valley" But it is not the only measure of sustainability. Our other goals and strategies are outlined in the vision section (A) of this document.

1.1 Climate Change Background

A balance of naturally occurring gases dispersed in the atmosphere determines the Earth's climate by trapping solar heat. This phenomenon is known as the greenhouse effect. Modern human activity, most notably the burning of fossil fuels for transportation, electricity generation, and heating our buildings introduces large amounts of carbon dioxide and other gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface temperature to rise, which in turn affect global climate patterns. In this report, these gasses are referred to as climate change emissions. They are expressed in units of carbon dioxide equivalents (CO_2e). (For assumptions imbedded the ICLEI software, see ICLEI's CACP software by going to www.iclei.org/usa.)

It is now commonly accepted worldwide that human activities are increasing the concentration of greenhouse gases in the atmosphere, causing a rise in global average surface temperature and consequent climate change. In response to the threat of climate change, communities worldwide are voluntarily reducing greenhouse gas emissions. The Kyoto Protocol, an international effort to coordinate voluntary reductions, went into effect in

February 2005 with 161 countries participating. The United States is one of three industrialized countries that chose not to sign the Protocol.

In the face of past federal inaction, many communities in the United States are taking responsibility for addressing climate change at the local level. Greenfield might be impacted by erratic rainfall causing floods and droughts, food supply disruption, disease, and the need to meet the needs of millions of future flood refugees from low-lying cities such as Boston and New York. Beyond our community, scientists also expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and land slides, summer water shortages as a result of reduced snow pack, and disruption of ecosystems, habitats, and agricultural activities.

1.2 ICLEI's Communities for Climate Protection Program & Greening Greenfield Campaign

By adopting a resolution committing Greenfield to advance climate protection, Greenfield has joined an international movement of local governments. As of 2008, more than 1000 local governments, including over 526 in the United States, have joined ICLEI's Cities for Climate Protection (CCP) campaign. In addition to Greenfield, the neighboring towns of Amherst, Northampton, Brattleboro, VT, and Keene, NH are all CCP participants. It should be noted that in 2007, over 20% of the US population lived in an "ICLEI community."

The CCP campaign provides a framework for local communities to identify and reduce energy use and cost, and greenhouse gas emissions, and to share success stories.

In Greenfield, this campaign started in 2007, and it is called **"Greening Greenfield."** It is a collaborative effort of the Town of Greenfield, and the citizen group, the Greening Greenfield Energy Committee. Greening Greenfield's mission is to use "greening" as the inspirational and economic engine to build a sustainable Greenfield so that current and future generations can enjoy life in this beautiful abundant valley. To learn more go to www.GreeningGreenfield.org.

This report is the completion of Greenfield/ICLEI Step #4, as noted below in the Greening Greenfield campaign. It provides a foundation for future work to reduce energy use and costs, and climate change emissions in Greenfield. This report will be used extensively by town government as well as by Greening Greenfield Energy Committee and ultimately the Greening Greenfield campaign, which aims to engage all the residents of Greenfield in reducing their energy costs, use, and climate change emissions. At the same time we are looking for ways to produce zero carbon energy locally and cost-effectively, and for game-changing ideas that can help us change our energy needs, and production and use patterns, and strengthen the quality of life in our community.

Greenfield/ICLEI 10-Step Process, Dates Accomplished, and Timelines

1. Sign on to ICLEI and designate staff liaisons – *Feb. 2008*
2. Engage people in the process - *ongoing*
3. Get ICLEI software & training – *June 2008*
4. Collect data and write Greenfield Energy Audit – *June 2008-March 2009*
5. Set long term goals – *Announced by the Mayor, Jan. 15, 2009*
6. Assess & analyze options & set achievable milestones – *Assessment started Dec '08*
7. Draft the plan - *by December 2010*
8. Implement the plan – *Although the Plan is not yet set, actions started in 2008*
9. Monitor & report progress
10. Revise & re-implement plan as needed

2. Inventory Methodology – What we did

ICLEI believes that "if you cannot measure it, you cannot control it." Therefore, the first step toward reducing climate change emissions is to identify baseline levels and sources of emissions in Greenfield.

2.1 ICLEI Methodology

As noted above, ICLEI's Communities for Climate Protection methodology assists local governments to systematically track energy and waste-related activities in the community, and to calculate the relative quantities of greenhouse gases produced by each activity and sector. The inventory methodology involves performing two assessments: 1) an inventory of government facilities and activities in great detail, and 2) a separate assessment of the entire community. The government energy use is also included in the community-wide inventory because it is part of the overall energy use in the community. After gathering information on energy use, the data is entered into the ICLEI software referred to as the Clean Air and Climate Protection (CACP) software. The software converts all forms of energy to a common unit, and calculates climate change emissions.

2.2 ICLEI Clean Air and Climate Protection (CACP) Software

To facilitate community efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO), and Torrie Smith Associates.

This software calculates emissions resulting from energy consumption and waste generation. The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. Climate change emissions are aggregated and reported in terms of equivalent carbon dioxide units, or CO2e. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide on a per molecule basis in its capacity to trap heat, so the CACP software converts one ton of methane emissions to 21 tons of carbon dioxide equivalents. The CACP software is also capable of reporting input and output data in several formats, including detailed, aggregate, source-based and time-series reports that can be generated using British or metric energy units of the community's choice. Greenfield chose to use millions of BTUs (MMBtu) and tons of climate change emissions, whenever possible.

The emissions coefficients and methodology employed by the CACP software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change (1996 Revised IPCC Guidelines for the Preparation of National Inventories) and the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA form1605).

The CACP software has been and continues to be used by over 526 U.S. cities, towns, and counties including New York, Boston, Chicago, and Miami to reduce their greenhouse gas emissions. However, it is worth noting that, although the software provides Greenfield with a

sophisticated and useful tool, calculating emissions from energy use with precision is difficult. The model depends on numerous assumptions and is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation of reality, rather than an exact value.

As noted above, our climate change emissions inventory consists of two distinct inventories: 1) emissions resulting from the Greenfield's internal government operations, and 2) a community-wide inventory defined by our geographic borders. The program is set up in such a way that government inventory is a subset of the community inventory (the two are not mutually exclusive). The government operations report gives details about every building etc., while the community inventory gives the broad view of emissions from our energy use. Each inventory provides the basis for the creation of an emission forecast, so that we can assess which measures will be most effective in reducing our emissions.

Creating our emissions inventory required the collection of information from a variety of sources, as noted in section 2.2.1 of this report, and in the appendices.

2.3 Collection of Energy Use and Cost Data

2.3.1 For the Government inventory, we collected the energy bills for FY2001, FY2007, and FY2008 from:

- Heating and lighting all 29 town-owned buildings including town hall, fire, police, library, schools, Council on Aging, Greenfield swimming facility, etc.
- Fueling vehicles used by the school, police, fire, and DPW departments
- Powering street lights and traffic signals
- Providing water and sewer services
- Providing waste management services

Where energy use data was missing for one year or another, since major energy upgrade had not occurred between FY01 and FY08, we assumed the energy use had not changed. For cost, when not available, we used cost data on other utility bills for the same time frame for the fuel in question.

2.3.2 For the community-wide inventory, we gathered information on all known energy consumed in Greenfield. This means that, even though the electricity used by Greenfield residents is produced elsewhere, this energy and the emissions associated with it appear in Greenfield's inventory. Additionally, the annual fuel use and emissions of vehicles registered in Greenfield associated with those vehicles are included in the community-wide inventory. The decision to calculate emissions in this manner reflects the general philosophy that a community should take full responsibility for the impacts associated with its energy consumption, regardless of whether or not the energy generation occurs within its geographic borders, or that the vehicle was always driven within Greenfield.

Overall, finding information on energy use was not as straightforward as it was for the municipal energy use, which was pulled from actual bills. Following is an explanation of where the data we used came from for each fuel type.

- *Natural gas*: Berkshire Gas gave us the total amount of energy used for FY2001 and FY2008 for each of the following users: residents, commercial, and industrial. Note that the town government energy use, as well as county, state, and federal building energy use, are included in the commercial sector. Since Greenfield is the county seat, we have an unusually large percentage of government-operated buildings and our commercial sector is not as large as it first appears. Cost was calculated using local average natural gas rates for FY2001 and FY2008.
- *Electricity:* Western Massachusetts Electric Company (WMECO) gave us the total amount of energy used for FY2008 for each of the following users: residents, commercial, and industrial. We did not receive energy use data for FY2001. We were, however, told that for the past few years, electricity use has been shrinking by about 1% per year. We therefore calculated FY2001 electrical use by adding 3% to the FY2008 numbers. Cost was calculated using local average electric utility rates for FY2001 and FY2008.
- *Oil, Propane, Wood, Coal*: Since oil, propane, wood, and coal do not have single suppliers, calculating use was more difficult. Following ICLEI's advice, we looked at the 2000 census to find out how many households used what type of fuel. From the US Department of Energy (DOE) Energy Information Administration (EIA), for oil and propane, we were able to find the average fuel use per type of fuel per household in the Northeast for 2001 and 2008, and average price of fuel for those years. As for coal and wood use and prices, we collected this information by asking local users what they paid for those fuels in those years.
- *Gasoline and Diesel Fuel for Transportation*: The number of vehicles per type was based on vehicle registration data for Greenfield from the Registry of Motor Vehicles, as well as very specific data for local buses from the Franklin Regional Transit Association (FRTA), and for our school buses from the Town of Greenfield and Kuzmeskus, where we rent most of our school buses. For fuel type, the ICLEI software makes certain assumptions on whether gasoline or diesel fuel is being used for various sized vehicles. For miles traveled, we relied on data from the Pioneer Valley Planning Commission (PVPC) for average miles driven per vehicle. According to their data, on average we travel 11,000 miles/year/vehicle. This is 1,000 less than the national average of 12,000. For cost, we used the average national cost for gasoline for 2001 & 2008 as noted by the USDOE EIA.

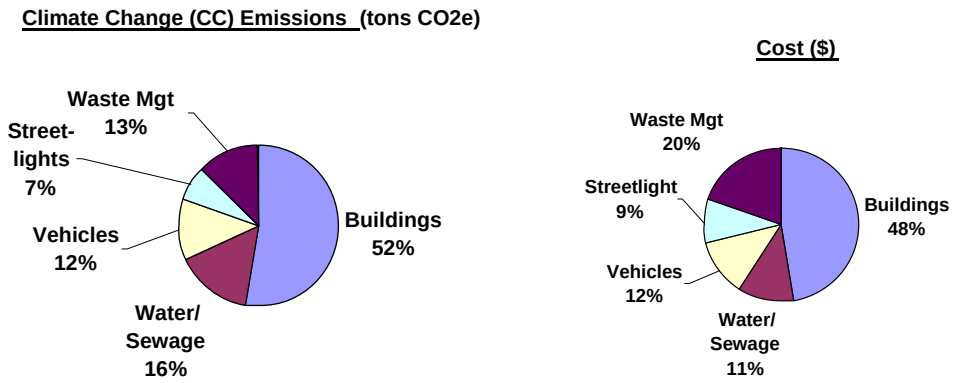
2.4 Calculating Climate Change Emissions

We took this energy use data and put it into the ICLEI Clean Air and Climate Protection (CACP) software, described above, which calculates climate change emissions, as well as criteria emissions, such as sulfur oxides, carbon monoxide, nitrous oxides, and particulates.

After discovering that the pie graph for climate change emissions for FY01 from the Town government sector by sector looked virtually identical to the pie graph for the money spent on energy sector by sector, we chose to focus primarily on money, instead of climate change emissions, because people understand money, and saving money is a great motivator. However, the connection between cost, energy use, and climate change emissions is made clear wherever possible.

3. Government Energy Audit FY01 & FY08

Since the cost is of great concern to Mayor Forgey, Town staff working within constrained budgets, and citizens who pay taxes to support Town expenses, and because as shown by the pie graphs below, cost and climate change emissions were highly correlated sector by sector in FY2001, we chose to focus on cost in this report. In particular we focused on cost trends between FY2001 and FY2008 for each sector. The connection of cost to use and climate change emissions was made wherever possible. Full data behind the graphs in this section is available in *Appendix 2*. In thinking about why there is such an excellent correlation between cost and climate change emissions, we believe it is driven by the fact that electricity is both the most expensive form of energy and also the largest emitter of climate change emissions per unit of energy.



Figures 1 and 2. Government climate change emissions and energy costs by sector.

Note that sector by sector, the cost and the climate change emissions are very similar. This is due to the fact that electricity, which has very high climate change emissions, is also the most expensive type of energy. This correlation enabled us to focus on cost, which is easily understood and of great interest and concern to Town officials and the average person.

Trends: Total cost vs. energy use and climate change emissions.

- FY01- $1.71 million or 4.4% of the Town budget
- FY08 - $2.36 million or 5.8% of the Town budget
- This is an increase of $644,872 over seven years.
- Over the same time period, energy use and climate change emissions were reduced by 3%. This rising cost of fuel is incentivising the town to cut its energy costs in every sector.

3.1 Sector Percentages

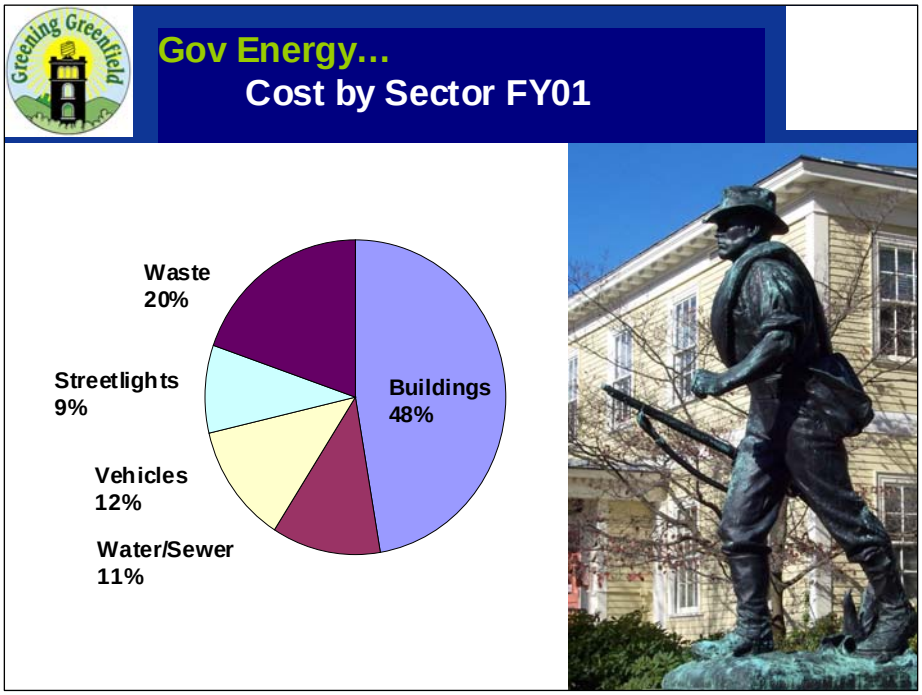


Figure 3. Cost by sector FY01. (See Appendix 2.1 for details)

As shown in this chart, building energy expenditures are almost half of all the expenditures. The other half is fairly equally divided between waste management, streetlights, vehicles, and water and sewer. Waste is the largest at 20% and streetlights the smallest at 9%

3.2 Costs by Sector

3.2.1 Water & Sewer

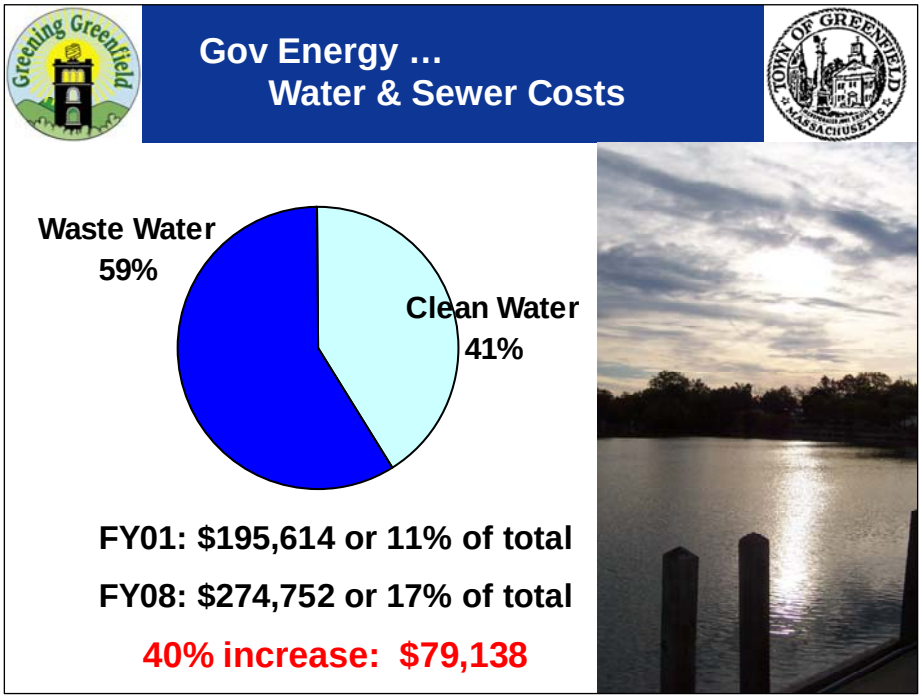


Figure 4. Water & sewer energy cost by activity/ FY 01 – FY08 (See Appendix 2.3 for details)

Between FY01 and FY08, costs increased by 40%, as noted in Figure 4., due to exponential rise in energy costs. Costs rose in spite of the fact that, energy use and climate change emissions were reduced by 14% and 15%, respectively. Over the past 10-years, large pumps have been upgraded with variable speed drives and energy efficient motors, and heat pumps have been installed to extract heat from the sewage treatment effluent to heat the two buildings at the water pollution control plant.

3.2.2 Streetlights

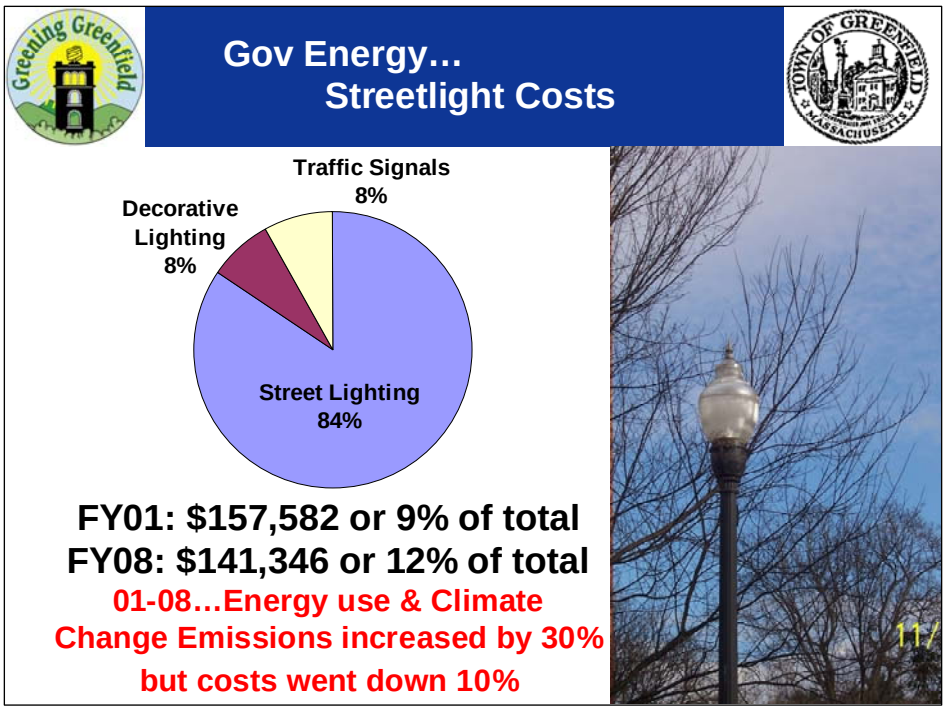


Figure 5. Streetlight costs FY2001 and FY2008 and lighting type costs by percentages. (See Appendix 2.4 for details)

From FY01-FY08 energy use and climate change emissions increased by 30%, due to an increase in the amount of energy used for decorative lighting. The traffic signals were changed over to energy efficient LED's in 1999, prior to this study. A streetscape was also done between 1999 and 2001. In spite of this energy use increase, the overall cost was decreased by 10% as noted in figure 5 due to changing utility companies and streamlining the billing process so that there are fewer accounts etc. Streetlights are the only sector whose energy use increased over the study period. The cause of the increase in use should be researched and eliminated if possible through the reduction of fixtures and the use of more energy efficient lights, such as the new LED's for decorative lighting and streetlights coming on the market, and the use of zero carbon electricity.

3.2.3 Vehicle Fuel Costs

Accurate Town vehicle data was not readily available for FY2001, so we assumed that the number and type of vehicles were about the same as in FY2008. Exact energy use during 2007 was also not readily available due to poor refueling data collection The 91% cost increase noted in figure 6 is based on the increase in the cost of gasoline and diesel fuel over this 7-year time period. Summary of vehicle numbers and types in Appendix 2.

As of January 2008, an excellent new system has been put in place so that each vehicle now has an account. So our ability to analyze fuel use, mpg, and miles traveled will be greatly improved. In March 2009, the town Assessor's car was replaced with a fuel efficient vehicle. This marks a change in policy. Previously this department used hand-me-down gas guzzling police cruisers.

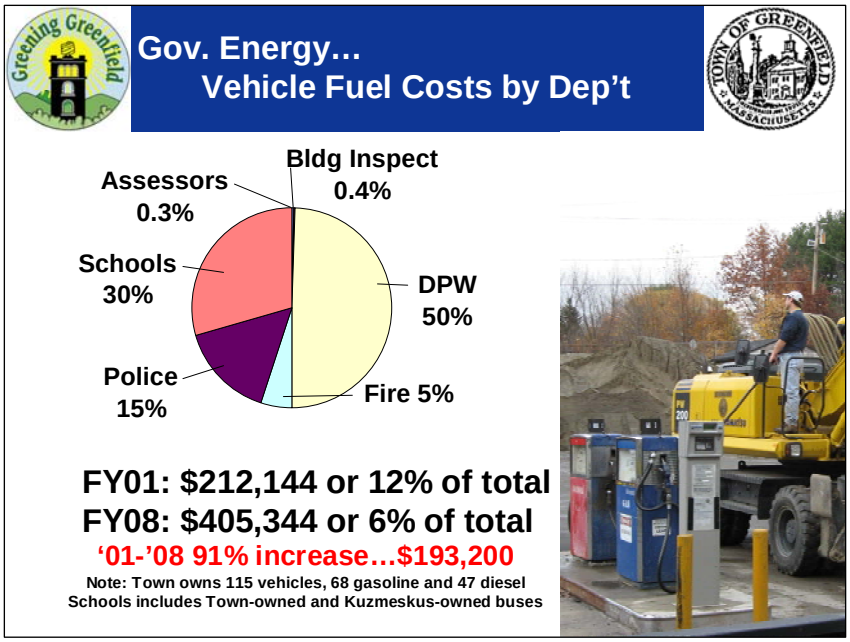


Figure 6. Vehicle fuel costs for FY2001 and FY2008, and percentages of costs by department. (See Appendix 2.5 for details)

3.2.4 Buildings: Heating, Cooling, and Lighting Costs

Energy use data for the Town-owned buildings is quite complete, with the possible exception of the High School, which has a large oil tank that is not always filled on the same date each year. Overall, between FY01 and FY08 the energy use of the buildings has decreased 4.5%. The 50% cost increase noted in Figure 7 is due to increased costs in heating fuel oil and gas and electricity.

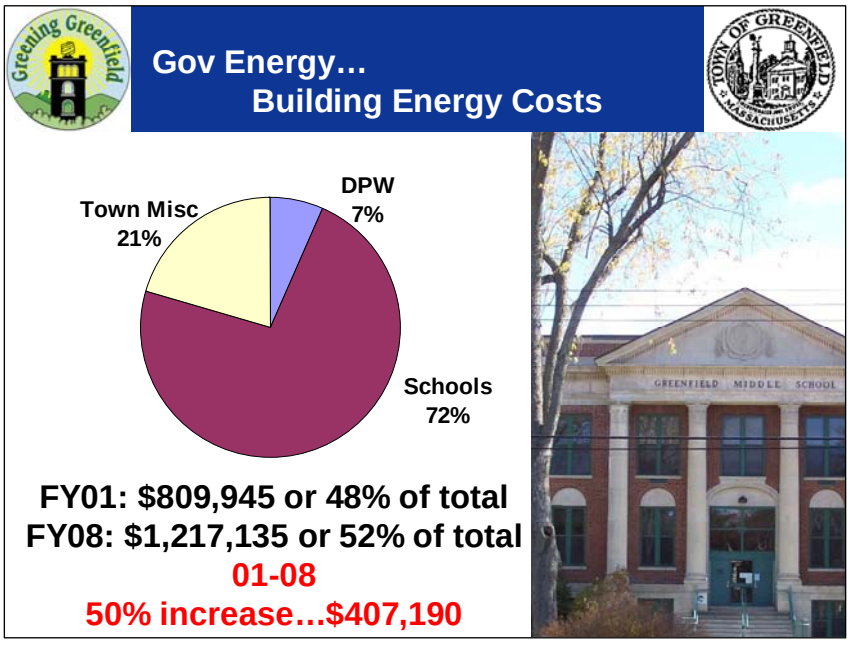


Figure 7. Town building energy costs for FY2001 and FY2008, with percentages of cost by department. (See Appendix 2.6 for details)

The most interesting and useful data is the "energy intensity" of the various buildings. The energy intensity refers to how much energy each building uses per square foot. The smaller the number the better. As noted in the graph below, some buildings use over four times as much energy per square foot as others.

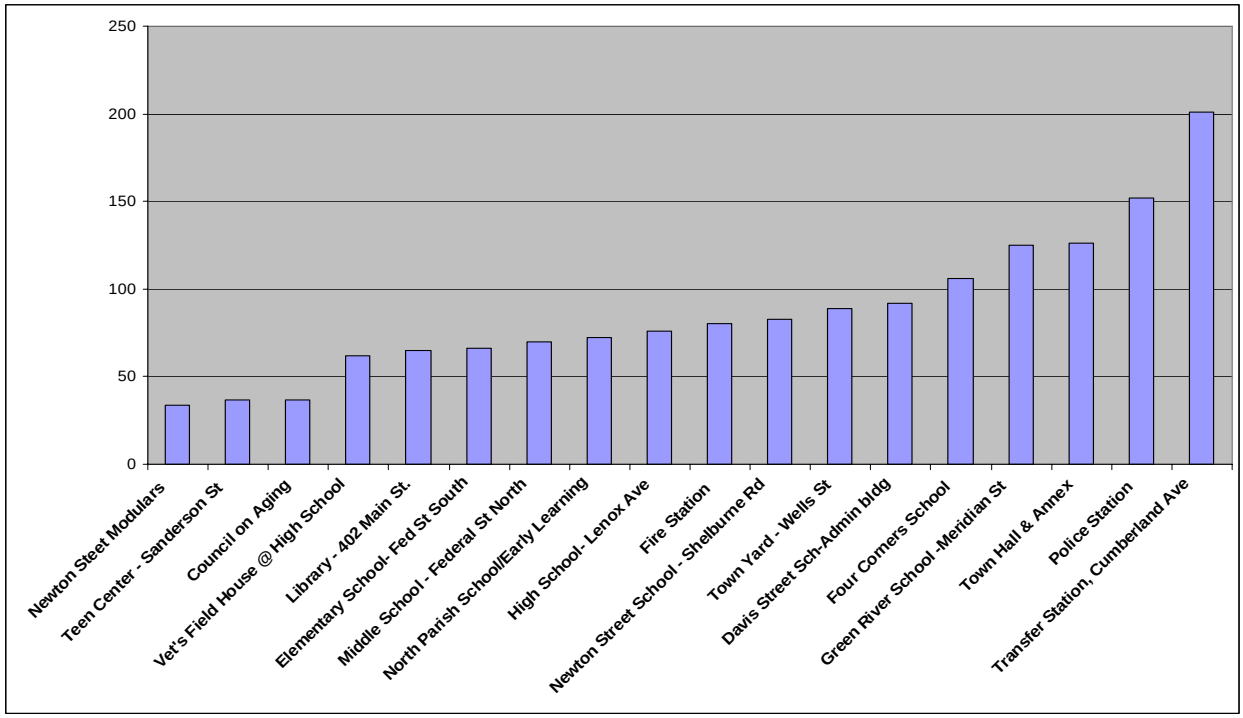


Figure 8. Town building energy use analysis: Thousands of BTUs (kBTU) per square foot. Energy use includes all energy to heat, cool and light the buildings. Note the worst building used 5 times as much energy as the best. (See Appendix 2.7 for details)

In this study we also compared energy use in FY2001 to energy used in FY2008. While, on average, energy use of the buildings as a whole did not change substantially, several of the buildings saw substantial energy reductions, but these were offset by other buildings that now use more energy than in the past. Specifically, the High School, Town Hall and Annex, Fire Station, Newton Street School, Town Yard and Police Station all cut their energy use. But the Middle School and the Federal Street Elementary School used more in FY2008 than in FY2001. See Appendix 2.15 for full details.

The Town is presently doing a deeper analysis of the energy use of its buildings. In 2007 almost all the Town's 29 buildings received a free audit from the Massachusetts Division of Energy Resources (DOER). In January of 2009, the Town learned it had been awarded a $250,000 grant from the DOER for energy upgrades. These upgrades will be done in the summer of 2009. The Town is also working with the Franklin Regional Council of Governments (FRCOG) to explore hiring an energy service company (ESCO), also known as a Performance Contractor. ESCOs offer a turnkey service of energy audits and building upgrades. Their services are paid for out of the energy savings so there is no direct cost to the Town for these upgrades. How it works is that the ESCO chosen prepares proposals for the Town's consideration on cost-effective energy

retrofits. The Town then reviews these proposals and decides which work to ask the ESCO to do, and whether it also wants to hire the ESCO to include follow-up maintenance and training in the contract.

3.2.5 Waste Management

Waste management is the big success story during the 7-year period of this study. As noted in figure 9, costs where reduced 5%, but it is the story behind this cost reduction that is interesting. Between 2002 and 2007 the tipping fees for trash disposal increased by 42%. However, the cost to Greenfield for disposing of our trash decreased by$18,420. This was made possible because:

- Total tons of trash taken to the controlled incinerator in Springfield was decreased by 2,180 tons. If we had NOT decreased our tonnage, it would have cost us an additional $161,320! (2,180 tons x $74/ton)
- Even more impressive was that the total amount of materials disposed of decreased by 1,605 tons.
- Greenfield has an excellent recycling program. Recycled tons increased by 575 tons. Overall recycling increased from 28% to 42% over the study period. Greenfield recycles paper, bottles, cardboard, construction waste, metal, cathode ray tubes, fluorescent lights, yard waste, crank case oil, paint, propane gas tanks, auto batteries and mercury.

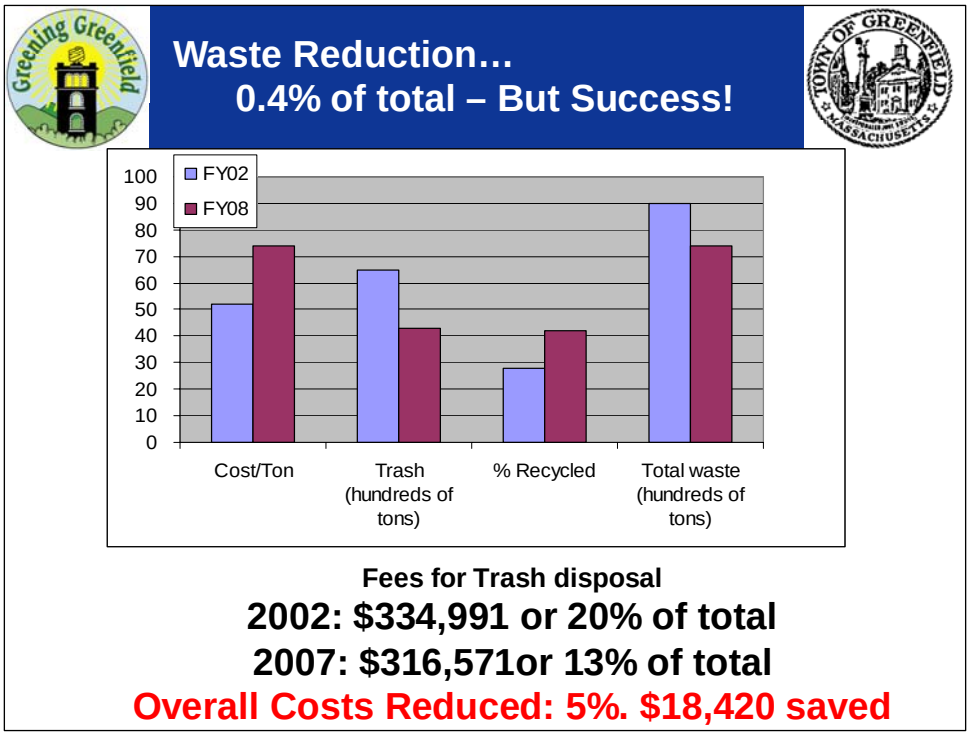


Figure 9. Waste management success story. While the trash tipping fee increased by 42% over the study period, the overall cost to Greenfield was reduced by 7% because the community reduced its trash by 33% or 2,180 tons. (See Appendix 2.8 for details)

In summary, in spite of increased cost per unit of trash, the overall costs were reduced. This is an example of how reducing use, in this case generating trash, saves money. Additionally, thousands of tons of climate change emissions were avoided by recycling, instead of disposing of waste.

This success is typical of towns that adopt pay-as-you-throw programs, where residents pay for each trash bag that they use. Greenfield adopted a pay-as-you-throw program in 2005.

While this is a great success story, there is also much room for improvement as demonstrated by the successes in other countries, such as New Zealand, which has an active Zero waste campaign, and recycling of up to 80 and 90% in many communities.

3.3 Criteria Emissions

The ICLEI software also generates information on air pollution know as criteria emissions, which can have a negative impact on health. The following graph gives an overview of that data. As noted, vehicles are the major contributor to carbon monoxide, which is an asphyxiate, and Nitrous oxide, which causes smog, which is a lung irritant. Buildings are the other notable source of air pollution. In addition to nitrous oxide, they emit sulfur oxide - the precursor for acid rain.

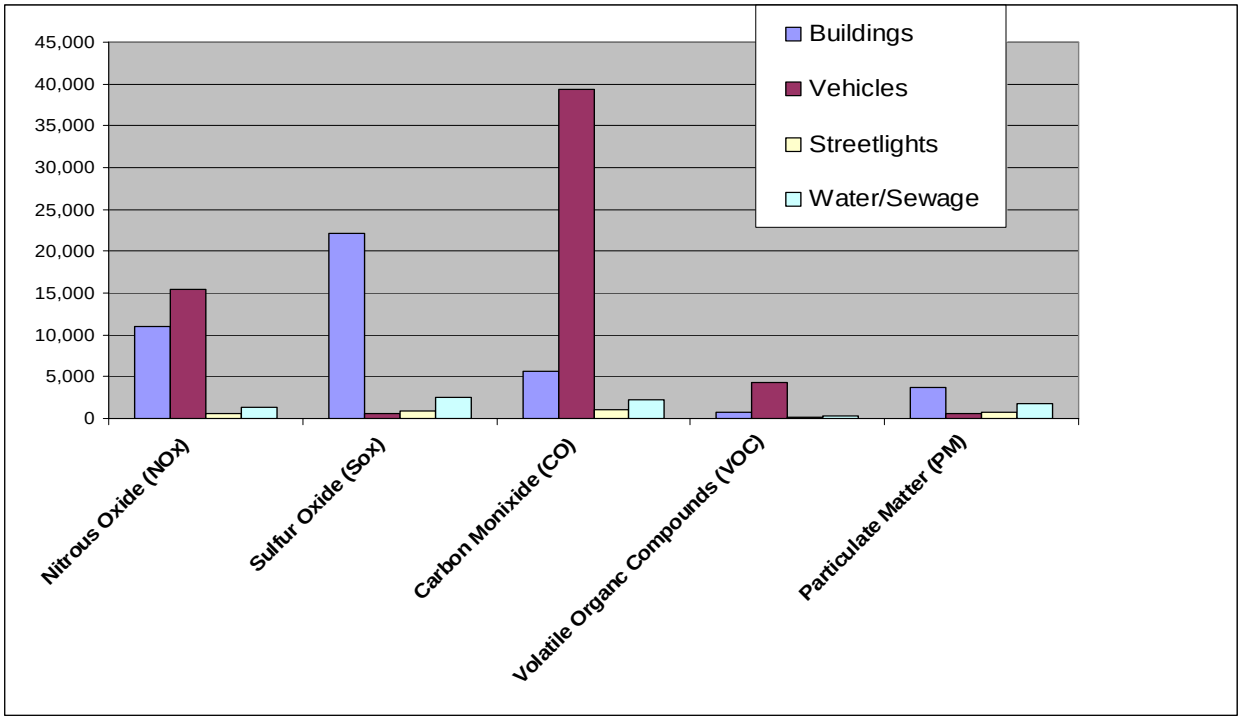


Figure 10. Pounds of emissions for EPA-regulated emissions often referred to as criteria emissions: nitrous oxide, sulfur oxide, carbon monoxide, volatile organic compounds, and particulate matter. (See Appendix 2.2 for details)

3.4 Summary

During the study period, the cost of energy used for Greenfield to heat, cool and light its buildings, run its vehicles, dispose of waste, and power its water/sewer system and street lights increased by 37%, or $645,995 to $2,357,367. Yet energy use and climate change emissions were reduced by 3%. Because of the increase in cost, the Town is highly motivated to reduce its energy use and climate change emissions.

The Town of Greenfield has already started the process of reducing its energy use. We have taken advantage of free energy audits from the DOER; we have a commitment of a $250,000

grant from the DOER for energy upgrades; we have committed funds in the FY09 budget for an energy upgrade for the transfer station; and we are receiving assistance from FRCOG so that we can explore working with Siemens Building Technologies, an Energy Service Company (ESCO) on deeper energy upgrades to our most energy-consumptive buildings. The Town has also made a commitment to purchase the most fuel efficient vehicles possible when replacing vehicles in its fleet, and recently purchased a fuel efficient vehicle for the town building inspector. Other sectors, however, need to be assessed, especially lighting, which saw a 30% increase in energy use over the study period.

Energy used for Greenfield's government operations constitutes about 2.7% of the community's total costs and climate change emissions. This is typical of most government energy use, which on average account for 2% to 4% of the total community-wide energy use. While this may appear to be a minor contributor to the total emissions, actions to reduce government energy use will keep town energy costs in check. Furthermore, government action has a value that extends beyond the magnitude of actual reduced costs and emissions because it sets an example and inspires community members to do their part in reducing the community's energy use and climate change emissions, and help build a more prosperous and sustainable community.

4. Community-Wide Energy Audit FY01 & FY08

4.1 Summary & Introduction

Figure 11. Total cost of community-wide energy use, and money leaving the community -FY2008. (See Appendix 3.11 and Appendix 3.12 for details of how this was calculated)

The most startling finding was that in FY 2008, $67.7 million left the community due to energy purchases. This is 78% of the total funds spent on energy by the community. This section of the report will focus on understanding how we came to this conclusion.
In FY2001 the community spent $48.1 million on energy. In FY2008 the community spent $85.8 million. This is a staggering 38% increase in the cost of energy in just seven years. During the same time period energy use decreased by 1-2%.

Since $85.8 million seemed like a HUGE number for a community of approximately 18,666 people, we looked at this number more closely. For example, for each person $4,638 was spent on energy either directly or indirectly by the commercial and industrial sector, and for each household that figure grows to over $10,000. For a community that has a below average mean income of $40,800, this is a tremendous burden, and a huge motivator for change.

The next question that came to mind was – how much of our money stays here, and how much goes out of the community? This lead us to explore industry standards of various fuels, so that we could calculate what stays here to pay for infrastructure, billing etc, and what goes out of the community to pay the fuel.

As in the government sector, we found cost and climate change emissions for each sector, percentage-wise, were very similar. Therefore, as with the government part of this report, we will focus on the cost, since this is more easily understood by the general public and is the greatest

motivator. Complete data in the form of charts and graphs for community-wide data for FY2001 and FY2008 can be found in *Appendix 3.*

4.2 Sources of Data

Finding information on energy use was not as straightforward as it was for the municipal energy use, which was pulled from actual bills. Please see Section 2.2.1b for an explanation of data sources.

4.3 Fuel Crazies – Understanding Fuels

It is extremely difficult to compare fuels. For example, gasoline, oil and propane are measured in gallons. Natural gas is measured in therms or cubic feet. Electricity is measured in kilowatt hours, wood is measured in both cords and tons, and coal is measured in tons. It is therefore handy to convert all fuels to a common unit. For this report, we followed ICLEI's lead and chose millions of BTUs (MMBTU). A BTU is a very small amount of energy (it is the heat that raises one ounce of water 1 degree F.) While this has little or no meaning to most people, it does enable us to create graphs that show relationships between the various fuels.

The following graph has the fuels organized by cost per MMBtu.(the pale bars) As you can see electricity is the most expensive. Natural gas is less than oil, and electricity from wind is just a bit less than gasoline, and quite a lot less than what we pay for electricity. Solar hot water is less expensive than solar electricity (photovoltaics or PV), and PV with the best possible rebates is about equal with today's electricity prices in Massachusetts.

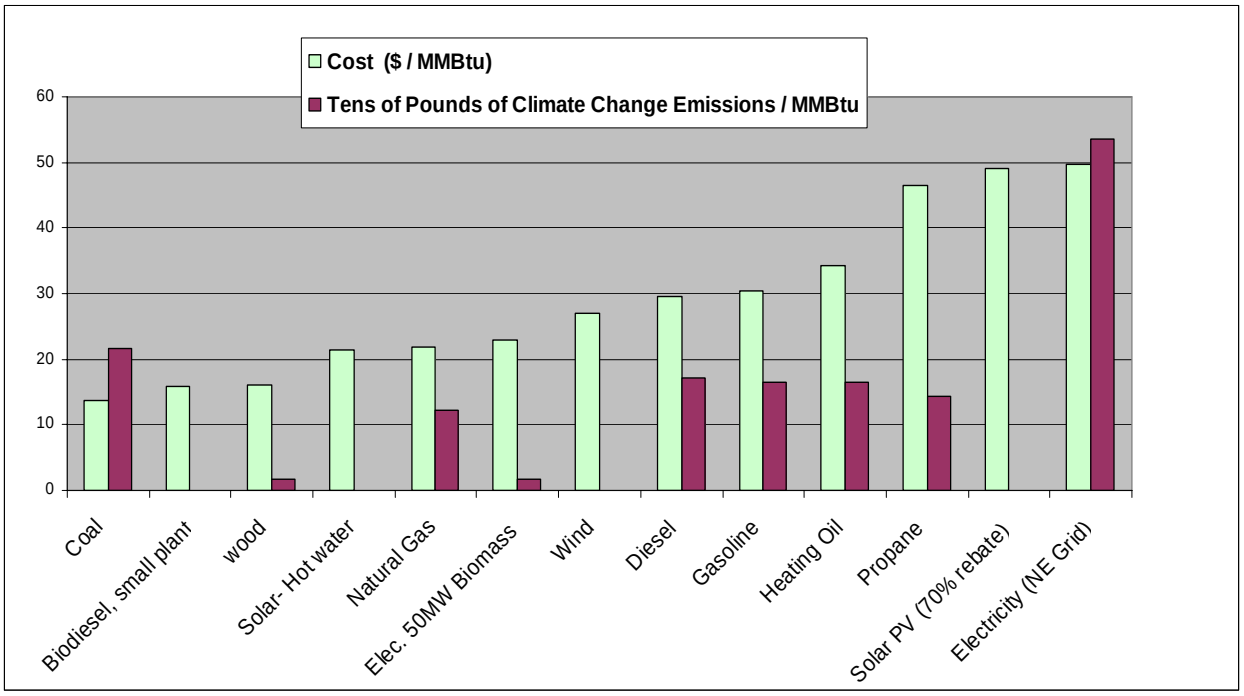


Figure 12. Making sense out of fuels: Comparison of various fuels. Cost per million BTU (MMBtu) pale bars, and tens of pounds of climate change emissions per MMBtu) dark bars. (See Appendix 3.18 for details.)

Also shown in this table is the amount of climate change emissions per fuel type. These are the dark bars. As you will see, coal is the cheapest fuel, but it is dirtier than all the primary fuels. Only electricity emits more climate change emissions than coal. This is because generating electricity is very inefficient. Only about 25-30% of the fuel can be converted into electricity. The rest of the energy is heat, which in conventional power plants is lost to the air. Today, some power plants are being built that use the waste heat. These plants are commonly called combined heat and power plants (CHP).

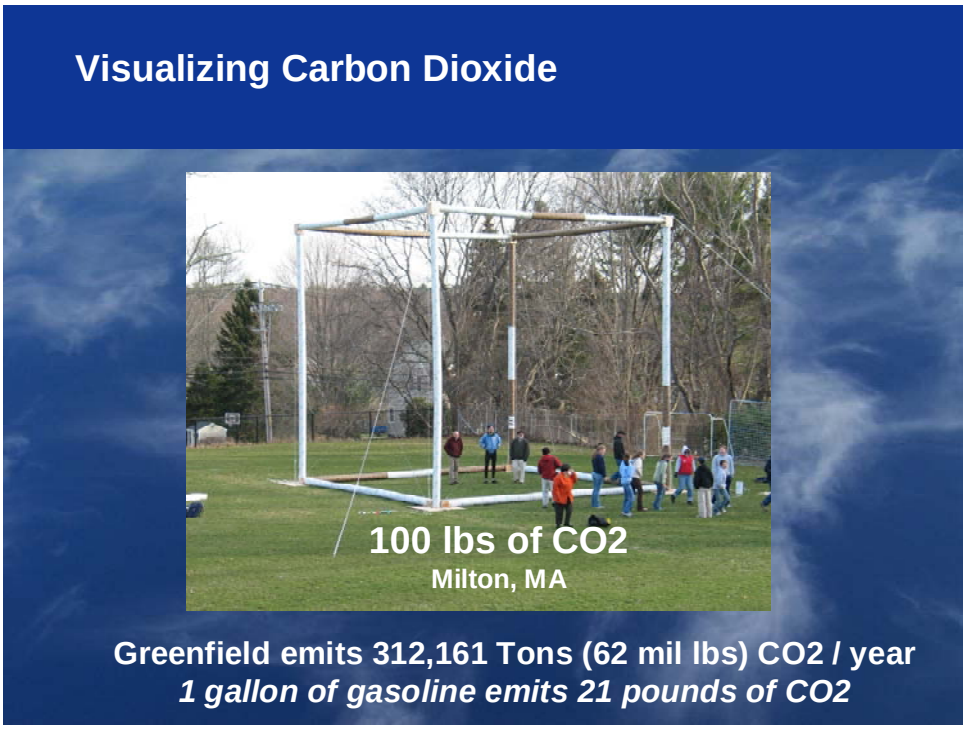


Figure 13. Visualizing carbon dioxide.

Also of note is that wind and solar emit close to zero climate change emissions. Wood (i.e. biomass) is also a very low emitter of climate change emissions. Wood is rated very low, because when growing, trees and other plants take carbon dioxide (CO_2), the major climate change emission, out of the atmosphere and give off oxygen. When we burn the wood, the CO_2 is re-released into the atmosphere. ICLEI therefore concludes that the overall CO_2 emitted from using wood is low because it consists only of the fuel used for harvesting and hauling the wood to the user.

Fuels are also not created equal in terms of how much of the cost of the fuel stays in the community and how much goes out of the community. The table below shows the industry averages for our community. The pale blue bars represent the % of the cost of the fuel that stays in the community, with the best fuel on the right. We were surprised by the huge variation!

It was interesting to note that the percentage of money spent on electricity and gas are about the same (40-44%). What these fuels have in common is that they have labor intensive infrastructures (wires or pipes) the companies have to install and maintain, as well as complex billing systems with meters in each home. Next is propane, coal, and oil. The common thread here is that locally, your dollars are supporting the delivery trucks and billing processes. As for

gasoline and diesel, the only thing the companies need to maintain are the gasoline stations, because we drive to them to pick up the fuel so only 2-5 cents per gallon stays in the community. As you might expect, wood is the clear winner with 100% of the costs staying within the larger community, supporting local forestry businesses and suppliers, unless you purchase pellets that come from far away.

It should also be mentioned that technically electricity is not a fuel. Many people call electricity an "energy carrier," because it needs to be made. In other words, we need to use a primary fuel such as coal, natural gas, nuclear, oil, wind, water, biomass (wood), landfill gas, or solar to produce it. One of the great advantages of electricity is that it can be produced from many different sources, many of which could emit zero climate change emissions and that it can be used for many different functions including lighting, electronics, motors for pumping etc. or cars, and heating when using air-to-air heat exchangers, geothermal heat pumps, or resistance heat.

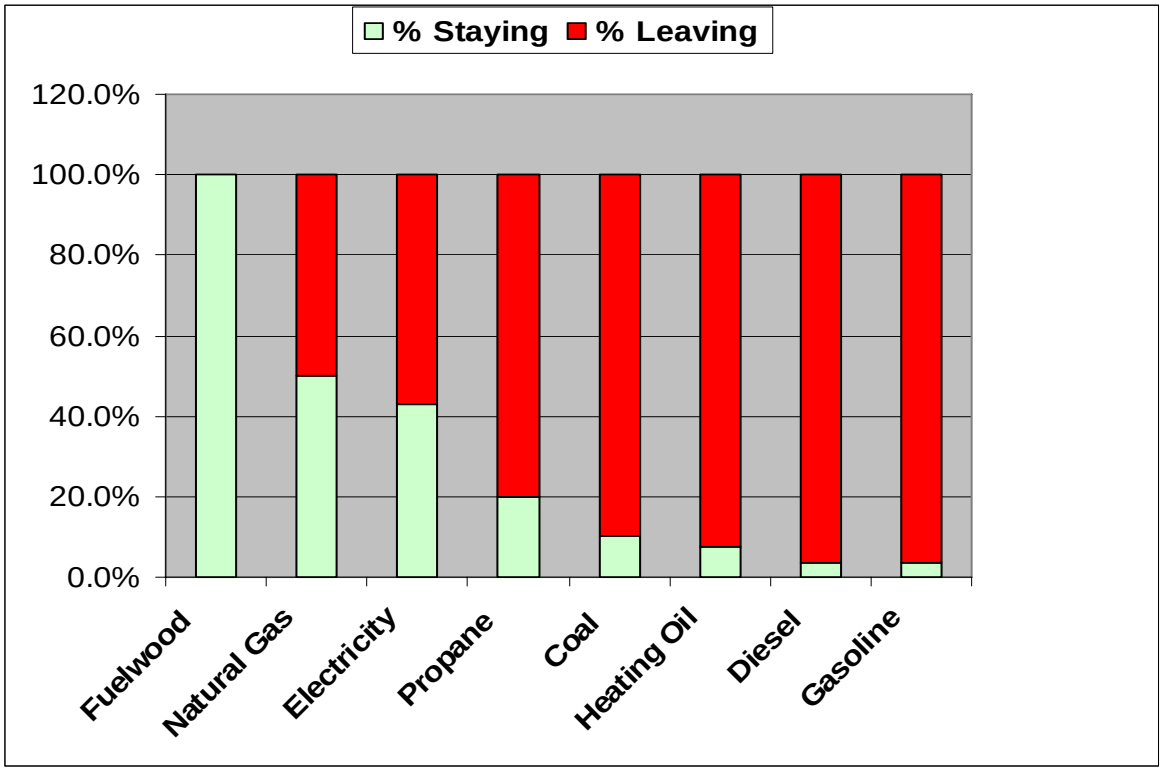


Table 14. Making sense out of fuels. Comparison of various fuels showing what percentage of the fuel cost stays in the community and what goes out to pay for the fuel. Firewood is the best, followed by natural gas and electricity. Gasoline and diesel fuel are the worst, with only 2-5 cents per gallon staying in the community. (See Appendix 3.18 for details.)

4.4 Analyzing Fuel Use: Fuel Cost by Sector – FY2008

In analyzing the cost of our energy use, we found that energy use was nearly evenly divided in thirds. One third is used by the residential sector to heat, cool, and light their homes. One third is used by the commercial and industrial sector for heating, cooling, and lighting their buildings and for operations. The final third is used for transportation. While we attempted to find out approximately how much of the transportation energy was used by businesses, and how much was used by the general public, we were unable to get this information from the Registry of

Motor Vehicles, although it was promised several times. The Franklin County Energy Study (1977) assumes that 75% of the energy used for transportation is used by the general public.

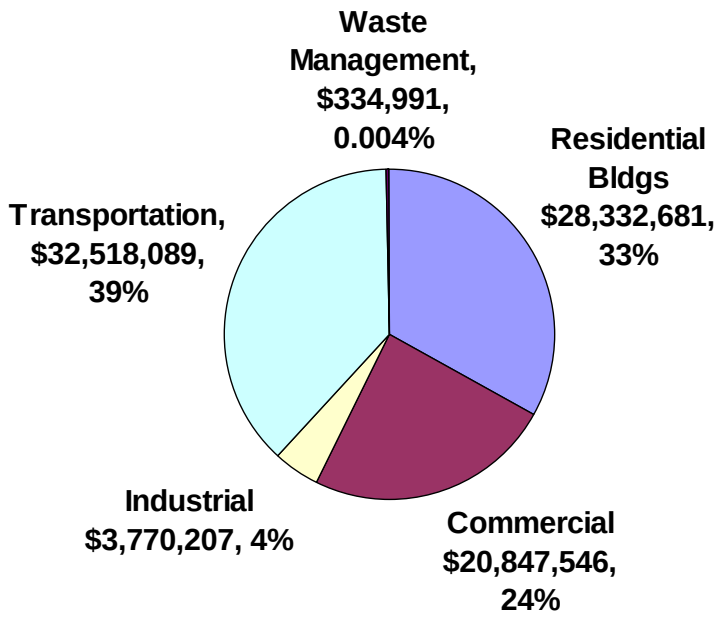


Figure 15. Greenfield energy costs are approximately one third each: residential, commercial/industrial and transportation. Transportation is a mix of residential and commercial. Cost and percentages by sector (FY2008). (See Appendix 3.2 for details.)

4.4.1 Residential Building Energy Use

In looking more closely at residential building energy costs, we discovered that residential usage was 56% of the total building energy use.

Understanding what fuels we use in the home. Figure 16 shows that we are heavily dependent on oil to heat our homes. If you recall the cost per MMBtu graph, we learned that in 2008 oil was more expensive than natural gas, and that a much larger percentage of the cost of oil goes out of our community. Additionally, oil prices are more volatile than gas and electricity prices. This makes us particularly vulnerable to oil price shocks. Interestingly, the Northeast uses about 80% of all the heating oil in the nation.

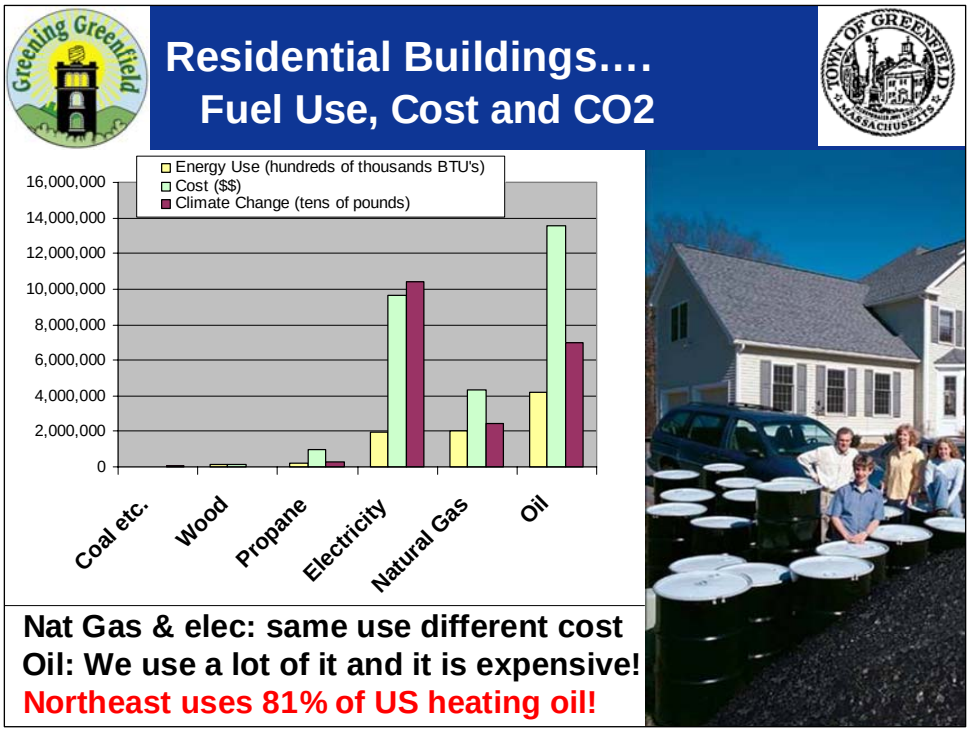


Figure 16. Residential sector. Fuels used to heat, cool, and light our homes: Energy use, cost, and climate change emissions. Note our heavy reliance on oil for heating. Remember that only about 10% of the cost of oil stays in the community compared to natural gas where 40% stays in the community. (See Appendix 3.5 for details.)

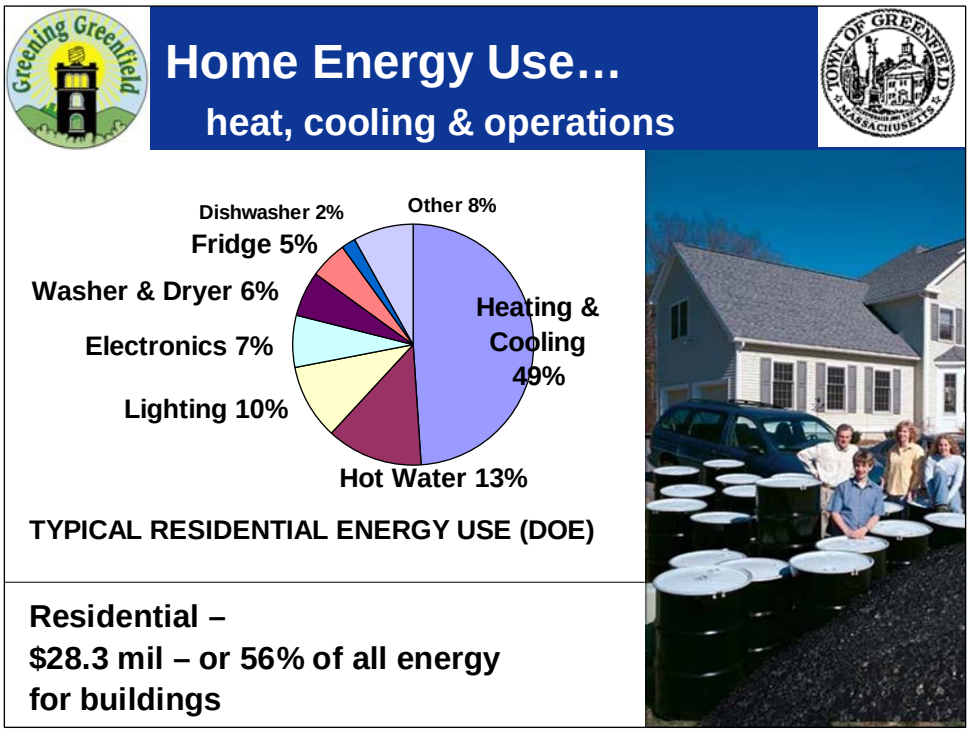


Figure 17. How energy is used in our homes nationally (Source: USDOE). (See Appendix 3.5 for details.)

Learning How to Reduce Your Energy Cost - Finding the Information and Funds: The Greening Greenfield Energy Committee (GGEC) offers workshops for homeowners on how to find free energy audits from the utility companies, and how to apply for utility rebates of up to $2,000 for

insulating and air sealing. GGEC also offers information on how to find zero or low interest loans, from utility companies, USDA and others for energy retrofits, and federal tax credits.

Understanding how energy is used in the home - To help residents better understand their energy use, Figure 17 from the US Department of Energy (DOE) shows where energy is typically used in a home. Since Europeans and Japanese use less than half the amount of energy that we use per person, we know that we can greatly reduce our home energy use.

4.4.2 Commercial and Industrial Buildings and Operations

Since the Commercial and Industrial building sector energy use also includes business operations, it is difficult to draw conclusions from the data show in Figure 18. However, we know that savings can be made. The Greening Greenfield Energy Committee (GGEC), the Franklin County Community Development Corporation (CDC), the Chamber of Commerce, and the Center for Ecological Technology (CET) have joined together and are offering workshops, support, and incentives for businesses so they can find the tools and resources to help them lower their energy costs. For more information on workshops, businesses should contact the CDC. The best on-line resources we have found are offered by the Massachusetts Department of Energy Resources (DOER).

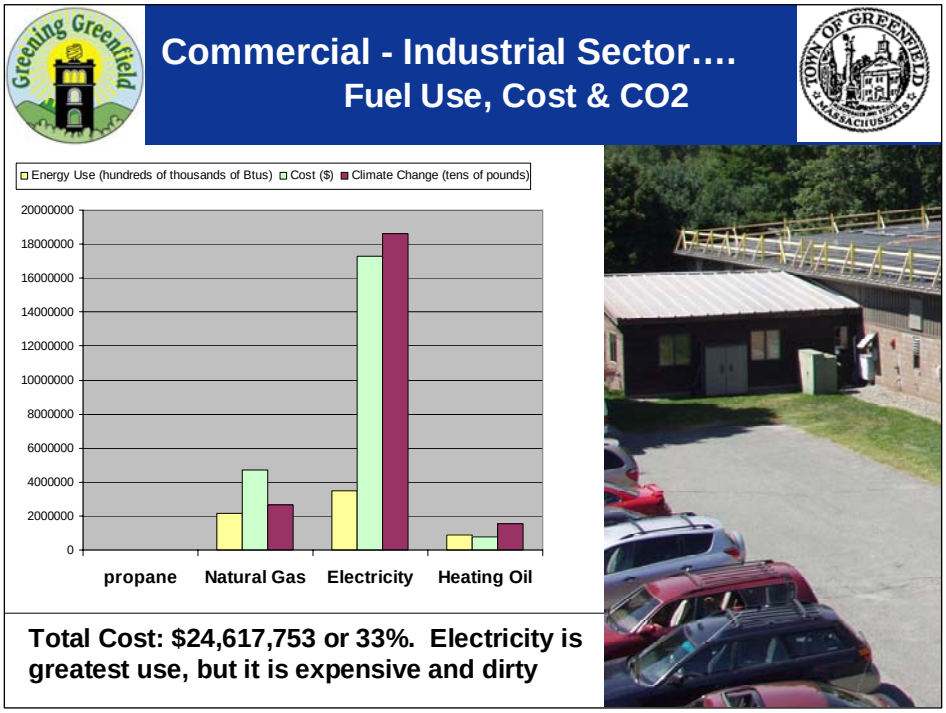


Figure 18. Commercial and Industrial sector: fuel use, fuel cost and climate change emissions. This graph shows that the commercial / Industrial sector in Greenfield is heavily reliant on electricity. Data for propane was not available. (See Appendix 3.6 for details.)

4.4.3 Transportation

In 2008 the community spent $32.5 million on transportation to travel approximately 152 million miles – almost all the way to the sun and back! Of this, approximately 93% of the miles driven were by cars, SUV, and pick-up trucks. As a community, we own almost 14,000 vehicles. The Pioneer Valley Planning Commission (PVPC) estimates that we each drive approximately 11,000 miles per year, which is 1,000 miles less than the national average of 12,000 miles.

Unfortunately, we were unable to get data on whether the private sector or commercial and industrial sectors used these vehicles, but The *Franklin County Energy Study* estimates that approximately 75% of the fuel used for transportation is used by residents.

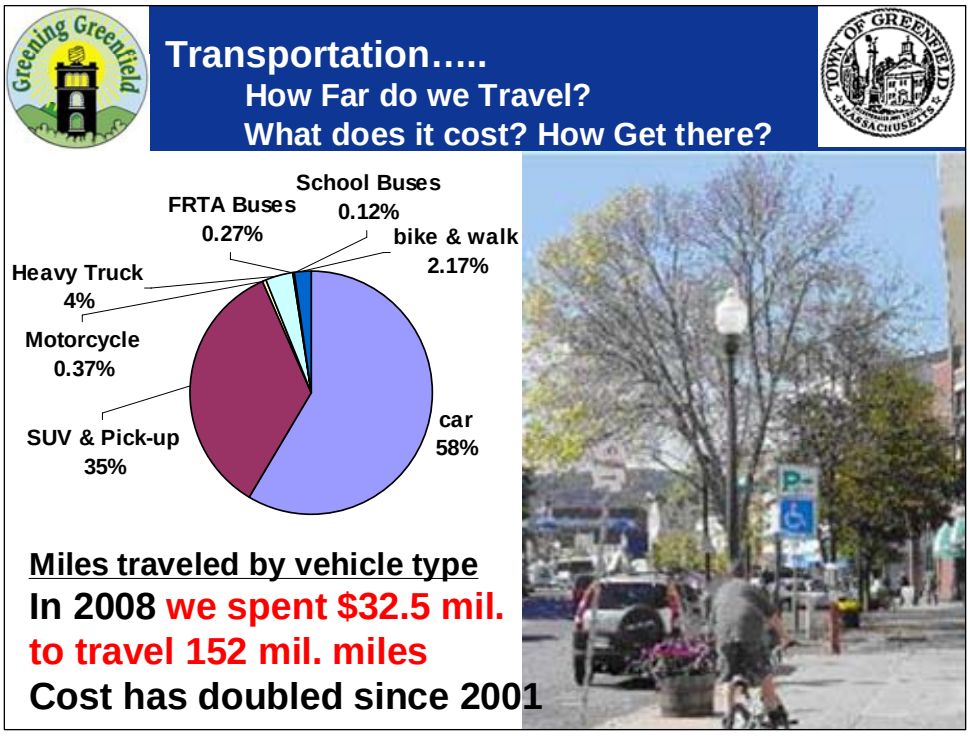


Figure 19. Percentage of miles traveled by vehicle type in 2008. (See Appendix 3.8 for details.)

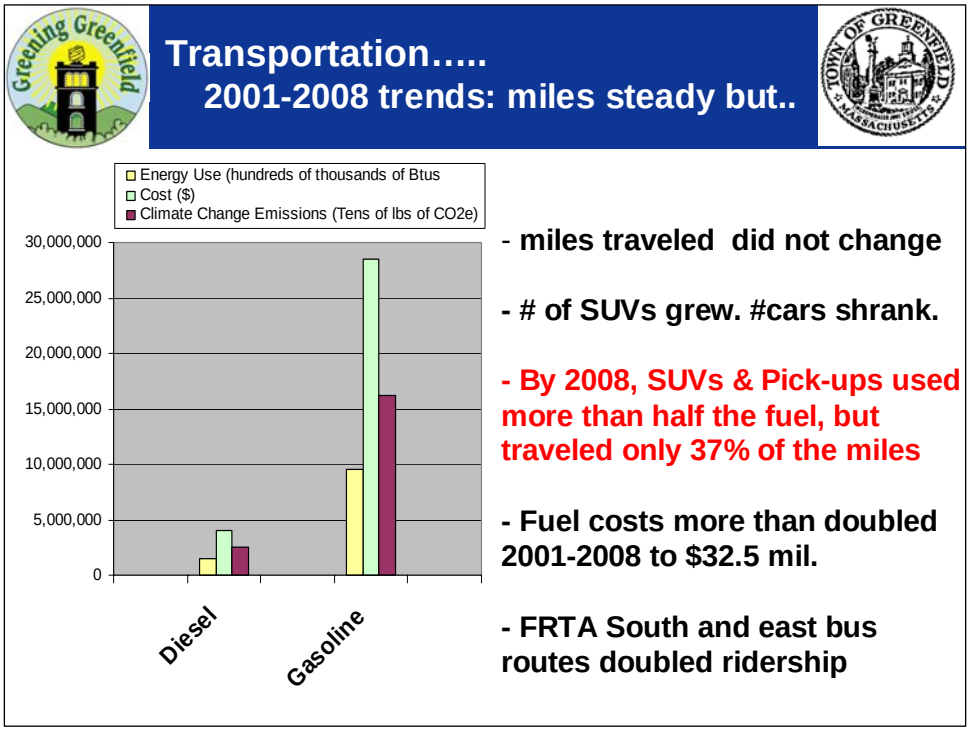


Figure 20. Transportation fuel use and car vs. SUV & pick-up trends Over the study period, SUVs and pick-ups have increased in numbers so that today they use more than half of the fuel, but travel less than 37% of the miles. (See Appendix 3.7 for details.)

We did, however, receive excellent data on mass transit and in-town vehicle use from the Franklin Regional Transit Authority (FRTA) and the Franklin Regional Council of Governments (FRCOG). The good news is that last year, ridership doubled on two of our bus routes - the ones that went east and south. Our ability to get good data on mass transit use and on the number of vehicles traveling on our in-town streets will be useful when setting goals and measuring progress in the transportation sector.

Overall, the most important driver to increased fuel costs is that fuel costs almost doubled during the study period from $1.72 in FY01 to $3.45 in FY08. While the cost of gasoline and diesel fuel has come down in the last few months, it is likely to go up again in the near future.

We also looked at vehicle types used in 2001 and 2008 using data on vehicles registered in Greenfield from the Registry of Motor Vehicles. We discovered that, much like the rest of the nation, many of us have shifted from cars to SUVs or pick-ups. In 2008, SUVs and pick-ups used more than half of the fuel used for cars and SUVs/Pick-ups combined, but they only traveled 37% of the miles. Overall, the number of vehicles owned in Greenfield, and by inference the number of miles traveled, did not change much over the study period.

4.5 Calculating $$ Spent on Energy Going Out of Our Community

Figuring out how much of our energy dollars were staying in the community and how much was going out was a three step process.

Step #1: As noted in section 4.3, the first step is to understand the industry averages of how much of the money we spend on a particular fuel stays in the community or leaves it.
Step #2: We calculated the total amount of fuel we used of each type, and who used it.

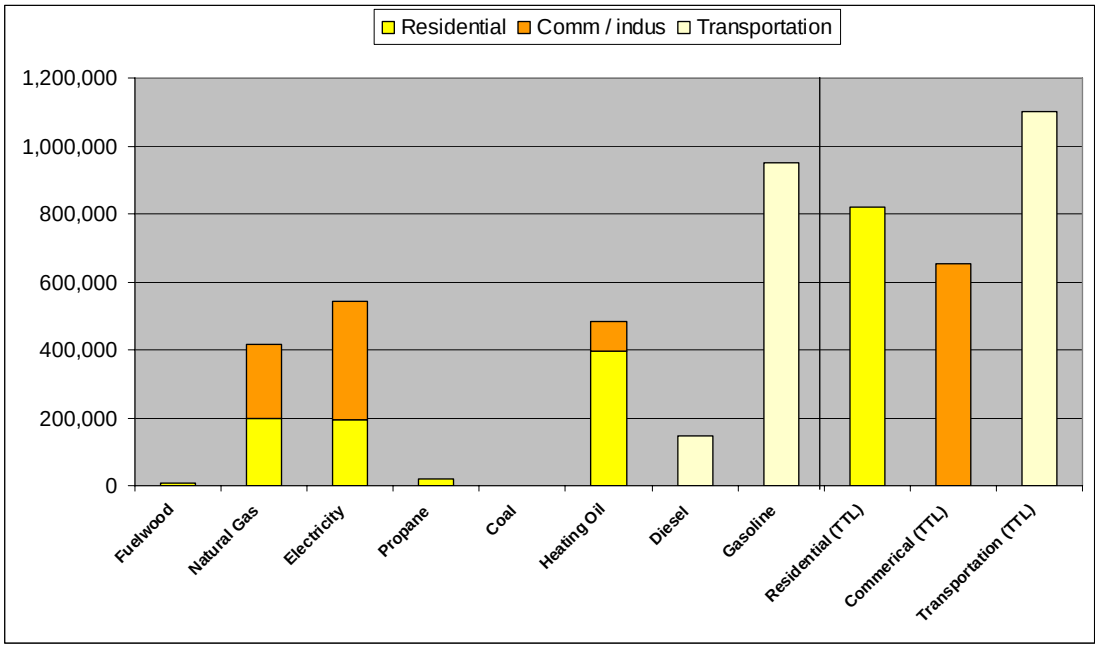


Figure 21. How much fuel Greenfield uses by fuel type and sector. FY2008. Note transportation uses more energy than the other sectors. Residential uses most of the heating fuel, and the commercial/industrial sector uses mostly electricity and gas. (See Appendix 3.10 for details.)

Step #3: Calculate how much money stayed in our community, and how much left by fuel type.

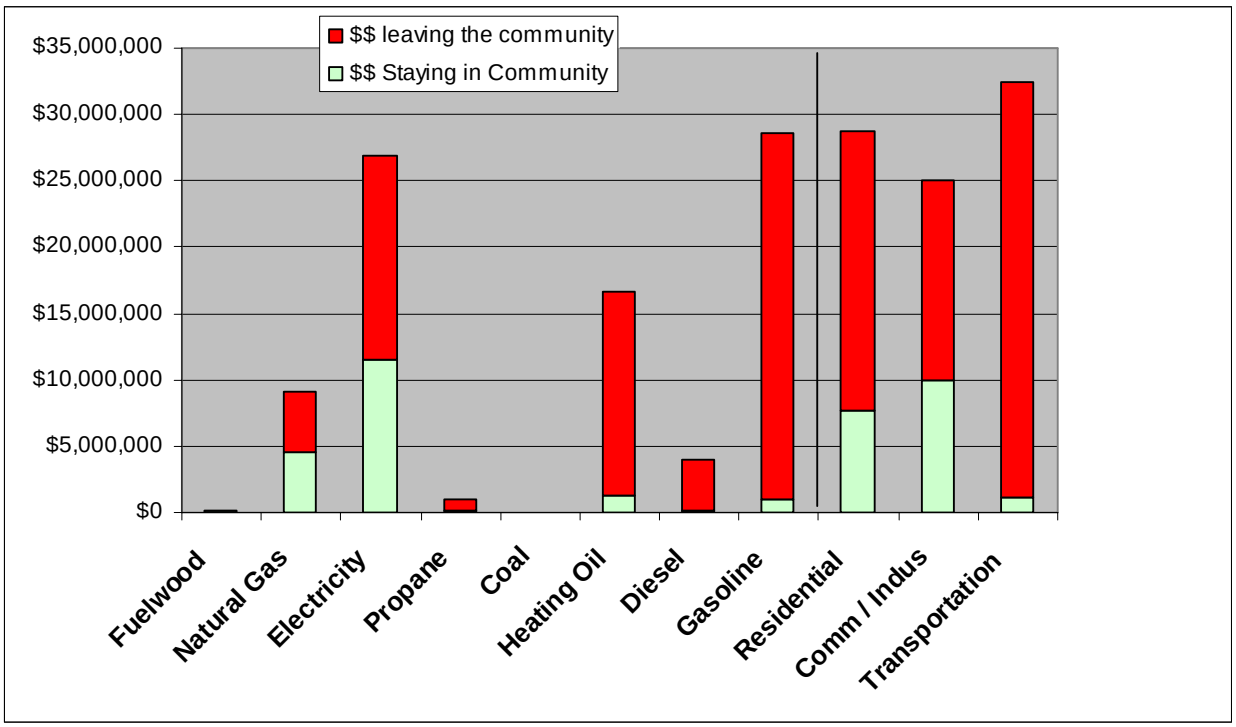


Figure 22. Money staying vs. leaving our community by fuel type and sector. You can clearly see that transportation not only uses more energy, but it is the largest cause of funds going out of the community. Heating oil and electricity are tied for the second place as the worst fuels, but a much larger portion of the money spent on electricity stays in the community (44% vs. 10% for heating oil). (See Appendix 3.11 and Appendix 3.12 for details.)

In looking at these charts, we can draw the following conclusions:

- We use more gasoline than any other type of fuel, and it is the largest cause of funds going out of our community because only about 3.5% of the funds spent on purchasing gasoline stays in the community.
- Approximately an equal amount of funds go out of our community for electricity and heating oil, but we use a lot less heating oil than electricity. The negative fact that only 7.5% of the cost of heating oil (as opposed to 44% for electricity) stays in our community illustrates how heating oil is not a good fuel to use from the perspective of dollars staying in our community.
- We can now compare natural gas and heating oil use side by side. We see that we presently use about twice as much oil as natural gas. As mentioned above, the heating oil has a greater penalty of sending money out of our community.
- Firewood: While 100% of the money spent on firewood stays in our region, in comparison to other fuels, we don't use that much, so the amount that stays here from the use of wood is miniscule. I might add that wood use is the most difficult of all the fuels to measure with accuracy, since there are many suppliers, and the amount used per household varies hugely.

- While propane, coal and diesel fuel tend to send large percentages of money spent on them out of the community, they are not of great concern because we presently do not use very much of them. But it is clear that increasing their use would not be a good thing because only a small percentage of the cost of these fuels stay in the community.

4.6 Total Climate Change Emissions by Fuel Type and Sector

It is also instructive to look at the source of our climate change emissions. As illustrated in Figure 23, while we use more gasoline than any other fuel, electricity now dominates as the problem. If climate change emissions are looked at from a sector perspective (bars on the right) climate change emissions are spread fairly evenly between residential, commercial/industrial and transportation.

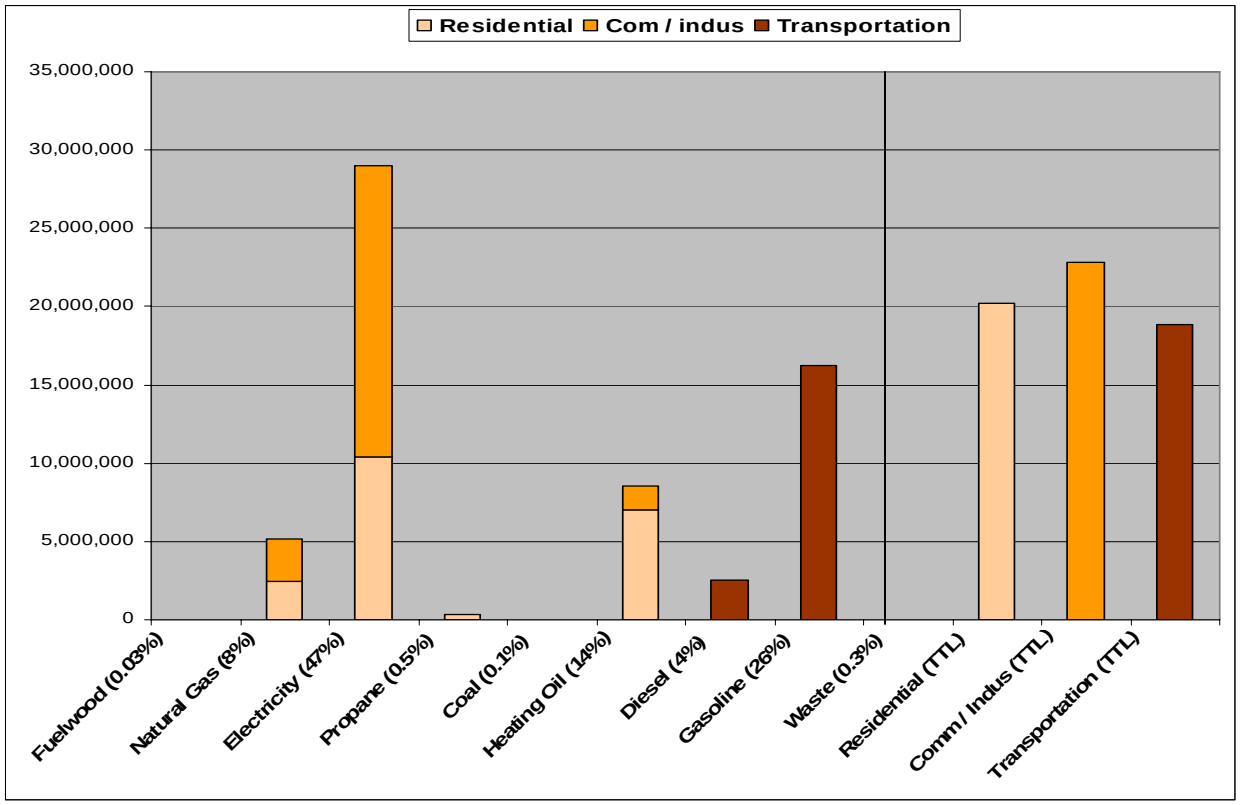


Figure 23. Climate change emissions by fuel type, and by sector. Electricity emerges as the largest problem (Emissions based on statistics for the New England utility grid). As for which sector produces climate change emissions, it is evenly spread between the three major sectors. (See Appendix 3.16 for details.)

4.7 Electricity – Understanding How it is Made

To understand the climate change emissions, and cost and availability of electricity, we need to look at how our electricity is made. Figure 24 shows how Western Massachusetts Electric Company (WMECO) makes our electricity. As you can see, natural gas is our major source, which has volatile prices and demand is exceeding supply. It does have the advantage that it is relatively clean, and that plants can be turned on and off rapidly. Nuclear is the second largest sector. This electricity is expensive, but it does not emit CO_2. Coal is inexpensive, but emits large amounts of CO_2. And oil is expensive, prices are volatile and supply could be disrupted. Presently only 6.8% of our electricity comes from renewable energy sources, which are the most

secure, from both a supply and price perspective. Locally, we generate quite a lot of energy from hydro, but this is dumped into the grid and shows up as only 2% of the total WMECO energy mix. In fact, in Franklin County there are several hydro plants that collectively are rated at 110 Megawatts, which is over twice as much capacity an is needed to meet the County's electrical needs. (See Appendix 6a for details.)

Figure 24 shows our present electrical use. Figure 25 is a chart published by Worldwatch Institute in 2008 of what the US electrical grid could look like in 2030 if we used as much sustainable energy as possible. Sustainable energy is made from sources that are not depleted when used (are renewable), and do not poison our environment, or emit climate change emissions. This scenario would dramatically improve our electrical energy security, stabilize energy prices, and reduce climate change emissions by 90%. Additionally, since most of our electricity would be produced domestically, it would keep almost 70% of our energy dollars in the USA.

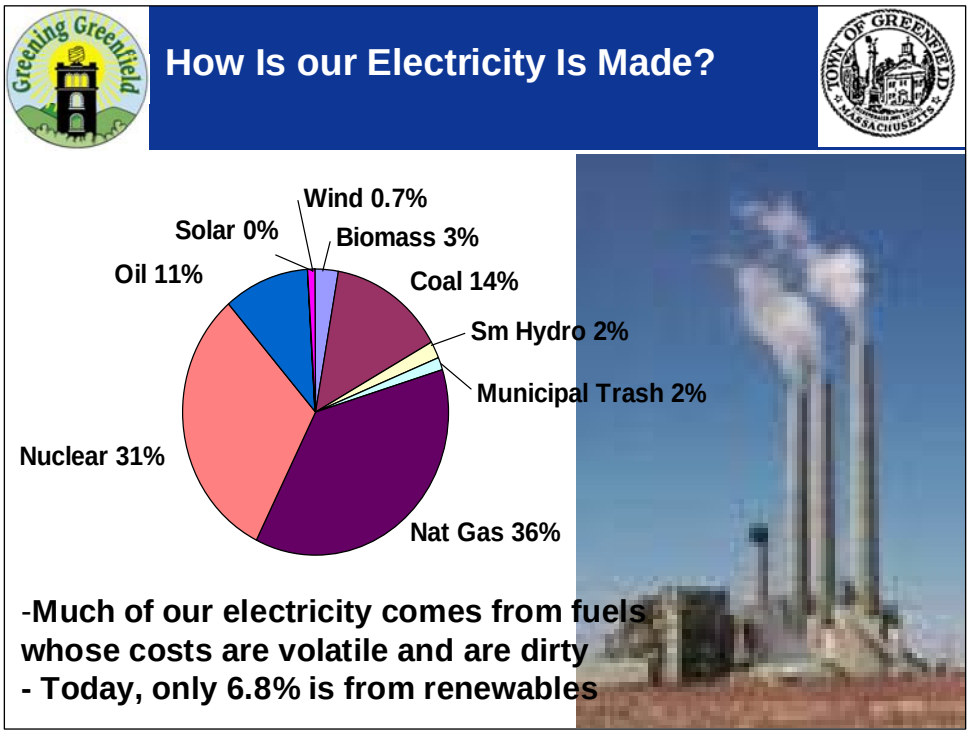


Figure 24. WMECO Electricity Sources 2008.

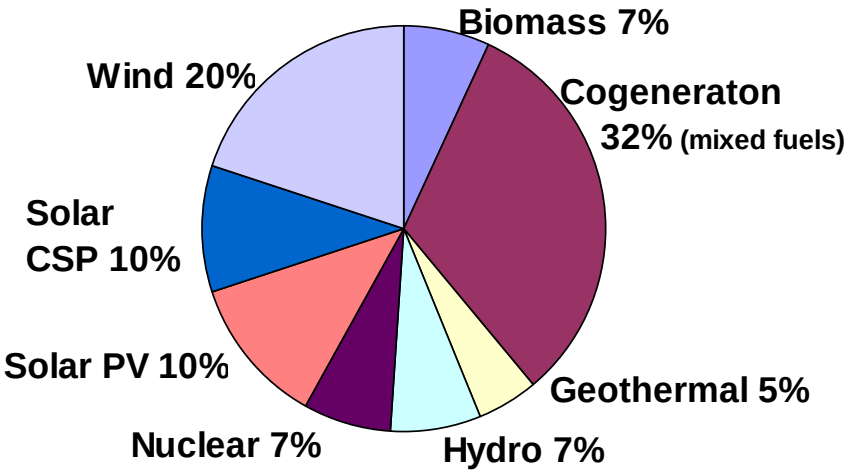


Figure 25. Projected electricity sources, 2030. Source: Worldwatch Institute, Low-Carbon Energy: A roadmap.

4.8 Air Pollution and Health Care Costs

The ICLEI software also calculates emissions regulated by the US Environmental Protection Agency (EPA). As you will see in Figure 26 carbon monoxide emissions from transportation dwarfs other emissions. However, small amounts of nitrous oxide and sulfur oxide have large health impacts.

Health Care Without Harm, a national organization that works primarily with hospitals, calculates the emissions from Greenfield's electrical generation alone will cost us over half a million dollars in direct costs for medical expenses and an additional $5.4 million dollars each year in society costs due to respiratory diseases, hospital visits, lost work, and medical expenses due to premature deaths.

Carbon monoxide is an asphyxiate. Nitrous oxides cause lung irritation and asthma when sunlight converts it to ground level ozone, and it causes acid rain. Sulfur oxides affect breathing, respiratory illnesses, alter pulmonary defenses, and aggravate existing cardiovascular disease. Particulates cause lung irritation and lung cancer. People most at risk are asthmatics and, individuals with cardiovascular disease or chronic lung disease, such as bronchitis or emphysema. Additionally, mercury emissions from coal-fired power plants is a known neurotoxin, and may be a carcinogen. The highest risk is for pregnant women. In unborn children it can cause brain damage, mental retardation, blindness etc. Direct medical expenses cost us 0.34 cents / kwh. Societal value is calculated as 3.4 cents/kwh. (Source: Health Care Without Harm.)

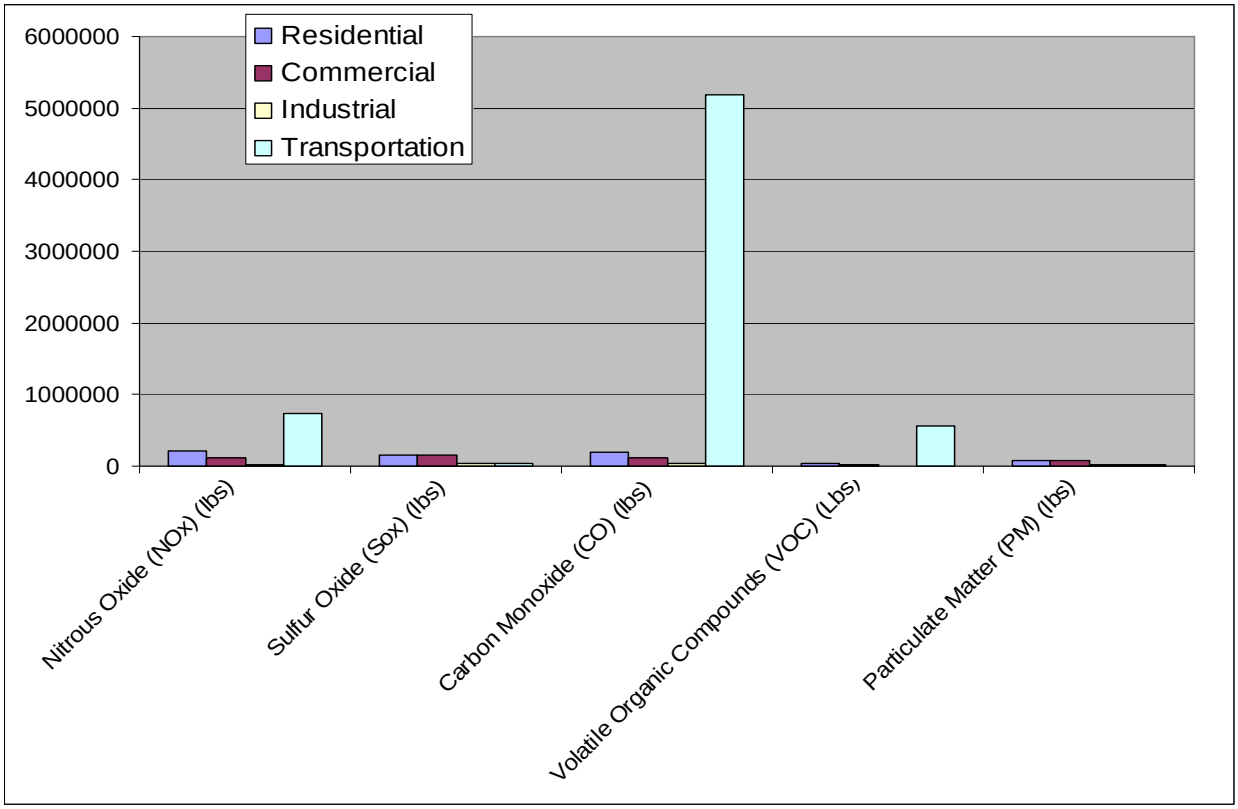


Figure 26. Criteria Air Pollutants from our Energy Use. Emissions from our energy use, in addition to climate change emissions. Health Care Without Harm calculates that our emissions from our electrical use only causes direct expenses of over $500,000 each year, and an additional $6.4 million per year in societal costs due to respiratory diseases, hospital visits, lost work, and premature deaths. (See Appendix 3.17 for details.)

4.9 Summary – Community-wide

During the study period, the cost of energy used to heat, cool, and light our homes, run commercial and industrial businesses, and fuel our cars and transit system increased by $38 million from $41.5 million in FY2001 to 85.8 million in FY2008. In FY2008 alone, over $67 million left our community because of our dependence on fossil fuels from outside our region and other countries.

Fuel use is fairly evenly divided among the three sectors mentioned above. In order to understand how much money leaves the community, we need to understand the characteristics of each fuel. We discovered that gasoline and diesel were the worst with only about 3.5% of the cost staying in the community. Next was oil, coal, and propane, with about 10-30% staying in the community. Natural gas and electricity were better, with 40-44% staying in the community respectively. The clear winner was biomass (wood), where 100% is likely to stay in the region. We also need to understand their relative costs, and which fuels emit the greatest amount of climate change emissions and criteria emissions that cause health problems.

Given these facts, gasoline emerges as not only one of the most used fuels, but its purchase also causes the greatest amount of money to leave the community. Heating oil used by residents also emerges as a fuel that is expensive to the user, and its purchase causes a significant amount of money to leave our community. Electricity emerges as the largest cause of climate change emissions, which is frustrating since Franklin County produces more than twice as much

electricity from hydropower than it uses, but it is sold to the New England grid. Greenfield is also incurring expenses to care for people who become ill because of air pollution caused by our energy systems. Given the fuels that we use, and that generate our electricity, we vulnerable to fuel price spikes and fuel supply interruptions.

Addressing this issue and reducing our energy use is a huge challenge. It requires that each person in the community focus on this problem and make personal changes. We know that Europe and Japan use less than half of the energy that we use, while at the same time maintaining a high quality of life, but making those changes are difficult. For example, cutting transportation use might require moving closer to work and play, or relying on a public transit system that is presently very sparse. Making major energy use reductions in our homes or businesses is out of the control of most people who rent. For people who own their own homes, or businesses that own their own buildings, it can be daunting task. Free utility energy audits and subsidies can help with the analysis and energy retrofitting for 5%-15% energy reductions, but are not adequate for the deep energy reductions of 40%-90% that we need.

At a minimum, it takes motivation, a vision of a better life, money, mentors, information and perseverance. Fortunately, there are already many organizations in the region working on these issues. **However, it will take nothing short of a community-wide effort, with everyone helping each other and working together, to make the changes that we know we must make.**

5. Greenfield/ICLEI Step #5: Setting Goals

Because of the findings of this report, on January 15, 2009 Mayor Forgey announced the following visionary goals for 2050:

- ZERO energy dollars spent by Greenfield residents will leave the region by 2050.
- Cut climate change emissions by 80% by 2050

Mayor Forgey said "It is in Greenfield's best interest to keep our hard earned dollars in our community. At first glance, this may seem like an impossible task, but I believe we can do it if we position ourselves to do so. Greenfield can take the lead for the region --- expanding local economic growth while protecting the environment makes good sense."

6. Greenfield/ICLEI Step #6: Assessing Options and Setting Milestones

This step involves assessing our options and establishing a time line with specific milestones. Following is a compilation of ideas that came out of the process of writing *The Greenfield Energy Audit*, as well as ideas put forward in both formal and informal settings by many organizations This report does not intend to take ownership of these ideas, it merely aggregates some of the major ideas and puts them in one place to facilitate the assessment and milestone-setting process.

We relied heavily on the work of the Pioneer Valley Clean Energy Plan (PVCEP) co-authored by the Pioneer Valley Planning Commission (PVPC) and the Franklin Regional Council of Governments (FRCOG) in 2008, and the Franklin County Energy Task Force and its 1977 Franklin County Energy Study. We also relied heavily on organizations, businesses, governments and individuals in the region working on these issues such as Greening Greenfield Energy Committee, Coop Power, Communities in Supporting Agriculture (CISA), Franklin County Community Development Corporation (CDC), Greenfield Redevelopment Authority (GRA), FC Chamber of Commerce, Greenfield Business Association (GBA), Community Action, Franklin County Home Care Corp (FCHCC), to name a few. There are too many businesses to name them here.
We will use a three pronged approach to asses if actions will achieve our goals by asking the following questions.

- 1. Will it reduce the amount of energy we use? ("doing more with less")
- 2. Will it produce zero carbon energy locally and renewably?
- 3. Is there a game-changing idea or technology that can help us achieve our goals?

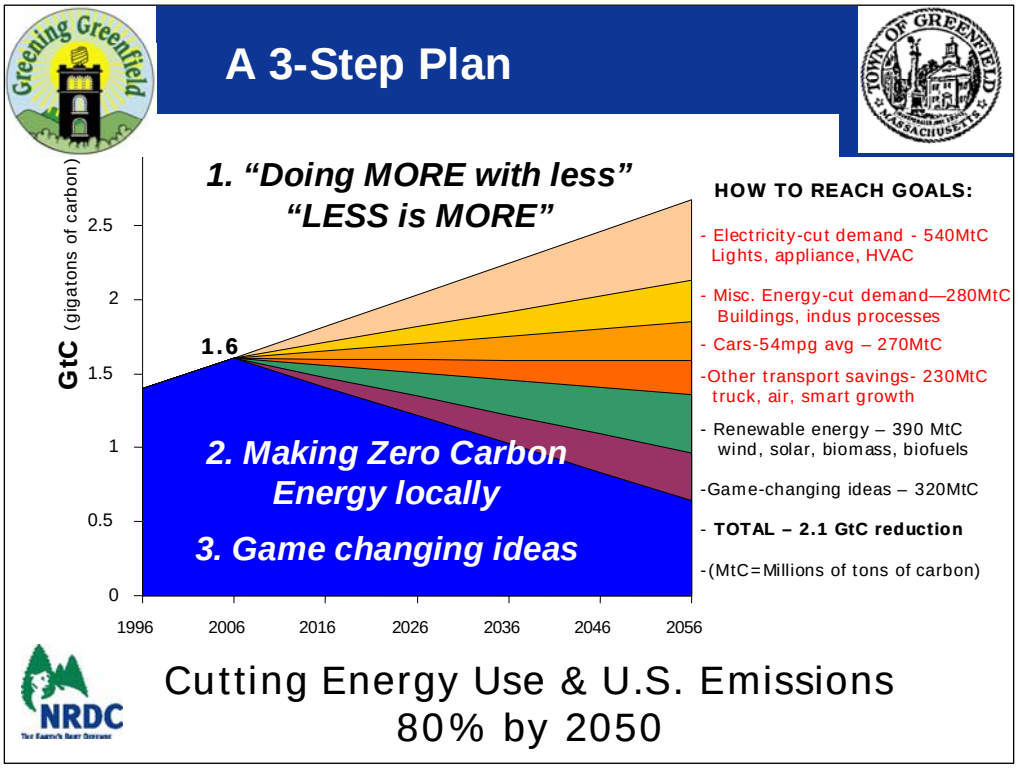


Figure 27. Our 3-step plan. 1. Doing more with less, 2. Making zero carbon energy, and 3. Examining game-changing ideas.

It cannot be repeated often enough that the first strategy, reducing our energy use, is absolutely necessary - and it is the most cost effective action of our three pronged approach. Remember that Europe uses only half the energy we use on a per person basis. Additionally, the Swiss believe they can reduce their energy use by another 80% by 2050. If we follow their lead, we could reduce our energy use by 90%. This in turn would greatly reduce the amount of zero carbon energy that we will need to produce.

6.1 Can We Afford To Invest in Green?

Recent studies, such as the McKinsey Report (2007) and a recent report by Dr. Robert Pollin, UMass Economist, make the case that not only can we afford it, it is the best possible investment that we can make. In fact, investing in "green" will stimulate and grow the economy. The recent rise in the cost of fossil fuels and the national and global economic crisis has given us the motivation to re-look at how we use energy.

We can do it – has become a slogan made popular by recently elected President Barack Obama. For evidence that we CAN do it, lets note that Europe and Japan use less than half the amount of energy we use on a per capital basis.

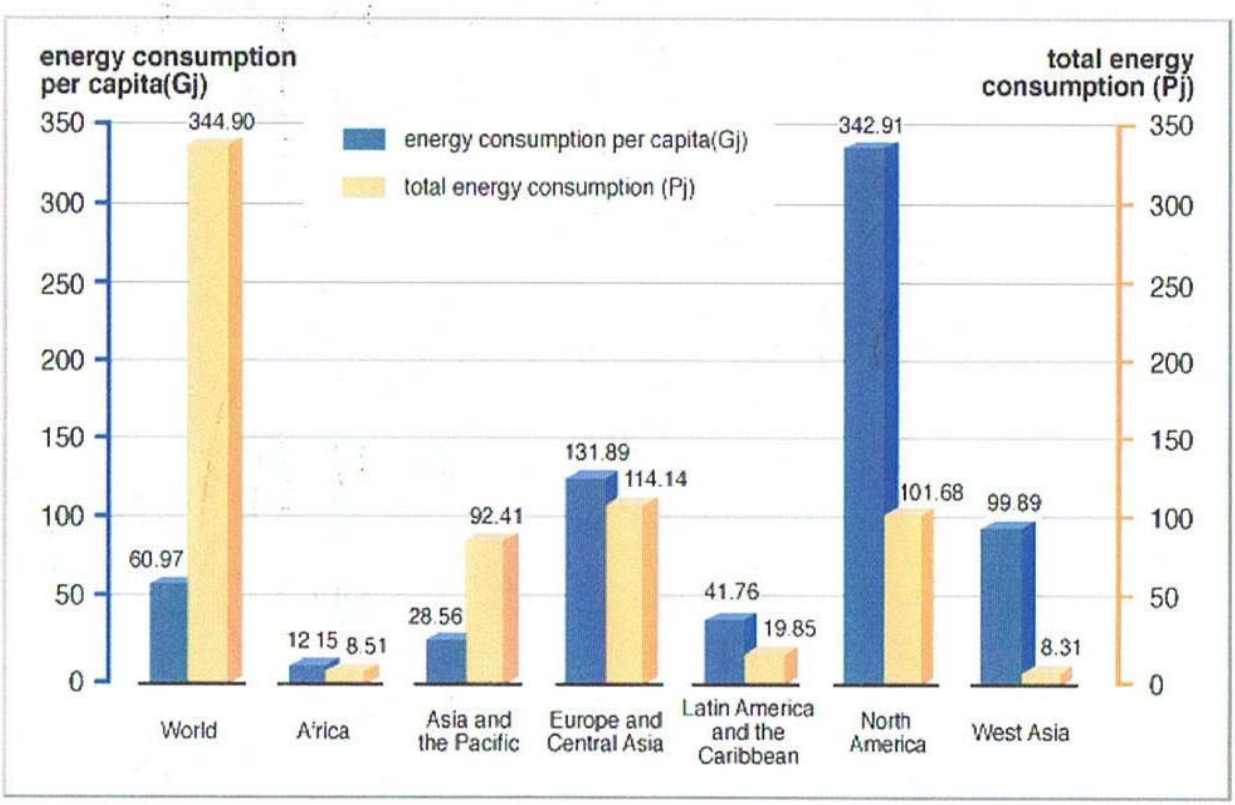


Figure. 28. Worldwide Energy Consumption per Capita (source USDOE, IEA)

Dr. Robert Polin, UMass professor calculated that for every $1million invested in the economy, if invested in the green economy, 17 jobs would be made. If the same amount were given as tax rebates or invested in the military or in oil and coal, 14, 10, and 5 jobs would be created respectively.

The McKinsey report assessed 250 possible investments and identified many investments that have a better return on investment than most other investment options. They identified investing in energy improvements in our buildings as #1 top investment option, with investment in efficient transportation as the second most lucrative investment.

We have examples of people in our community that have made such investments in their homes and reduced energy use by 30-75%. Also in our community, Small Corp, a successful business which produces museum display cases, used approaches #1 & #2 discussed above. They reduced their electrical use (doing more with less) and then installed solar PV on their roof (made zero carbon energy from the sun). They now generate 90% of their electricity with zero climate change emissions. A game-changing idea (approach #3 mentioned above) is demonstrated by Rural Development Inc.'s Solar Village, located in Greenfield, which shows that it is possible to build new homes that over the year, do not need to use any fossil fuels. They have shrunk their energy use to such a small amount, that they can meet 100% of their needs with modest-sized solar hot water and solar electric panels on their roof.

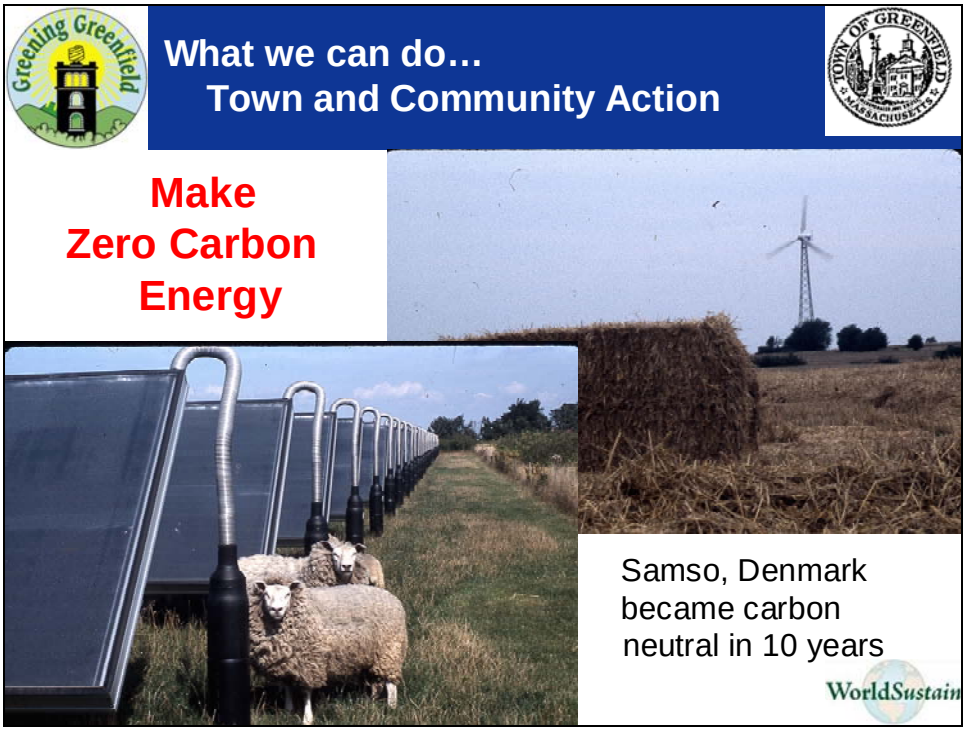


Figure 29. Samso Denmar is an inspirational community that became carbon neutral in 10 years.

Another inspiration comes from Denmark. The island of Samos reduced their climate change emissions to net zero in 10 years. They now meet 100% of their energy needs for heating and electricity without emitting climate change emissions, and they export zero carbon electricity to their neighbors, offsetting transportation fuels that they still import. How did they do this? They reduced their energy needs and then looked for clean energy sources. They found wind power, waste straw, and sunshine – all of which they developed.

6.2 Assessing Options

This will be the most challenging and the most exciting part of our journey. As individuals, we cannot do it alone – but each of us has a crucial role to play.

6.2.1 Our 3-Step Process

We will analyze our energy use by asking three key questions as they apply to the Town government expenses and our individual and business expenses

1. Does our action reduce our energy use? Are we doing more with less?
2. Does our action produce zero carbon energy locally and renewably? And avoid any unintended consequences?
3. Can we find and implement an appropriate game-changing idea? (E.g. an idea that will open the door do doing things that we have not thought of before, and that will make reaching our ultimate goal easier.)

Fortunately, we have many tools, and many organizations that have paved the way, and in some cases we have already taken major steps to reduce our energy use. To avoid reinventing the wheel, following is the beginning of a list of resources that already exist in the Greenfield area. This is not meant to be an exhaustive list. We will expand it during our assessment process.

6.2.2 Overview of our Existing Resources

- Franklin County Energy Study: A Renewable Energy Future. This first-of-its-kind study was published by UMass in 1977.
- The Pioneer Valley Clean Energy Plan, written in 2006 by the Pioneer Valley Planning Commission (PVPC), and the Franklin Regional Council of Governments (FRCOG) and many citizen groups and individuals.
- Coop-Power, a regional company based in Greenfield, has several visionary projects in process including Northeast Biodiesel, which hopes to build a biodiesel plant in the area; its Franklin County Sustainable Biomass Working Group, which is exploring the use of wood; a member-to-member solar hot water program,; and fuel buying programs to name a few.
- A vibrant utility audit program implemented by the Center for Ecological Technology (CET), a 4-county non profit that offers one-stop shopping to homeowners interested in energy retrofitting their homes. CET is also a member of the Energy Federation, a group of non-profits dramatically reducing material costs through bulk purchasing.
- Many government agencies involved in offering weatherization, fuel assistance, etc. such as Community Action, Franklin County Home Care Corp., etc.
- Quasi-governmental organizations such as the Greenfield Redevelopment Authority that has been working on a recently unveiled Urban Renewal Plan for the downtown.
- Business associations such as the Franklin County Community Development Corporation, which is committed to supporting small businesses interested in sustainability; the Greenfield Business Association, and the Franklin County Chamber of Commerce.
- Greenfield Community College – which recently launched a sustainability institute, and offers numerous courses in from Human Ecology to technical courses that prepare

students to become certified as home auditors, and installers of insulation and solar systems.

- Three groups have emerged interested in developing our use of biomass for heating and electricity (Madera Energy, Greenfield District Heating, and Co-op Power).
- Photovoltaics (PV, solar electricity). Massachusetts Renewable Energy Trust (previously known as the Massachusetts Technology Collaborative) offers rebates on PV systems to residents. Companies offering third party ownership of PV systems to the Town such as Ansar Energy LLC, who is proposing installing a PV array on Greenfield's discontinued landfill that they estimate would generate over $400,000 in annual income for the Town.
- Quality Local food: Community Involved in Sustaining Agriculture (CISA), the GreenFields Market, two farmers markets, many Community Supported Agriculture (CSA) businesses, at least five restaurants committed to quality locally-grown/produced food, locally-owned supermarkets, the Western Massachusetts Permaculture Guild, and the Organic Trade Association are all working toward changing the way we grow and obtain our food. For example, they are, among other things, developing the market for organic produce and helping to distribute locally-grown produce, which will cut down on our need for fossil fuels for transport and fertilizers, and improve the quality of our soils, and our food.
- Affordable Zero Net Energy Buildings: Rural Development, Inc, based in Turners Falls is leading the region and the nation in building the Wisdom Way Solar Village, the first development of affordable near zero net energy homes in the country. A zero net energy home generates as much energy as it uses on an annual basis.
- The Interfaith Council that among other things, works with Greening Greenfield Energy Committee to engage area faith communities in energy trainings such as Savings Through Energy Management (STEM), the Low Carbon Diet (LCD) action study groups etc.
- Greening Greenfield Energy Committee (GGEC), a citizen committee partnering with the Town of Greenfield on the Greening Greenfield campaign, this report, and many other projects in town.
- Educational groups, such as the Pioneer Valley Institute, affiliated with Greenfield Community College etc.

6.2.3 Legislation Supporting our Efforts

- Massachusetts now has some of the most progressive legislation in the nation to support communities in their efforts to become "greener." These include the Green Communities Act, Global Warming Solutions Act, and the Green Jobs Bill.
- Barak Obama has been elected with a promise to use a stimulus package to fund renewable energy development and deployment, and to mitigate climate change emissions.

6.3 Government Assessment of Opportunities

Following is a compilation of ideas that came out of the ICLEI Energy Audit, as well as ideas put forward in the PVCEP, and by other organizations and people in both formal and informal settings. This report is not taking ownership of these ideas, it is just aggregating some of the major ideas and putting them in one place.

6.3.1 Government Strategy #1: Energy Use Reduction Ideas

Remember, cutting energy use and "doing more with less" is the most effective strategy of our three-pronged approach.

Over the past ten years, Greenfield had instituted a number of energy-saving measures. Please see Appendix 4 for an Annual Energy Report to Mayor Forgey dated August 2008 on this topic..

Following is a brief overview of the five sectors referred to in *The Greenfield Energy Audit*, what has been done, and next steps.

6.3.1a Buildings

As noted in this report, buildings use 67% of the energy in Town government operations. The Town has already taken great strides in assessing the energy use of its buildings. The next step is to identify what can be done and in what time frame, and to set specific milestones.

- Audits: In 2008, Greenfield applied for and received free audits for almost all of its 29 buildings from the Department of Energy Resources (DOER). Because of these audits, completed in January 2009, Greenfield got confirmation that it would receive a $250,000 grant from DOER for energy upgrades. The upgrades will be implemented through the summer of 2009.
- ESCOs: Greenfield has signed up to work with the Franklin Regional Council of Governments (FRCOG), which is hiring an Energy Service Company (ESCO) to look at larger building energy reduction opportunities. We expect to have proposals by the end of spring of 2009, and to start work before the next heating season.

6.3.1b Transportation

Transportation is a very difficult area to address. For Greenfield this represents 20% of the energy use.

- The town has already made a commitment to build a state-of-the art energy efficient downtown transportation center. Construction on this facility will start in 2009.
- The town will continue to invest in bikeways and walkways, and extend the Greenfield bikeway system that links downtown Greenfield to the Green River Swimming and Recreation Area to other bikeways in neighboring communities.
- The Town has made a commitment that future vehicle purchases will be most energy efficient vehicles possible that are affordable and meet the needs of the department, instead of relying on police hand-me-downs. For example, in March 2009, a new fuel-efficient vehicle (Toyota Yaris) was purchased for the Town Assessor.
- To assess this area, an inventory of all the vehicles, including fuel efficiency, age, use etc. should be made. This list should be analyzed and a plan put in place for timing of vehicle replacement, and possible replacement options. Grants should be explored from US DOE's Clean Cities Program and other options.

6.3.1c Lighting

Lighting accounts for only 4% of the energy use, but between 2001 and 2008 energy used increased by 30%!

- Traffic Signals were upgraded to LED's in 1999, prior to this study.
- Streetlights accounts for 76% of the town lighting. The need for this lighting and the energy efficiency of this lighting should be assessed.
- Decorative lighting is the major reason for the 30% increase between 2001 and 2008. An analysis of the need for decorative lighting that is in place, as well as its energy efficiency could lead to changes that could save both energy and money.

6.3.1d Waste Management

As noted above, waste management has a great success story to tell – where overall cost was reduced while the cost per ton of trash disposal increased over 40%. This is largely due to a Pay-as-you-throw program that was instituted 2005.Today 42% of the items brought to the transfer station are recycled. However, there is room for improvement. Setting goals for increased recycling, and overall reduction of things bought to the transfer station and trucked to Springfield for incineration should be set.

6.3.1e Water & Sewer

Water & Sewer account for 9% of the energy use, but 11% of the cost is due to the fact that electricity is the primary fuel.

- Large pumps have been upgraded with variable speed drives and energy efficient motors.
- The disinfection and sludge pump building are heated with waste heat from the effluent installed in 2005.
- A back-up generator is in place, and Greenfield belongs to a utility program (Demand Response Program) that uses the generator when the utility company requests. Greenfield earns several thousand dollars from the utility company for this service.
- The Town is currently writing specifications for the installation of heat pumps in two of its potable water treatment plants. These heat pumps should provide 95%+ of the heat needs for the buildings, significantly cutting the use of propane which will remain in place for backup heating and powering of emergency generators.
- Finding further savings would be difficult. But the DPW will keep their eyes open for new opportunities.

6.3.2 Government Strategy#2: Green Energy Production.

While green energy production will be discussed more fully in the community-wide section, there is one opportunity worth mentioning that is unique to Town government.

6.3.2a Third Party Ownership of PV

Due to regulations adopted in 2008, while municipal governments are not eligible for rebates for installing solar electric panels, aka photovoltaics or PV (hereafter referred to PV), they can take advantage of third party ownership, Ansar Energy LLC has already approached the Town about this possibility. They are presently looking at town-owned land such as the capped land fill and Industrial Park, as well as school buildings and other municipally-owned buildings.

6.3.3 Government Strategy #3: Game-Changing Ideas

Following are a couple of examples of game-changing ideas, some of which have been implemented, and others that are being proposed. A game-changing idea is an idea that could open up new doors not previously available to us. We should keep our eyes and our imaginations open to new game-changing ideas as they emerge.

6.3.3a Snow Dumping.

One game-changing idea implemented in the winter of 2008-2009 was to change the location of snow dumping to be closer to downtown, to cut on fuel use of trucking downtown snow for disposal.

6.3.3b Town Planning.

Another game-changing idea is to focus on continuing to make the downtown more vibrant and dense, and to make the Town more walkable. Evidence shows that people will park and walk longer distances if the downtown is vibrant. A new Urban Renewal Plan for the Bank Row and Olive Street area was written in 2008. There is, however, much more work that can be done in this area and avoid sprawl, especially sprawl of the commercial area.

6.3.3c Transportation.

As mentioned above, the town could find ways to cut down on the miles that the town-owned vehicles need to travel, and smart growth principles could be implemented to cut down on the need for personal transport. This will be discussed in the town-wide section in greater detail.

6.4 Community-wide Energy Assessment & Ideas

Residents use 97.3% of all the money spent on energy in the community. Community-wide milestone setting and implementation, however, is more challenging than on the government side because energy changes are voluntary and they depend on thousands of people making changes to their habits, homes, and vehicles.

6.4.1 Community-wide Strategy #1: Energy Reduction

With the community using over 97% of all the energy in the community (with town government making up the balance) it is critically important that everyone be engaged in reducing their energy use. Remember, this is the most effective strategy of our three pronged approach. Following are some ideas on how to tackle this challenge.

6.4.1a Buildings: Residential, Industrial & Commercial.

Buildings account for almost one third of all the energy used in the community, and we know that we could likely reduce energy use 50% - 70%. Of the energy used in our buildings, approximately 58% is for residential use. The commercial sector is 36%, while the industrial sector is only 5%.

It is very difficult to make changes in this area for several reasons. While we know the aggregate energy used, 1) we do not know how much energy each building is using; 2) we must rely on the voluntary efforts of the building owners to upgrade the buildings; and/or 3) we must rely on the building users to voluntarily change their habits. Examples of this might include turning off lights and appliances when not in use, taking shorter showers, using a clothesline instead of a dryer, changing to energy-efficient light bulbs or appliances, or

making the major investment of insulating and air sealing their building or replacing windows or an inefficient heating system. See Appendix 5a for a list GGEC has compiled.

On the plus side, the utility companies offer incentives to homeowners and businesses. As of January 2009, MassSAVE.com offers residential customers free energy audits, and then will pay 75% of the cost of air sealing and/or insulating up to $2,000 per home. They also offer 0% interest loans up to $15,000. The challenges are that: 1) people do not know about the audits and rebates, 2) in some cases landlords pass on energy costs to their tenants so they don't care about the cost of the utilities, and in other cases the landlords pay for the utilities and the tenants don't care about how much energy they use, and 3) the utility rebates and federal tax credits are adequate for an energy retrofit that will result in 5-15% savings, but not for the deeper 40-75% savings that we would like to see.

Inspiring people to take action, and giving them the information they need has been one of the main focuses of the Greening Greenfield Energy Committee. Following is a list of strategies GGEC has used, or plans to use to in the near future. Please note that GGEC is not the only organization offering information and workshops on energy issues. Coop Power, CET, FRCOG, Fiver Rivers Council, Traprock Center for Peace and Justice, and others also offer programs and resources.

1) Educational and inspirational activities such as the 2008 Turtle Island Medicine Show, which attracted six hundred people to attend this giant puppet show based on the Iroquois creation myth that transforms into a climate protection story, and the 2009 spring film and discussion series.

2) GGEC offers workshops for homeowners on a regular basis on how a house works and how to find an energy audit and the resources necessary to follow through with the recommendations. These workshops have been videotaped, and have been shown repeatedly on Greenfield Community Television (GCTV).We also have offered workshops on finding resources for installing renewable energy on your home or business. GGEC has developed informational handouts on audits, financing options, and sweat equity options, as well as an energy analysis spreadsheet. These are posted in the resources section of Greening Greenfield's web site (www.GreeningGreenfield.org) and in Appendix 5. GGEC offers similar workshops for business people in partnership with Franklin County CDC, and the Chamber of Commerce, and the Center for Ecological Technology, and others.

3) GGEC offers a study action workshop which uses the *Low Carbon Diet* developed by the Empowerment Institute to work with people interested in lowering their energy use. This workshop has been offered to the general public through faith communities and other venues. Eight Faith Communities also took the Savings Through Energy Management (STEM) training in 2008.

4) GGEC has met with Community Action fuel assistance program director and the FC Home Care Corp (FCHCC) to increase weatherization opportunities for income-eligible people. GGEC is also working with others in an effort to secure more funds for energy retrofits.

5) In the spring of 2009 GGEC is initiating the *Greenfield 10% Challenge*, a community-wide high profile campaign to reduce energy use and carbon emissions by 10% by 2010. This campaign uses the New England Carbon Calculator, incentives, lawn signs, and a major

public relations campaign to reach its goal, as well as raising funds to help lower income elders take advantage of the MassSAVE insulation program by making the required matching funds available to them..

Given how difficult it is to get people to change their habits, adopting new codes and/or regulations should also be explored. For example, Massachusetts is promoting a new "Stretch Code" and in March 2009 the Commonwealth released a report called *Getting to Zero, the Final Report of the Massachusetts Zero Net Energy Buildings Task Force*. Some progressive and effective ideas from that report and from other communities include: 1) requiring homes, when sold, to meet a stated energy-efficiency standard (CA); 2) all new homes must be "zero net energy ready" (Austin, TX); and 3) all homes have a right to solar access (CA); 4) co-sponsor a mortgage write-down program for deep energy retrofit projects; 5) utility in-bill financing for photovoltaic installations (Berkeley, CA). A group of citizens or a college intern should explore these options, the new Massachusetts stretch code, and propose updated codes for Greenfield.

6.4.1b Transportation.
Transportation uses 42% of the energy consumed in the community. Unfortunately, we have been unable to get information from the Registry of Motor Vehicles on how many of Greenfield's vehicles have commercial plates and how many have regular plates. In any case, this is an area that is not easy to effect change because: 1) change is voluntary; 2) the most effective changes involve behavioral changes; 3) it is difficult to increase mass transit options with such a dispersed population; and 4) energy efficient vehicle options (50-100 mpg) that use different kinds of fuels are limited and expensive.

Some ideas about how to address these issues are: 1) organize a massive campaign to encourage people to get out of their cars. This could be done by educating the public about the advantages of walking, biking, mass transit, telecommuting, car pooling, and car sharing; 2) If they must own a car, encourage them to buy a more fuel efficient vehicle; 3) Encourage them to meet the 10% challenge by reducing their transportation energy use; 4) Offer more and attractive mass transit; 5) offer better bikeways; 6) Build a denser downtown to encourage walking; and 7) Offer fun events that get people out of their cars such as car-free days, walk or bike days etc.

All of these options should be considered, and further brainstorming and implementation is necessary.

6.4.2 Community-wide Strategy #2: Green Energy Production, Locally and Renewably
Our ultimate goal is to meet our energy needs with energy that does not emit climate change emissions or other toxic emissions, uses renewable fuels, and that supports the local economy. Remember, that we need three types of energy: electricity, energy to heat our buildings, and energy for our vehicles.

According to this study, today, Greenfield used 496,905 million BTUs (MMBtu) of electricity which could be produced by an 18 megawatt (MW) power plant. As for heat, in 2008 Greenfield used almost twice that amount, or 958,632 MMBtu. And transportation used slightly more at

1,199,094MMBtu. If energy efficiency measures were instituted, we could conceivably reduce our needs by 50-70%, so that we would need an 8 megawatt power plant to meet our needs, and four times that to meet our heating and transportation needs.

Historically, Franklin County has been a net-exporter of electricity, which is produced by hydropower, and that is still true today. Madera Energy estimates that Franklin County would need a 50 megawatt power plant to meet its electrical needs. Last year hydropower plants in Franklin County were rated at 110 MW, and therefore generated more than twice the electrical needs of the county. Because of utility regulations, this clean electricity cannot be sold directly to us in Franklin County, but must be sold to the utility companies, so in this study, we have to report emissions from the New England utility grid, and so our climate change emissions from electricity are 45% of our total instead of the zero emissions that our hydro plants emit. We can, however, feel good that we are contributing to making New England electricity cleaner.

Looking at electricity in this way led us to explore our energy use in a new way - in terms of services that we want from energy: *electricity* for lights, appliances etc., *heat* for our buildings, and *fuels* for transportation. As show in Figure 30 electricity is only about one fifth of the energy that we use. Heat is about double that, and fuels for vehicles a bit more than heat.

Energy Type	Energy Use (million Btu)	Climate Change (CC) Emissions (tons CO2e)	% of total CC Emissions	Estimated Cost ($)
Electricity	496,905	133,251	44.9%	$26,941,090
Heat	958,632	69,673	23.5%	$26,009,344
Fuels for Vehicles	1,099,094	94,103	31.7%	$32,518,089
TOTALS	**2,554,631**	**297,027**	100%	**$85,468,523**

Figure 30. Community-wide energy use organized by TYPE of service delivered: electricity, heat, and fuels for vehicles. Noted is energy use (million Btu's),, climate change emissions and cost. (See Appendix 3.13 for details.)

So when thinking about renewable energy, we should not only be thinking about local renewably produced electricity but also about local renewably-produced heat and fuels for transportation, and think about how we might apply some game-changing ideas about what types of fuels we use to deliver services such as heat and fuels for our vehicles - it might be electricity!?

Following is a brief overview of the technology options and past assessments. (See Appendix 6 for details.)

Wind to generate electricity - No economically viable resource in Greenfield, but there is some regionally.

Hydro (water) to generate electricity – As noted above, we have 110 MW of hydro installed in Franklin County. This does not include the pump storage facilities in Northfield, which are used for energy storage and "load-leveling" by the Vernon nuclear power plant. How it works is that at night, or other times when the demand for electricity is low, energy from the nuclear power plant is used to pump water into the upper reservoir. In the daytime, when demand is high, the water is released from the reservoir to generate electricity. Anecdotally we have heard that there is not much undeveloped hydro in the region. Also, there are environmental considerations to

hydro development. Nevertheless, an assessment of the options could be instructive. For example, Greenfield is presently assessing one of the old dams on the Green River. (See Appendix 6a for details on hydro.)

Geothermal - Is available for individual heating and cooling. Some say that it is also possible to produce electricity. This should be assessed individually. This technology uses heat or cooling from the earth. In the US, electricity is used to run geothermal.

Solar: Passive solar heating, hot water & electricity (Photovoltaics aka PV) - We have enough sun, rebates from the Massachusetts Renewable Energy Trust, and tax credits from the IRS and the Commonwealth to make these technologies cost-effective. Passive solar involves designing a home to take advantage of the heat offered by the winter sun, and cooling in the summer. Solar hot water is most often used for domestic hot water, though it can also be used for heating pools and home heating. Solar panels that produce electricity are commonly referred to as photovoltaics or PV.

Use of solar hot water and photovoltaics could likely be measured by looking at building permit request for installing such devices. This could be tracked over time to assess progress in this area

Existing resources in Greenfield are as follows:

1) GGEC has a fact sheet for homeowners interested in exploring the solar hot water and PV options, which is posted on our web site. March 2008 versions are in Appendix 5b and 5c. Solar rebates, and other options, are also available for business-people. The100 watt PV system installed at Small Corp in 2008 is an excellent example of what we can accomplish. It generates approximately 100% of their electric needs on an annual basis.
2) Greenfield has several businesses involved in installing solar equipment and/or selling other solar items. Coop Power also offers a member-to-member program that involves shared installation of hot water panels on each other's homes.
3) Several non-profits in the region promote solar including the Center for Ecological Technology.

Biofuels – Biodiesel could be produced from waste vegetable and animal oils. Northeast Biodiesel, a project of Coop Power, is exploring this option. Ethanol could be produced from plant material. Biofuels have a long list of positives and negatives that are hotly debated, and will not be addressed here.

Biomass (wood) – Many believe that this resource is one of the region's most valuable resources. It is also incredibly versatile and is the only fuel that can produce all three types of energy that we use: electricity, heat, and liquid fuels for transportation. For example, we use cordwood or wood pellets to heat our homes. Wood chips could be used in a power plant to produce heat for our homes and electricity. And there is much research into finding a way to produce ethanol from plant material efficiently and cost-effectively.

Use of biomass, however is very controversial, and many fear agricultural land will be lost to the effort to grow plants for energy. As for forests, our largest biomass resource, some believe our forests are valuable source of renewable energy, while others believe that they are more valuable as "carbon sinks" which will pull carbon dioxide, the major source of climate change emissions out of our atmosphere. Some people think that our forests can serve both functions simultaneously, and that harvesting of invasive species and poor quality wood will improve the

carbon capture capabilities of our forests, and avoid methane, a gas 21 times as potent as carbon dioxide, from being emitted by dead and rotting trees.

Many people consider using biomass as "carbon neutral," because although carbon dioxide is emitted when the biomass is burned, this carbon dioxide has recently been pulled out of the atmosphere while the biomass was growing. Many point out that it requires energy to grow biomass, or extract the wood from the forest and transport it to its point of use, so that it is not carbon neutral. When full cycle analysis is taken into consideration, biomass gives off much less climate change emissions than most other options if looked at on a 100-year cycle, but others argue that because of accelerated climate change, we cannot afford to emit any carbon dioxide into the atmosphere over the next 100 years.

Air quality is also a critical issue. Our area already exceeds air pollution (ground level ozone etc) standards. Using biomass would add particulate matter and other pollutants that cause asthma, heart and lung diseases. Some point out that using biomass in large plants is much less polluting than using it in wood stoves, others point out that the sheer size of a large plant dwarfs pollution from wood stoves.

Efficient use of this valuable resource is also a major issue for many. For example, if electricity is generated, about 25% of the energy stored in the wood is used. If heat is generated, approximately 80% of the energy is used. Combined heat and power plants have efficiencies between 33% and 80% depending on how they are configured. They become more efficient if they focus on heat delivery and if the demand for heat is consistent throughout the year, rather than varying with the seasons.

The Massachusetts Division of Energy Resources recently published a series of reports assessing this resource. The studies include assessment of the size of sustainably harvestable biomass, and its economic and environmental impacts on the region. DOER's report, *Energy from Forest Biomass: Potential Economic Impacts in Massachusetts (2007)* estimates that in western Massachusetts we could sustainably harvest 1.7 million tons of green woody biomass per year, which could support 165 megawatts (MW) of new power plants. They estimate that this would create $57 million in income and 440 jobs in the region In 2008 the Franklin County Clean Energy Plan (PVCEP) concluded that there was enough sustainably harvestable wood to support several large electric power plants (25-50MW each), combined heat and power plants (5-10 MW each), and numerous small 1-5 million BTU/hr heat-only systems.

Some people estimate that biomass could meet 20-25% of the region's energy needs. If looked at on a state-wide basis, it is estimated that it could meet just over 1% of the total energy needs of the state, or 33% of the renewable energy portfolio (RPS) requirements of utility companies which are 4% in 2008 rising to 7% in 2015.

Presently, in Greenfield, there are several proposals on the table, which are not mutually exclusive. Madera Energy is exploring the possibility of building a 47MW plant near the Greenfield Industrial Park. Greenfield District Heating is interested in developing a community-owned heat generating plant and distribution system, which is talked about more in the section on community-wide game-changing ideas. Coop Power is looking at helping to launch a Wood Chip and Pellet Manufacturing Plant in Greenfield to support the local forest industry and new biomass power plants.

In any case, if used, this valuable resource should be used wisely and there should be 1) strict sustainable harvesting requirements and in place. 2) the state should not grant more permits for facilities that use biomass than the region can support, 3) large plants should be required to use the wood at 50% efficiency or better, and 3) in an ideal world, all wood chips produced in Massachusetts would stay in Massachusetts. (See Appendix 6b for a list of existing and proposed biomass plants in the region.)

Other Emerging Technologies: Biodigesters, which are common in India, are being considered for our area. Biodigesters are usually small in scale (one-farm size). They use cow manure, or other waste, and produce methane for cooking and heating, with fertilizer as a useful byproduct. Other technologies offer energy savings by using less energy to deliver heat. Geothermal is an example of this approach. Another one is a mini-split air to air heat pump. These appliances have been used in the south for many years, and they can now be used effectively in our climate.

6.4.3 Community-wide Strategy#3: Game-changing Ideas

As mentioned previously, a game-changing idea is a technology, behavior, or new way of thinking that changes our need for energy, or the way that we can meet our energy needs. Some people have called these strategies "disruptive technologies" when referring to a new technology or a paradigm shift when referring to a behavior change. New technologies and ideas are emerging all the time, so this is an exciting area for engineers and other researchers. But remember, the pre-requisite for all of these ideas is implementing every energy efficiency strategy we can think of.

Following are some game changing ideas for consideration.

6.4.3a District Heating

District heating involves creating hot water at a central location and then piping it to buildings to heat them. This system, which is common in Scandinavia, is very energy efficient, avoids the need for a furnace or boiler in the building being heated, and opens up the possibility of using new fuels such as biomass (wood chips) in a clean and efficient way coupled with small amounts of gas and/or oil, or by using waste heat from an electricity-producing plant, or other operation that has waste heat. As noted above, Greenfield District Heating is proposing such a system for Greenfield.

6.4.3b Buildings

- Make all new buildings zero net energy. The 2009 Massachusetts report *Getting to Zero* defines a zero net energy building as "one that is optimally efficient and, over the course of a year, generates energy onsite, using clean renewable resources, in a quantity equal to or grater than the total amount of energy consumed onsite." Greenfield is a leader in the nation. Rural Development Inc.'s Solar Village is one of the first affordable zero net energy developments.

- Do deep energy retrofits (70%-90% reduction in energy needs) to existing buildings and meet the remaining energy needs with zero carbon electrical energy or biomass.

- Cut electrical needs and then meet 100% of those needs with photovoltaics on the building. Greenfield's SmallCorp in the industrial park, is an example of a business that has implemented this strategy successfully.

- See the report *Getting to Zero* for ideas of how to institutionalize these changes.

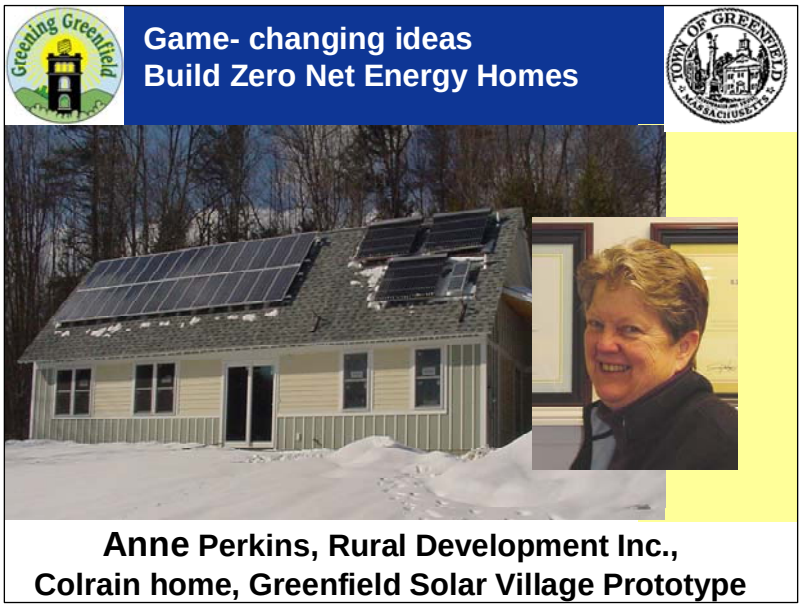


Figure 31. Rural Development Inc's Colrain home, which is a prototype for Greenfield's Solar Village. Greenfield= is a national leader in building affordable zero net energy buildings.

6.4.3c Transportation

Transportation has many game-changing possibilities. As mentioned above, people could make decisions that greatly reduce the need to use a car or other form of motorized transit. For example, I have met several people recently who moved to Greenfield so they could walk to work, shopping, and entertainment, and get rid of their car, or leave it parked in their driveway. This is sometimes called "reverse-sprawl" or "smart growth." People could also choose to use a bike instead of a car, or to car pool.

Another game-changing idea is telecommuting, or 4-day work weeks, which cuts down on the need to travel to work.

Figure 32. Game Changing ideas for transportation. Behavior changes to walking, biking, telecommuting and mass transit, and technology changes such as shrinking the size of our cars or switching to fuels that emit less carbon and are made renewably and locally.

Finally there are several auto-technology ideas. The most often discussed is creating “plug-in hybrids” or “battery-electric vehicles.” The advantages cited are that: 1) the life cycle fuel efficiency is greatly enhanced; 2) by switching to electricity as the primary fuel, we can wean ourselves off of gasoline, and use “green electricity” (we have to be sure that our grid is green today, or will be green in the near future); and 3) some people have proposed that the battery in the car could be used by the electric utility companies to store renewable energy that is only generated intermittently (such as wind and solar). This would enable the utility companies to maintain electricity quality (i.e. even constant supply), so that they could increase the percentage of the electricity that is created by the sun and the wind and make our electricity “greener.” Others feel this will never happen because it is too expensive to install the equipment that would enable the cars to perform this function.

6.4.3d Summary: Big Picture Thinking

In summary, if we reduced our energy needs by 60%-90% we could cost-effectively meet our needs with local power created by hydro, solar, biomass and more regionally wind. For example, all of our electrical needs could be met by our existing hydro and solar panels on our roofs, which do not emit climate change emissions. Our heating needs could be met by passive solar, new technologies that run on electricity such as air to air heat exchangers, and possibly biofuels. And our transportation needs could be met by moving closer to work and play, walking, biking, and electric-powered mass transit and some small cars. When looking for solutions we must keep our three strategies in mind, and we must keep in mind the characteristics of each type fuel in terms of its climate change emissions, environmental impact, cost per unit of energy delivered, and how much of what we pay for that energy stays in our region or leaves, and we must remain vigilant for unintended consequences.

7. Measuring Our Progress Toward Sustainability

Measuring our progress toward reducing our climate change emissions and freeing ourselves from costly and polluting fuels is fairly straightforward, as noted in this report, and it is possible. The Swiss Federal Institute of Technology recently determined that it is possible for Europe to reduce energy needs by 80% by 2050 by replacing current technologies with more efficient ones. Given that Europeans use half the amount of energy as we do, this is amazing information! As demonstrated by this report, measuring our progress toward a similar goal is straightforward – and per capita energy use is an excellent metric.

The Greening Greenfield Energy Committee's vision, however is not only to reduce our energy needs, and help build new sources of energy that do not emit toxic or climate change emissions, our vision is to "build a more sustainable Greenfield so that current and future generations can enjoy life in this beautiful abundant valley."

Greening Greenfield aims to "foster sustainable: land use and agriculture; transportation' local economies, green businesses, jobs and manufacturing; healthy and equitable lifestyles' and quality education, health care, arts, entertainment, parks and recreation." (Greening Greenfield brochure.) Our ultimate goal is to strive toward sustainability as defined by the Brandtland Commission in 1987: "Sustainability is a system of thinking that strives to meet present economic, social and environmental needs without compromising future generation's ability to meet their own needs."

Numerous groups have attempted to define more clearly what we mean by sustainability, and then establish metrics that could be use to measure our progress toward those goals. Over the past year, the Pioneer Valley Sustainability Network (PVsustain), a collaborative effort lead by the Pioneer Valley Planning Commission and the University of Massachusetts, has been engaged in this process, and we can follow their lead. For example the group feels that clean air and water are fairly easy to measure, as is the shift of transportation from autos to mass transportation; human, plant and animal health; and the availability and use of quality local food. A more illusive metric would be a "gross domestic happiness index." We could study how the country of Bhutan has defined its "happiness index which in their country replaces GDP as the major way of measuring if their country is moving in the right direction and improving its quality of life. We could also use metrics devises by economist Herman Daley or Hazel Henderson's "Quality of Life Index."

It is recommended that Greenfield work closely with PVsustain.org and other associations to figure out metrics for achieving our broader sustainability goals. Other partners could include FRCOG and Franklin Regional Transit Association (FRTA) who promote alternative forms of transportation and have the data we need to assess progress in reducing auto energy use. To assess our progress toward producing our food locally, sustainably, and safely, we could work with Communities Involved in Sustaining Agriculture (CISA), the Organic Trade Association (OTA), Land Trusts, Permacultrualists, the Pleasant Street Community Garden, and Just Roots, a newly formed group looking at preserving agricultural land in Greenfield.

8. Conclusions

The Greenfield Energy Audit gives us the data we need to motivate the Town government and its citizens to reduce the cost of our energy, and in so doing improve our economics and quality of life while reducing our energy use and climate change emissions. This report gives us a baseline, and the beginnings of ideas on how we can achieve our goals. It aims to support the implementation of the Pioneer Valley Clean Energy Plan's goals for the region.

In response to this report, on January 17, 2009, Mayor Christine Forgey set two long-term goals for Greenfield:.

1) ZERO energy dollars spent by Greenfield residents will leave the region by 2050.
2) We will cut climate change emissions by 80% by 2050.

Next Steps -Action Plan Recommendations:
The next step outlined by ICLEI is for Greenfield to draft an Action Plan. To accomplish this step, we recommend the following actions.

1. We recommend that Town government continue to take a leadership role as follows:

    a. The Mayor work with staff responsible for Town government energy use from the five energy use areas: buildings, vehicles, streetlights, water/sewer, and waste management to i) assess specific opportunities, ii) create a time line of for the specific actions such as working with ESCOs etc.,, iii) set 1 to 5 to10 year milestones for energy reductions and local renewable energy generation on Town-owned buildings and land.

    b. The Mayor set up "green teams" made up of staff and citizen stakeholder groups responsible for energy use to set 1 to 5 year milestones for energy reductions and local renewable energy generation. This process will feed into or be part of the Master Planning process.

    c. The Mayor and Town Council make a commitment to start updating Master Plan next year, using sustainability as the overarching goal; integrate sustainability principals such as smart growth, strict building codes etc. into the plan; and use what we learned from the *Greenfield Energy Audit* and the *Pioneer Valley Clean Energy Plan* to inform the plan wherever appropriate. The Master Plan will include an Action Plan. The Master Planning process will be inclusive and participatory.

    d. Apply for *Green Communities* designation, which makes us eligible for future funding.

    e. The Town consider adopting the new Massachusetts Stretch code for buildings, which will make Greenfield eligible for additional state funds.

    f. The Town continue to work closely with the Greening Greenfield Energy Committee (GGEC) as an advisory committee.

    g. The Town support GGEC in its efforts to engage all 18,666 residents by continuing to meet with GGEC leaders on a regular basis; offer accounting support for grants that support GGEC efforts, such as MTC's Clean Energy Choice program;

host ICLEI software; make a desk available in the DPW office; and endorse GGEC programs on an "as requested" / appropriate basis.

1. The Greening Greenfield Energy Committee (GGEC) continue to create programs that give the public the motivation and tools they need to take action in reducing their personal energy use and, if feasible, generate renewable energy on their homes. For example, In April 2009, GGEC launched the *Greenfield 10% Challenge.* GGEC will also continue to offer informational workshops, films, and handouts, maintain the Greening Greenfield web site, conduct a major public relations campaign about the Greening Greenfield campaign, and seek new ways of being more effective.

Summary of this report:
The most startling things we discovered are that:

- In FY08, the residents of Greenfield spent over $85.8 million on energy. Of that, only 22% stayed in the community to pay for infrastructure and billing etc, while 78%, or $67 million, left our community to pay for the fuel used.
- There are huge savings to be had by energy retrofitting our buildings, and we could likely reduce building energy use by 50-80%. We discovered that some Town buildings use five times as much energy per square foot as others. This is likely also true of our homes and commercial buildings.

In response to these challenges, on January 17, 2009 Mayor Christine Forgey set two long long-term goals for 2050 as noted above.

In this report, we have started the process of analyzing how we can reduce our energy use, what we pay for energy, and our climate change emissions so that we address the next step in the Greenfield/ICLEI process and set near-term goals and milestones.

We will use three key strategies to assess Town government energy use and expenses and our individual and business energy use and expenses as follows:

1) Reduce our energy use (doing more with less)
2) Produce zero carbon energy locally, with renewable resources
3) Seek out and use appropriate game-changing ideas

We will apply these three strategies when assessing the five Town government sectors: buildings, vehicles, waste, water/sewer and lighting, and to the three community-wide sectors: residents, commercial/industrial, and transportation. When applying these strategies we will not only look at who uses energy, but also keep in mind the three major types of energy we use - electricity, heat, and transportation fuels. Additionally, we will keep in mind the characteristics of each type of fuel in terms of its climate change emissions, environmental impact, cost per unit of energy delivered, and how much of what we pay for that energy stays in our region or leaves it.

We will then set challenging but achievable milestones for each sector.

Our Challenge
The adage "think globally, act locally" could never be more appropriate. Another way of framing the challenge is that we need to build "energy self-reliance." This will strengthen our economy, our security, and build community.

On a technical level, we understand that if we are able to reduce our energy use by 50%-80% we could cost-effectively meet our needs with energy generated by hydro, solar, biomass, and wind, which do not emit climate change emissions.

On a practical level, we recognize that the task is daunting.

While Town government uses only 2.7% of the energy used by our community, it is critically important that Town government take the lead and demonstrate that reducing energy use is not only possible but cost effective. At first glance, with the Town budget stretched to the limits, this may seem impossible, but in fact, town government is in a better position to reduce its energy use than residents. For example, there are numerous new and old state and federal grants for Towns, and Energy Service Companies (ESCOs) offer energy assessments and upgrades to municipal buildings at no up front cost to towns. ESCOs are paid out of the energy savings.

For residents, the barriers to making energy upgrades to their homes is even more challenging. To deeply cut our energy use we need not only technical fixes, but also lifestyle changes - and we all know how difficult it is to change our habits and how we live. As with Town government, Greenfield residents are strapped for cash. The average household income of $40,800/year in Greenfield is below the state and national average. Additionally many people live on fixed incomes of less than $14,000 per year. Over the study period the cost of energy rose 38%, and it is likely to continue to rise as demand outstrips supply as population grows and fossil fuel resources diminish. While residents can cut their energy by 5-10% with low and no-cost actions, to achieve the deeper energy reductions that we need will take motivation, time, knowledge, and money. To help with home energy use reductions, utility companies and Community Action offer free energy audits and rebates that would reduce home energy use by 5%-20%, but not the 50% -80% that we need. While utility companies also offer zero % interest loans, they are not adequate for a deep energy retrofit, and it takes a special homeowner or landlord who will take on the challenge of such a large project.

As for transportation, most people feel that owning a car is a necessity due to the sprawling nature of our community. While some people are investing in new energy efficient vehicles that use 20-50% less fuel per mile, and others are making lifestyle changes and moving closer to the town center so that they can walk or bike, still others are asking for more mass transit options. Statistics show, however, that over the 8 years of this study, we did not reduce the amount of fuel that we used for transportation. In fact the use of fuel inefficient vehicles grew. Additionally, due to the sprawl and low population density, it is difficult to make public transit economically viable.

Businesses face similar challenges as residents do. In fact "small commercial buildings," which encompasses the majority of our commercial buildings, are the most underserved sector. Utility programs do not offer businesses whole building energy audits, and most ESCOs do not offer their services for these smaller buildings.

Our Resources
On the plus side, there are numerous, highly motivated and talented individuals working in local government, government agencies, non profits, and businesses that are already actively engaged in working toward our common goals. For example, some people are moving to Greenfield so that they walk instead of use their car. Others are investing in their homes in order to save money, cut energy use and climate change emissions, and generate zero carbon energy by installing solar panels. Still others are building zero net energy buildings and installing solar panels on their homes.

On a state level, in late 2008 and early 2009, Massachusetts became one of the most progressive states in the country when it passed the Green Communities Act, the Global Warming Solutions Act, and the Green Jobs Act, all of which aim to support our common goals of growing the green economy and moving toward sustainability. On a national level, President Barak Obama's election and first few months in office raises hope that the resources we need to invest in our community could be available soon, because he understands that the growth of the economy and reduction in climate change emissions are two sides of the same coin.

In closing
It is our hope that this Audit, the recommendations above, and the Greening Greenfield campaign can help mobilize people in Greenfield by providing a collaborative focal point for Town government, residents and businesses; a unique opportunity to strengthen our community by creating solidarity between advocates for "greening" and advocates for economic development; incentives and motivational information; a window to the many active groups in the region; timely reports on progress toward our common goals; visibility for Greenfield heroes and successes; a regional and global context for Greenfield's efforts and successes; and a PR campaign that will foster town pride in our collective efforts and successes.

We see the steps to reduce and change our energy use as discussed in this Audit as critical to meeting our overarching goal of "building a sustainable future so that future generations can enjoy life in this beautiful abundant valley," but our efforts to reduce energy use are not sufficient. In addition to working on energy issues, we recognize that there are many other aspects of sustainability such as healthy and equitable lifestyles, local food security, and quality education, health care, arts, entertainment and recreation as noted in our vision statement at the beginning of this document and on Greening Greenfield's web site.

It will take nothing short of a community-wide effort, with everyone helping each other and working together, to make the changes that we know we must make

It will take motivation, a vision of a better life, money, mentors, information and perseverance.

Appendix Table of Contents

#1 Appendix:

ICLEI Membership & Cities for Climate Protection® Campaign

WHEREAS, scientific consensus has developed that carbon dioxide (CO_2) and other greenhouse gases released into the atmosphere have a profound effect on the Earth's climate; and

WHEREAS, the 2007 Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) states that it is very likely that most of the observed increases in globally averaged temperatures since the mid-20th century are due to human-induced greenhouse gas emissions; and

WHEREAS, in 2006 the U.S. National Climatic Data Center confirmed clear evidence of human influences on climate due to changes in greenhouse gases; and

WHEREAS, the U.S. Conference of Mayors endorsed the 2005 U.S. Mayors' Climate Protection Agreement initiated by Seattle Mayor Nickels and signed by more than 60 mayors in the United States as of August 2007; and

WHEREAS, the Urban Environmental Accords adopted by local government delegates during UN World Environment Day 2005 call for reduced emissions through energy efficiency, land use and transportation planning, waste reduction, and wiser energy management; and

WHEREAS, in 2003 the American Geophysical Union adopted a Statement noting that human activities are increasingly altering the Earth's climate and that natural influences cannot explain the rapid increase in near-surface temperatures observed during the second half of the 20th century; and

WHEREAS, in 2001, at the request of the Administration, the National Academy of Sciences (NAS) reviewed and declared global warming a real problem likely due to human activities; and

WHEREAS, the 2000 U.S. Global Change Research Program's (USGCRP) First National Assessment indicated that global warming has begun; and

WHEREAS, 162 countries including the United States pledged under the United Nations Framework Convention on Climate Change to reduce their greenhouse gas emissions; and

WHEREAS, energy consumption, specifically the burning of fossil fuels, accounts for more than 80% of U.S. greenhouse gas emissions; and

WHEREAS, local government actions taken to reduce greenhouse gas emissions and increase energy efficiency provide multiple local benefits by decreasing air pollution, creating jobs, reducing energy expenditures, and saving money for the local government, its businesses, and its residents; and

WHEREAS, the Cities for Climate Protection® Campaign sponsored by ICLEI – Local Governments for Sustainability has invited the **City/Town/County** to join ICLEI and become a partner in the Cities for Climate Protection Campaign;

NOW THEREFORE, BE IT RESOLVED, that the **City of Greenfield, MA** will join ICLEI as a Full Member and participate in the Cities for Climate Protection Campaign and, as a participant, pledges to take a leadership role in promoting public awareness about the causes and impacts of climate change.

BE IT FURTHER RESOLVED, that the **City/Town/County** will undertake the Cities for Climate Protection Campaign's five milestones to reduce both greenhouse gas and air pollution emissions throughout the community, and specifically:

- Conduct a greenhouse gas emissions inventory and forecast to determine the source and quantity of greenhouse gas emissions in the jurisdiction;
- Establish a greenhouse gas emissions reduction target;
- Develop an action plan with both existing and future actions which when implemented will meet the local greenhouse gas reduction target;
- Implement the action plan; and
- Monitor and report progress; and

BE IT FINALLY RESOLVED that the **City of Greenfield** requests assistance from ICLEI's Cities for Climate Protection Campaign as it progresses through the milestones.

Christine Forgey, Mayor of Greenfield Date: February 2008

#2 Appendix

Government Energy Audit Charts

Table of Contents

Appendix 2.1

Greenfield: Municipal Operations

Summary: Energy, Climate Change Emissions, and Cost

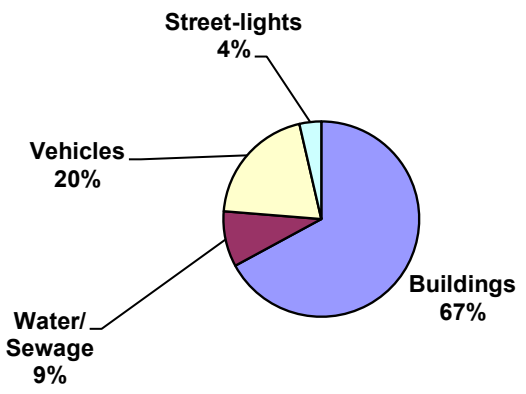
Base Year: FY2001

Sector	Energy Equivalent (million Btu-MMBtu)	Climate Change (CC) Emissions (tons CO2e)	% CC Emissions	Cost ($)
Buildings	50,919	5,628	52%	$811,045
Water/Sewage	6,954	1,672	16%	$195,614
Vehicles	15,237	1,313	12%	$212,140
Streetlights	2,731	732	7%	$157,582
Waste	na	1,386	13%	$334,991
TOTAL	**75,841**	**10,731**	100%	**$1,711,372**

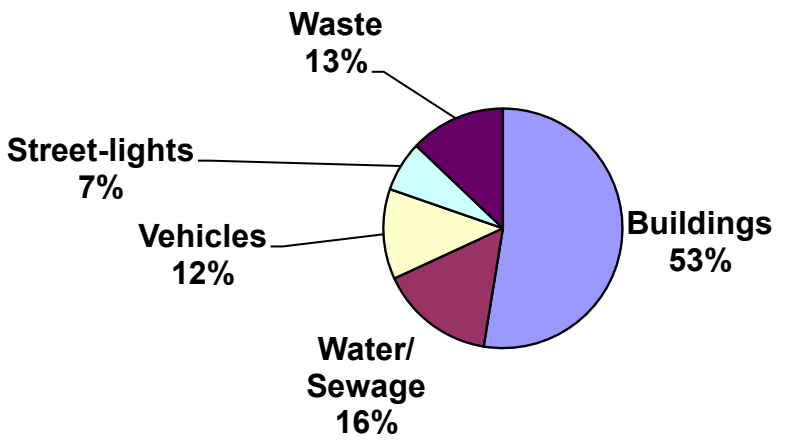
Energy Equivalent: All energy use, such as oil, natural gas, electricity, has been converted to millions of BTUs (MMBtu), so that we can add them all up. ONE BTU (British Thermal Unit) is equal to the burning of one match or technically it can raise one ounce of water one degree farenheit.

CO2e or eCO2 referrs to "Carbon Dixide equivalants" In other words, the effect of other climate change emissions, such as methane, nitrous oxide etc, have been converted into the effect of carbon dioxide. Methane, for example, is 20 times more potent than CO2.

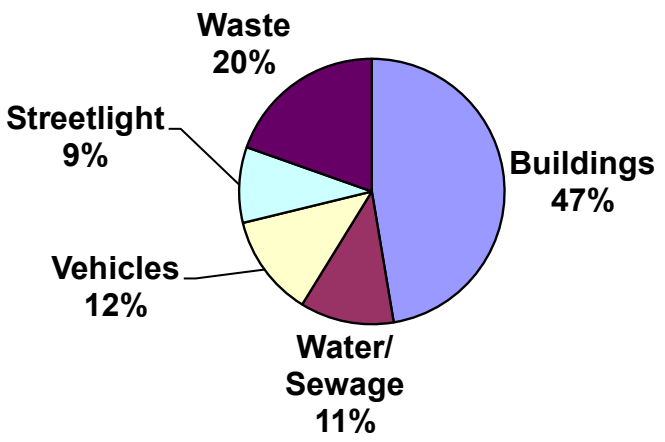
Energy Equivalent (million Btu-MMBtu)



Climate Change (CC) Emissions (tons CO2e)



Cost ($)



Appendix 2.2

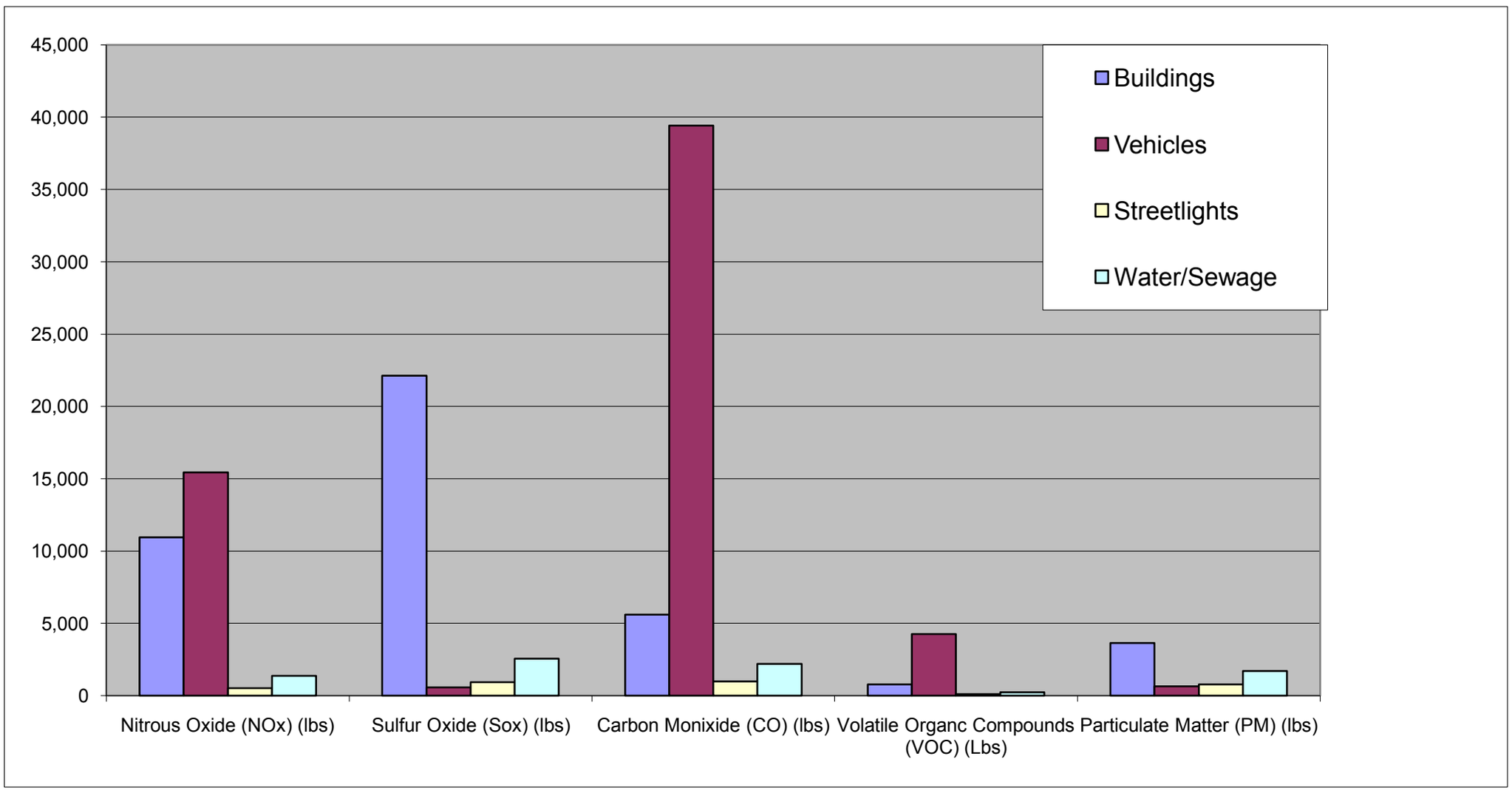
Greenfield: Municipal Operations Summary

Criteria Air Pollutants

Base Year: FY2001

Sector	Nitrous Oxide (NOx) (lbs)	Sulfur Oxide (Sox) (lbs)	Carbon Monixide (CO) (lbs)	Volatile Organc Compounds (VOC) (Lbs)	Particulate Matter (PM) (lbs)
Buildings	10,959	22,111	5,606	774	3,640
Vehicles	15,445	574	39,427	4,265	656
Streetlights	523	938	992	110	781
Water/Sewage	1,364	2,559	2,198	248	1,719
Waste	na	na	na	na	na
TOTAL	**28,291**	**26,182**	**48,223**	**5,397**	**6,796**

NOx & VOCs- causes smog-related health problems - lungs, heart etc.
SOx - causes acid rain
CO - asphyxiant
PM - lung irritant causes lung disease



Appendix 2.3

Greenfield: Municipal Operations Summary

Water and Sewage: Energy Use, Climate Change Emissions, and Cost

Base Year: FY2001 (13% of total CO2e Emissions)

Municipal Buildings: Energy Use & Climate Change Emissions: FY01						
Building Name	**Elec use (MMBtu)**	**Oil use (MMBtu)**	**Propane (MMBtu)**	**Total Energy Use (MMBtu)**	**Climate Change (Tons CO2e)**	**Cost $$**
Adams Hill Pump Station	140			140	38	$4,560.00
Green River Pump Station	1014		138	1152	282	$29,115.00
Millbrook Wellfield	1486		56	1542	403	$42,512.00
Oak Hill Filter plant	70		194	264	33	$4,408.00
Wastewater Treatment Plant	3225	630		3855	917	$115,019.00
TOTALS	**5935**	**630**	**388**	6953	**1673**	**$195,614.00**

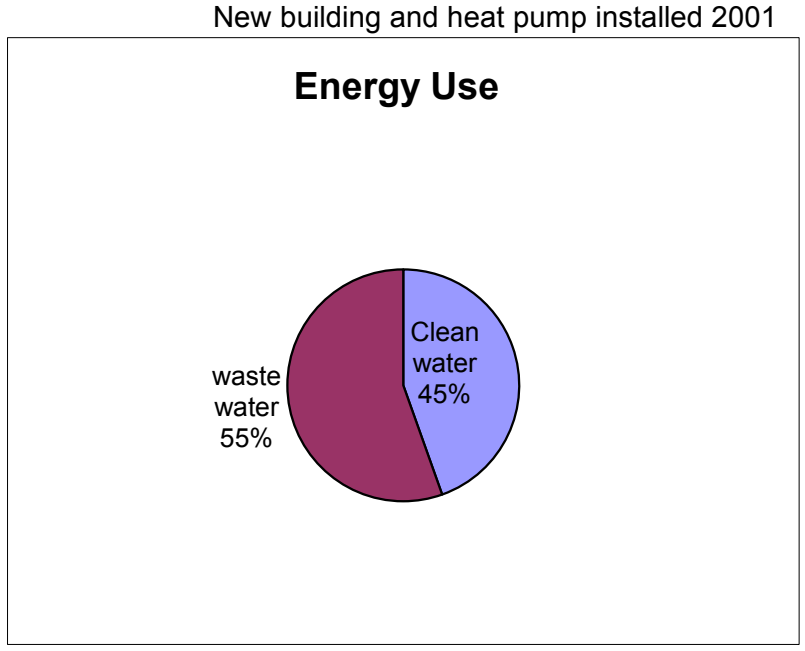
Notes: IF water pumping were consistent from year to year, we could look at energy used / gallons pumped

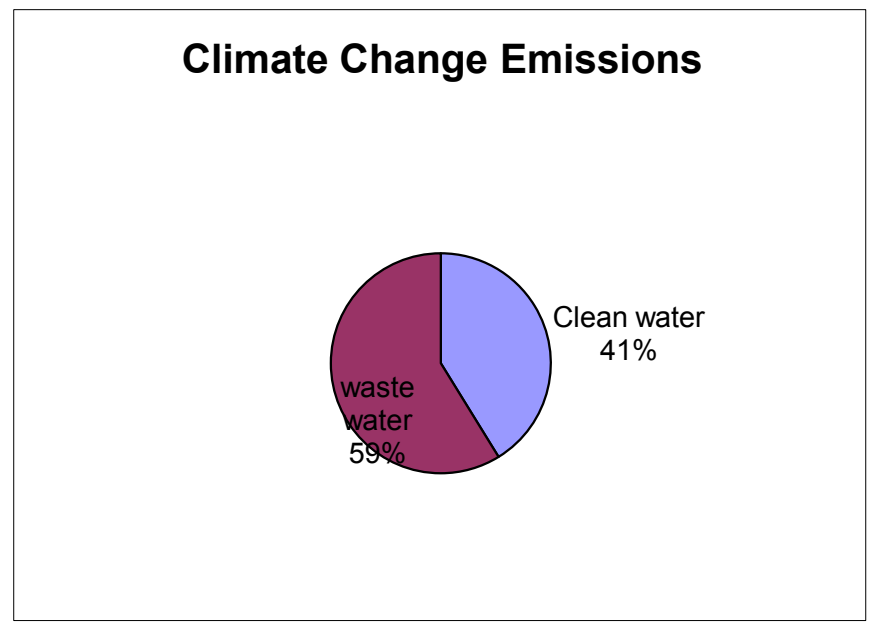
Plant notes:

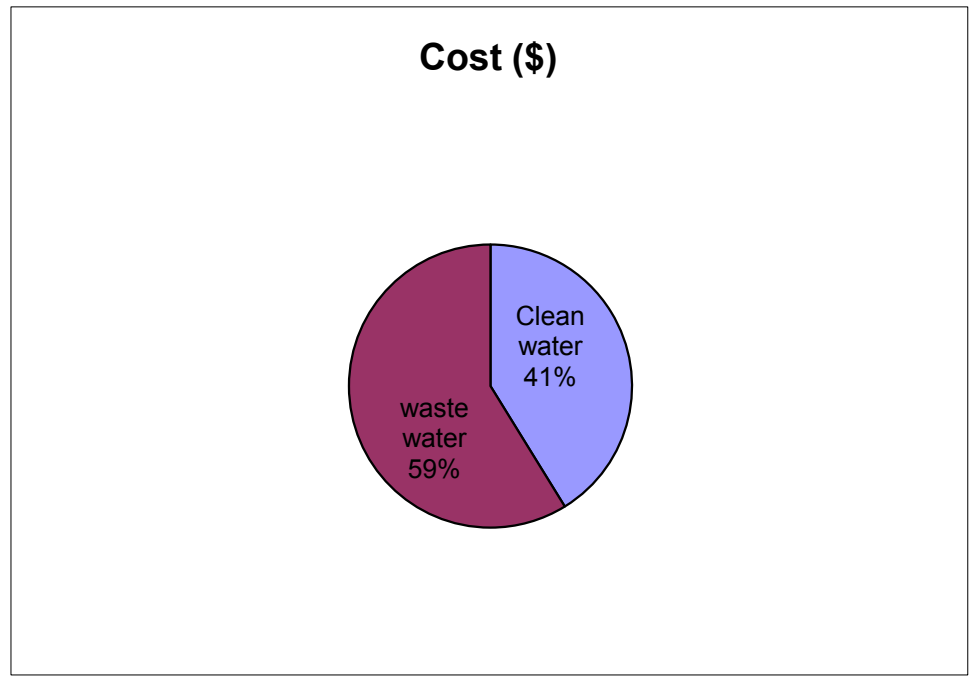
Millbrook Wellfield pumps upgraded as follows: Wel l#1-2001; well #3-2003; well #2-2008

Wastewater Treatment: pumps upgraded 1999 & 2001

New building and heat pump installed 2001







Appendix 2.4

Greenfield: Municipal Operations Summary

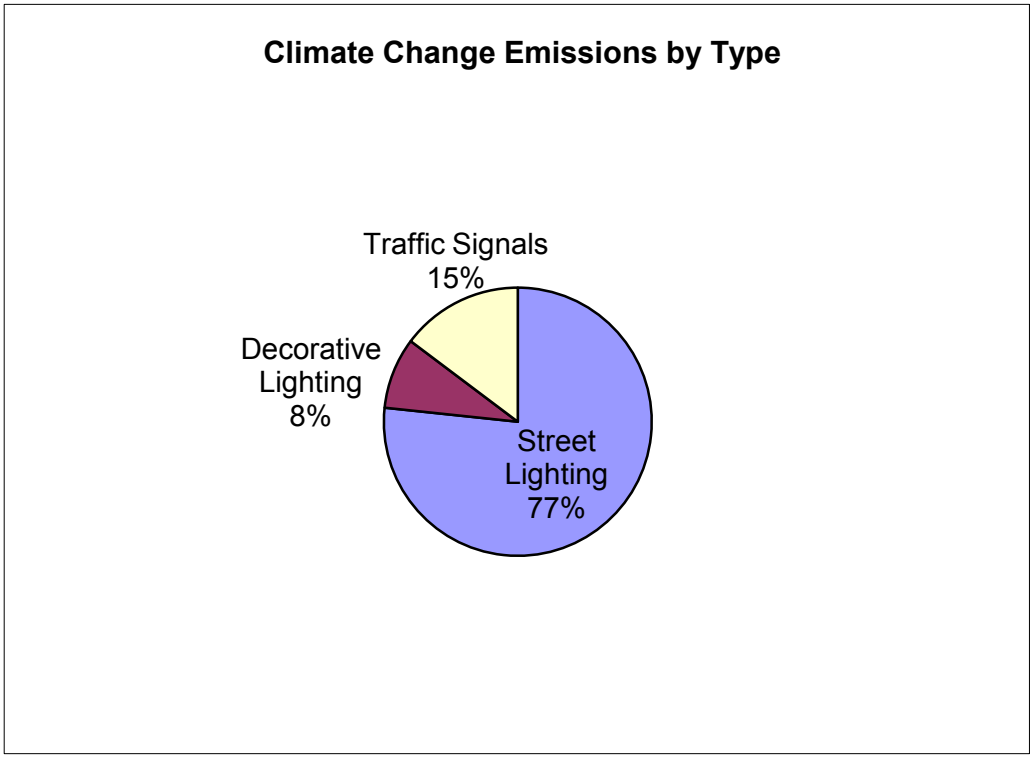
Lighting

Base Year: FY2001

7% of Total CO2e Emissions

What	Electricity use (kwh)	Energy use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Street Lighting	614,039	2096	562	$132,923
Decorative Lighting	68,413	223	63	$12,076
Traffic Signals	117,814	402	108	$12,583
TOTALS	**800,266**	**2,721**	**733**	**$157,582**

Notes: Traffic signals updated to LEDs (Low Emitting Diodes) installed 200-2001



Appendix 2.5

#2.4 Appendix

Greenfield: Municipal Operations Summary

Vehicles

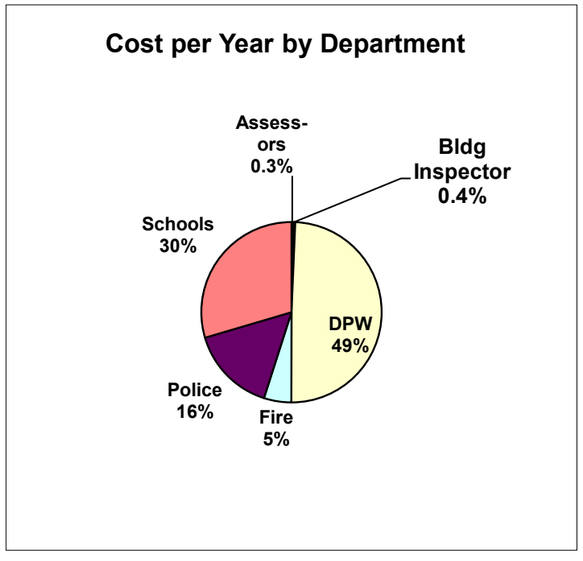
Base Year: FY2001

12% of Total CO2e Emissions

	Gasoline Vehicles			Diesel Vehicles			TOTAL	CC Emissions	TOTAL
Department	# vehicles	gallons	Cost	# vehicles	gallons	Cost	MMBtu	Tons CO2	Cost
Assessors	1	334	$591	0	0	$0	42	4	$591
Bldg Inspector	2	482	$829	0	0	$0	61	5	$829
DPW	28	14,206	$24,434	34	46,672	$80,276	7,479	646	$104,710
Fire	3	1,808	$3,110	4	4,252	$7,313	747	65	$10,423
Police	21	19,116	$32,880	0	0	$0	2,401	206	$32,880
Schools	13	16,534	$28,438	9	19,936	$34,273	4,508	387	$62,711
Sub-Totals	**68**	**52,480**	**$90,282**	**47**	**70,860**	**$121,862**	**15,238**	**1,313**	**$212,144**
Schools-Kuzmeskux bues				**5**	**na**	**na**	**na**	**na**	**na**

Notes: # of vehicles and gallons used assumed to be the same as 2008
COST: based on DOE info on cost/week and then averaged ($1.72/gal)
good news: data on gallons used / vehicle is now being collected

Town owned Vehicles & school buses: Number and Type of vehicles owned						
	Gasoline Vehicles					
	Assessor	Bldg inspect	DPW	Fire	Police	Schools
auto FULL	1	1	3	2	15	
auto MID						
auto SUB					1	`
SUV & Pick Ups		1	7	1	2	2
passenger vehicle		0	3		3	6
van						3
transit bus						2
Heavy truck			15			
TOTALS-gasoline	**1**	**2**	**28**	**3**	**21**	**13**
Gasoline total=68						
	Diesel Vehicles					
	Assessor	Bldg inspect	DPW	Fire	Police	Schools
auto FULL						
auto MID						
auto SUB						
SUV/PU						
passenger			1			
van						
transit bus						1
Heavy truck			33	4		
Kuz. School buses						8
TOTALS-diesel	**0**	**0**	**34**	**4**	**0**	**9**
Diesel Total =47						
TOTAL ALL Vehicles = 115						



Appendix 2.6

Greenfield: Municipal Operations Summary

Buildings: Sorted by Department and Energy Use / Sq Ft

Energy Use, Climate Change Emissions, and Cost

Base Year: FY2001

53% of total CO2e emissions

Building Name	Area (sq Ft)	Energy kBTU/ sq ft	Cost $/ sq ft	Elec use (MMBtu)	Oil use (MMBtu)	Natural Gas (MMBtu)	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
DPW (See water-sewer report for additional facilities)									
Town Yard - Wells St*	30,377	89	$1.17	294	210	2,213	2,717	233	$35,645
Transfer Station, Cumberland Ave*	7,707	201	$2.64	191	196	1,160	1,548	139	$20,339
Sub Total - DPW	**38,084**	**na**	**na**	**485**	**406**	**3,373**	**4,265**	**372**	**$55,984**
Schools									
Newton St, Modulars	4,020	34	$0.67	31	0	107	137	15	$2,687
High School Modulars**	4,020	44	$0.85	37	0	138	175	18	$3,436
Vet's Field House @ High School	7,200	62	$0.95	29	420	0	449	42	$6,871
Elementary School- Fed St N&S	62,140	66	$1.00	871	0	3,220	4,091	433	$62,149
Middle School - Federal St	120,692	70	$1.04	1,355	5,039	2,046	8,439	906	$125,385
North Parish School/Early Learning	29,590	72	$1.08	431	0	1,711	2,142	221	$32,098
High School- Lenox Ave	169,650	76	$1.28	2,617	9,518	768	12,903	1,536	$216,576
Newton Street School - Shelburne Rd	32,732	83	$1.42	807	0	1,911	2,718	335	$46,317
Davis Street Sch-Admin bldg	18,000	92	$1.45	251	1,296	0	1,647	201	$26,154
Four Corners School	37,439	106	$1.37	409	0	3,546	3,956	329	$51,308
Green River School -Meridian St	20,570	125	$2.15	360	2,204	0	2,565	279	$44,145
Sub Total - Schools	**506,053**	**na**	**na**	**7,198**	**18,477**	**3,546**	**39,222**	**4,315**	**$617,126**
Town - misc buildings									
Council on Aging	7,000	37	$1.61	257	0	0	257	69	$11,303
Fire Station	21,200	80	$1.33	228	1,470	0	1,697	183	$28,125
Industrial Museum - PettyPlain Rd	1,440	29	$0.49	3	39	0	42	4	$705
Library - 402 Main St.	15,990	65	$1.24	367	0	676	1,043	140	$19,845
Police Station	11,500	152	$2.82	735	0	1,018	1,753	260	$32,384
Teen Center - Sanderson St	14,410	37	$0.62	72	462	0	534	58	$8,898
Town Hall & Annex	16,430	128	$2.22	469	1,638	0	2,106	261	$36,470
Town Pool - Nash's Mill Rd	na	na	na	1	0	0	1	0	$205
Sub Total - Town	**87,970**	**na**	**na**	**2,132**	**3,609**	**1,694**	**7,433**	**975**	**$137,935**
TOTALS	**632,107**	**81 average**	**$1.29 avg.**	**9,815**	**22,492**	**8,613**	**50,920**	**5,662**	**$811,045**

* Uses waste crank case oil, so cost for oil less than market rate

** Not in use. Building kept at low temperature

Appendix 2.7

Greenfield: Municipal Operations Summary

Buildings Sorted by Energy Use Per Square Foot

Thousands of BTU's (kBtu) - the lower the better

Also, Energy Use, Climate Change Emissions, and Cost

Base Year: FY2001

53% of total CO2e emissions

Building Name	Area (sq Ft)	Energy kBTU/ sq ft	Cost $/ sq ft	Elec use (MMBtu)	Oil use (MMBtu)	Natural Gas (MMBtu)	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Industrial Museum - PettyPlain Rd	1,440	29	$0.49	3	39	0	42	4	$705
Newton St, Modulars	4,020	34	$0.67	31	0	107	137	15	$2,687
Council on Aging	7,000	37	$1.61	257	0	0	257	69	$11,303
Teen Center - Sanderson St	14,410	37	$0.62	72	462	0	534	58	$8,898
High School Modulars	4,020	44	$0.85	37	0	138	175	18	$3,436
Vet's Field House @ High School	7,200	62	$0.95	29	420	0	449	42	$6,871
Library - 402 Main St.	15,990	65	$1.24	367	0	676	1,043	140	$19,845
Elementary School- Fed St. N&S	62,140	66	$1.00	871	0	3,220	4,091	433	$62,149
Middle School - Federal St.	120,692	70	$1.04	1,355	5,039	2,046	8,439	906	$125,385
North Parish School/Early Learning	29,590	72	$1.08	431	0	1,711	2,142	221	$32,098
High School- Lenox Ave	169,650	76	$1.28	2,617	9,518	768	12,903	1,536	$216,576
Fire Station	21,200	80	$1.33	228	1,470	0	1,697	183	$28,125
Newton Street School - Shelburne Rd	32,732	83	$1.42	807	0	1,911	2,718	335	$46,317
Town Yard - Wells St	30,377	89	$1.17	294	210	2,213	2,717	233	$35,645
Davis Street Sch-Admin bldg	18,000	92	$1.45	251	1,296	0	1,647	201	$26,154
Four Corners School	37,439	106	$1.37	409	0	3,546	3,956	329	$51,308
Green River School -Meridian St	20,570	125	$2.15	360	2,204	0	2,565	279	$44,145
Town Hall & Annex	16,430	128	$2.22	469	1,638	0	2,106	261	$36,470
Police Station	11,500	152	$2.82	735	0	1,018	1,753	260	$32,384
Transfer Station, Cumberland Ave	7,707	201	$2.64	191	196	1,160	1,548	139	$20,339
Town Pool - Nash's Mill Rd	na	na	na	1	0	0	1	0	$205
TOTAL USE (by unit noted)	**632,107**	**81 average**	**$1.29 avg.**	**9,814**	**22,492**	**18,514**	**50,919**	**5,662**	**$810,840**

Appendix 2.8

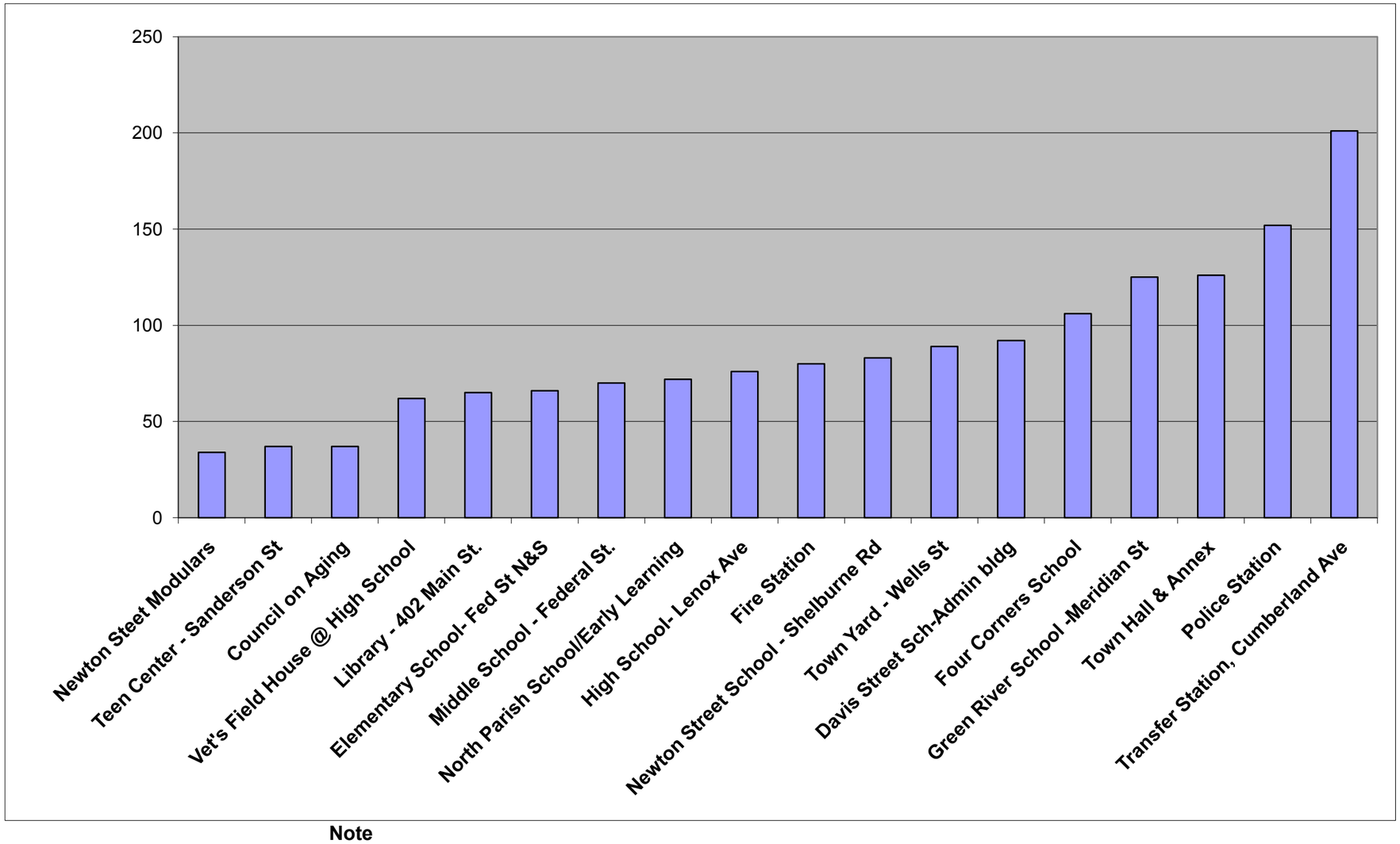
Greenfield: Municipal Operations Summary

Buildings: Energy Use Per Square Foot.

Thousands of BTU's (kBtu) - The lower the better!!

Base Year: FY2001

53% of total CO2e emissions



Note

The worst building uses 5 times as much energy as the best

There is much room for improvement

Appendix 2.9

Greenfield: Municipal Operations Summary

Waste Mangement

2002 - 2007 (Base year: Waste is 13% of Total CO2e emissions)

ANALYSIS: Total cost went down from $334,991 to $316,571 in spite fo the fact that the tipping fee incresed. This was possible by reducing total waste, AND increasing % recycling.

what	where goes	2002	2003	2004	2005	2006	2007	Recycled outcome
Trash -tons	Spfld incinerator	6,469	6,189	6,225	5,344	4,537	4,289	Electricity generated
COST of Trash disposal		$334,991					$316,571	
COST /Ton - disposal (Springfield Incinerator)		$52					$74	
CO2e from trash (Tons)		1,386					952	
Recycled Tons	see below	2,494	2,695	2,885	2,890	2,988	3,069	see below
Recycled - % of total waste measurable by Tons		28%	30%	32%	35%	40%	42%	
CO2e avoided by recycling (tons)		7,038					8,644	
DETAILS of Recycling - Materials Measurable in Tons								
Materials tracked by Tons	**where goes**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Recycled outcome**
Paper - Tons	MRF	1,253	1,154	1,189	1,348	1,431	1,318	paper products made
comingled-Tons	MRF	367	398	403	441	518	545	new products made
Cardboard-Tons	cardboard place	223	168	130	129	84	103	new carbard made
Construction waste	F&G via Dave Wickles	22	na	na	na	na	188	recycled in Connecticut
Scrap metal-Tons	Kramers recycle	21	364	553	359	341	301	new products made
CRTs-Tons	Viola - recycle	16	19	19	21	22	23	reycycle raw materials
Flourescent lights-Tons	Viola - recycle	0.76	0.58	0.19	1.25	0.82	0.15	reyccle raw materials
Yard waste	composted	591	591	591	591	591	591	Compost used by town
Trash - Tons	Spfld incinerator	6,469	6,189	6,225	5,344	4,537	4,289	Electricity generated
Total - Tons		**8,963**	**8,884**	**9,110**	**8,234**	**7,525**	**7,358**	
Other Materials being Tracked -- note UNITS below								
Flourescent (Linear Ft)	Viola - recycle	9,830	7,498	2,456	16,207	10,616	1,932	recycle raw materials
Crank case oil (gal)	DPW heat &*Envirosave	3,600	2,695	2,800	2,950	2,700	165	Heat DPW bldgs OR recycle
Paint (gal)	*Envirosafe	na	na	na	na	220	185	"safe disposal"
Propane gas tanks (#)	Interstate Refrigeration	135	485	543	556	387	387	recycle metal, cannot be refilled
Auto Batteries (#)	Sullivan	480	435	350	107	na	115	new batteries made
Mercury	*Envirosafe	na	na	na	na	na	na	08- shed acquired-reycle
	* put out to bid annually							

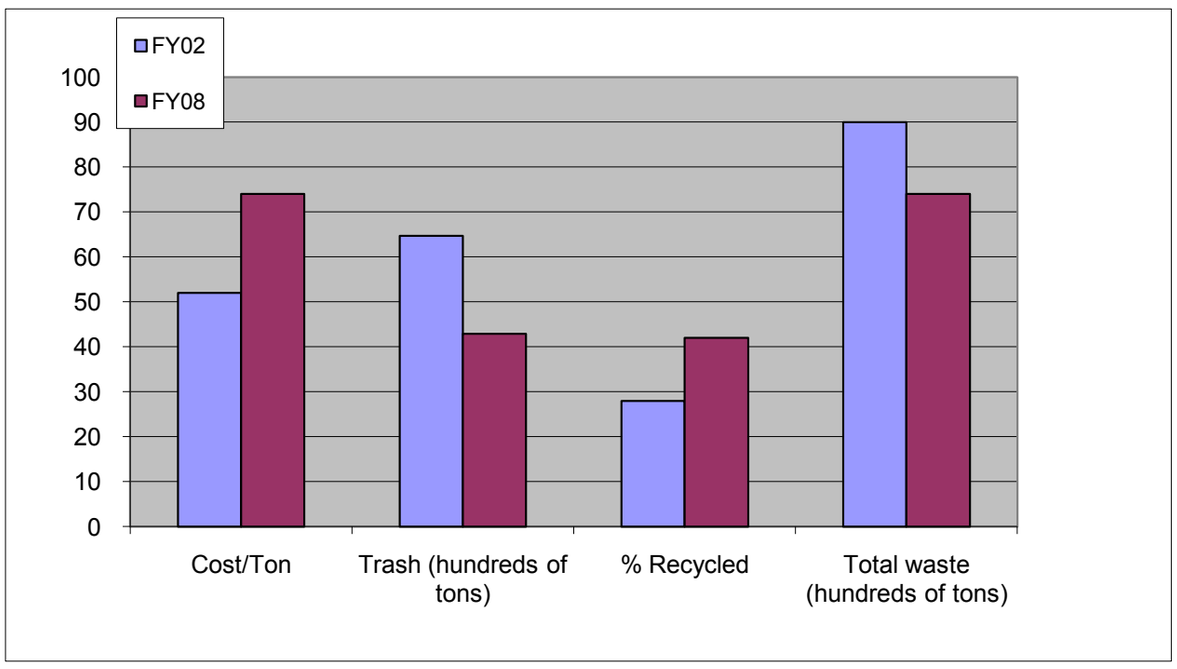
Notes:

Note units under WHAT

Comingled includes plastic, glass, aluminum bottles etc.

CRT: Cathoid Ray Tubes - such as TVs and computer Monitors

flourescent light conversion from linear feet (LF) to tons 0.1547 lbs/ln ft div by 2000= Tons



Appendix 2.10

Greenfield: Municipal Operations

Analysis By Fuel Type

Energy, Climate Change Emissions and Cost

FY 2001 & FY2008

FY2001 Energy Type	Energy MMBtu	Climate Change Emissions CO2e	Cost
Electricity	18,584	4,919	$664,024
Heating Oil	23,121	1,911	$292,139
Natural Gas	18,512	1,144	$203,794
Diesel	8,645	750	$121,862
Gasoline	6,593	563	$90,278
Propane	388	28	$4,284
Waste	na	1,385	$334,992
Total	**75,843**	**9,315**	**$1,376,381**

FY2008 Energy Type	Energy MMBtu	Climate Change Emissions Tons CO2e	Cost
Electricity	20,194	5,415	$973,562
Heating Oil	16,902	1,397	$345,953
Natural Gas	20,727	1,281	$307,512
Diesel	8,645	750	$245,184
Gasoline	6,604	562	$160,522
Propane	308	22	$8,063
Waste	na	953	$316,571
Totals	**73,380**	**9,427**	**$2,040,796**

% Change FY08 compared to FY01 (hange div by 01)	Energy MMBtu	Climate Change Emissions Tons CO2e	Cost
Electricity	8.7%	10.1%	46.6%
Heating Oil	-26.9%	-26.9%	18.4%
Natural Gas	12.0%	12.0%	50.9%
Diesel	0.0%	0.0%	101.2%
Gasoline	0.2%	-0.2%	77.8%
Propane	-20.6%	-21.4%	-1.8%
Waste	na	-31.2%	-5.5%
Totals	**-26.7%**	**-26.4%**	**293.2%**

Appendix 2.11

Greenfield: Municipal Operations
Analysis by Sector FY2001-FY2008

Sector		FY2001	FY2008	Variance FY2008-FY2001	Variance %
Buildings					
	Energy (MMBtu)	50,919	48,603	-2,316	-4.5%
	eCO2 (tons)	5,628	5,742	114	2.0%
	Cost ($)	$811,045	$1,218,992	$407,947	50.3%
Water/Sewage					
	Energy (MMBtu)	6,954	5,968	-986	-14.2%
	eCO2 (tons)	1,672	1,419	-253	-15.1%
	Cost ($)	$195,614	$274,752	$79,138	40.5%
Vehicle Fleet					
	Energy (MMBtu)	15,237	15,249	12	0.1%
	eCO2 (tons)	1,313	1,311	-2	-0.2%
	Cost ($)	$212,140	$405,706	$193,566	91.2%
Streetlights					
	Energy (MMBtu)	2,731	3,560	828	30.3%
	eCO2 (tons)	723	955	231	31.9%
	Cost ($)	$157,582	$141,346	-$16,236	-10.3%
Waste					
	Energy (MMBtu)	na	na	na	na
	eCO2 (tons)	1,386	952	-434	-31.3%
	Cost ($)	$334,991	$316,571	-$18,420	-5.5%
Recycling - Tons of CO2e avoided					
		-7,038	-8,644	-1,606	22.8%
Totals (without recycling info)					
	Energy (MMBtu)	**75,841**	**73,380**	**-2,462**	-3.2%
	eCO2 (tons)	**10,701**	**10,378**	**-323**	-3.0%
	Cost ($)	**$1,711,372**	**$2,357,367**	**$645,995**	37.7%

This report has been generated for greenfield, ma using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith Associates, Inc.

Appendix 2.12

Greenfield: Municipal Operations Summary

Buildings: Sorted by Department

Thousands of BTUs (kBtu) - the lower the better

Energy Use, Climate Change Emissions, and Cost

FY2008

53% of total CO2e emissions

Building Name	Area (kq Ft)	Energy kBTU/ sq ft	Cost $/sq ft	Elec use (MMBtu)	Oil use (MMBtu)	Natural Gas (MMBtu)	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
DPW (See water-sewer report for additional facilities)									
Town Yard* - Wells St	30,377	77	$1.38	286	210	1,843	2,338	208	$41,796
Transfer Station,* Cumberland Ave	7,707	204	$4.03	331	210	1,027	1,569	170	$31,030
Sub Total - DPW	**38,084**	**na**	**na**	**617**	**420**	**2,870**	**3,907**	**378**	**$72,826**
Schools									
Newton St, Modulars	4,020	34	$1.00	33	0	104	137	15	$4,014
High School Modulars**	4,020	45	$1.42	76	0	104	181	27	$5,700
Vet's Field House @ High School	7,200	58	$1.39	24	392	0	415	39	$9,995
North Parish School/Early Learning	29,590	58	$1.34	401	0	1,320	1,721	189	$39,625
High School- Lenox Ave	169,650	66	$1.73	2,341	8,549	269	11,160	1,351	$292,760
Newton Street School - Shelburne Rd	32,732	68	$1.86	610	0	1,600	2,210	263	$60,873
Elementary School- Fed St South	62,140	73	$1.68	1,121	0	3,408	4,529	511	$104,501
Middle School - Federal St North	120,692	80	$2.12	3,076	854	5,789	9,714	1,253	$256,048
Davis Street Sch-Admin bldg	18,000	101	$2.59	262	1,558	0	1,820	199	$46,683
Four Corners School	37,439	115	$2.20	450	0	3,857	4,307	359	$82,437
Green River School -Meridian St	20,570	123	$2.98	222	2,307	0	2,528	250	$61,210
Sub Total - Schools	**506,053**	**na**	**na**	**8,616**	**13,660**	**16,451**	**38,722**	**4,456**	**$963,846**
Town - misc buildings									
Industrial Museum - PettyPlain Rd	1,440	33	$0.83	2	46	0	48	4	$1,202
Council on Aging	7,000	43	$2.35	300	0	0	300	81	$16,476
Teen Center - Sanderson St	14,410	44	$1.31	164	465	0	629	82	$18,856
Fire Station	21,200	55	$1.59	310	791	63	1,164	152	$33,785
Library - 402 Main St.	15,990	67	$1.41	395	0	673	1,068	148	$22,529
Town Hall & Annex	16,430	82	$2.67	479	865	0	1,344	200	$43,801
Police Station	11,500	122	$3.85	728	0	675	1,402	237	$44,302
Town Pool - Nash's Mill Rd	na	na	na	18	0	0	18	5	$1,369
Sub Total - Town	**87,970**	**na**	**na**	**2,396**	**2,167**	**1,411**	**5,973**	**909**	**$182,320**
TOTALS	**632,107**	**81 average**	**$1.29 avg.**	**11,629**	**16,247**	**20,732**	**48,602**	**5,743**	**$1,218,992**

*** Uses crank case oil**

**** Not in use. Low temperature**

Appendix 2.13

Greenfield: Municipal Operations Summary

Buildings: Sorted by Energy Use Per Square Foot

Thousands of BTUs (kBtu) - the lower the better

Energy Use, Climate Change Emissions, and Cost

FY2008

53% of total CO2e emissions

Building Name	Area (kq Ft)	Energy kBTU/ sq ft	Cost $/sq ft	Elec use Kwh (MMBtu)		Oil use gal (MMBtu)		Natural Gas ccf (MMBtu)		Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Newton St, Modulars	4,020	34	$1.00	9,781	33	0	0	1,039	104	137	15	$4,014
Industrial Museum - PettyPlain Rd	1,440	33	$0.83	451	2	332	46	0	0	48	4	$1,202
Council on Aging	7,000	43	$2.35	88,020	300	0	0	0	0	300	81	$16,476
Teen Center - Sanderson St	14,410	44	$1.31	48,040	164	3,322	465	0	0	629	82	$18,856
High School Modulars**	4,020	45	$1.42	22,405	76	0	0	1,023	104	181	27	$5,700
Fire Station	21,200	55	$1.59	90,880	310	5,654	791	628	63	1,164	152	$33,785
Vet's Field House @ High School	7,200	58	$1.39	7,161	24	2,800	392	0	0	415	39	$9,995
North Parish School/Early Learning	29,590	58	$1.34	117,520	401	0	0	12,938	1,320	1,721	189	$39,625
High School- Lenox Ave	169,650	66	$1.73	676,635	2,341	51,085	8,549	5,792	269	11,160	1,351	$292,760
Library - 402 Main St.	15,990	67	$1.41	115,716	395	0	0	6,602	673	1,068	148	$22,529
Newton Street School - Shelburne Rd	32,732	68	$1.86	175,357	610	0	0	15,681	1,600	2,210	263	$60,873
Elementary School- Fed St N&S	62,140	73	$1.68	326,400	1,121	0	0	33,978	3,408	4,529	511	$104,501
Town Yard* - Wells St	30,377	77	$1.38	86,730	286	1,500	210	18,063	1,843	2,338	208	$41,796
Middle School - Federal St North	120,692	80	$2.12	861,696	3,076	6,100	854	58,125	5,789	9,714	1,253	$256,048
Town Hall & Annex	16,430	82	$2.67	140,291	479	6,180	865	0	0	1,344	200	$43,801
Davis Street Sch-Admin bldg	18,000	101	$2.59	76,635	262	11,133	1,558	0	0	1,820	199	$46,683
Four Corners School	37,439	115	$2.20	134,242	450	0	0	37,831	3,857	4,307	359	$82,437
Police Station	11,500	122	$3.85	213,200	728	0	0	6,614	675	1,402	237	$44,302
Green River School -Meridian St	20,570	123	$2.98	66,228	222	17,304	2,307	0	0	2,528	250	$61,210
Transfer Station*, Cumberland Ave	7,707	204	$4.03	97,116	331	1,500	210	10,071	1,027	1,569	170	$31,030
Town Pool - Nash's Mill Rd	na	na	na	5,369	18	0	0	0	0	18	5	$1,369
TOTALS	**632,107**	**81 average**	**$1.29 avg.**	**3,359,873**	**11,629**	**106,910**	**16,247**	**208,385**	**20,732**	**48,602**	**5,743**	**$1,218,992**

*** Uses crank case oil**

**** Not in use. Low temperature**

Appendix 2.14

Greenfield: Municipal Operations Summary

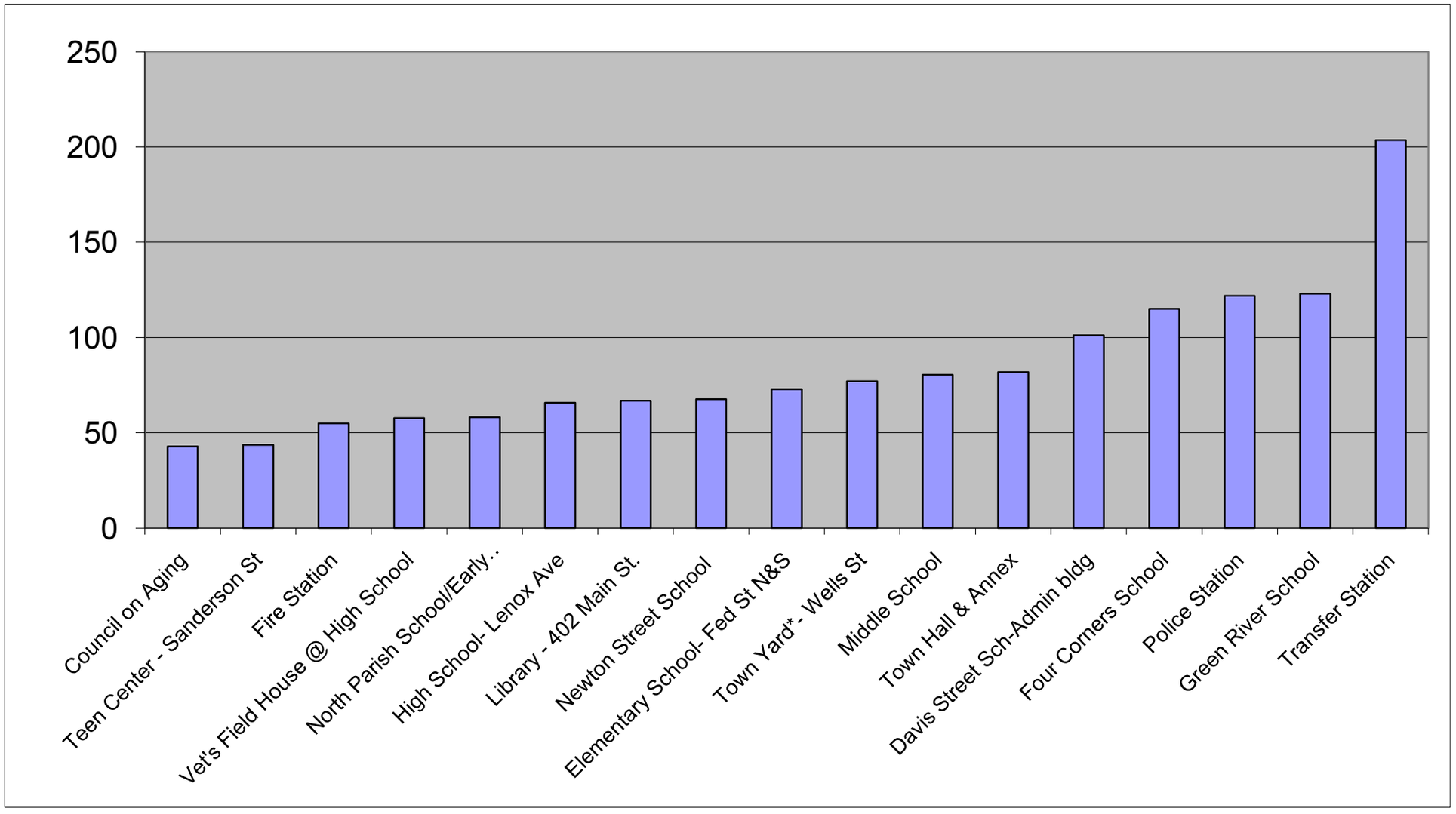
Buildings: Sorted by Energy Use Per Square Foot

Thousands of BTUs (kBtu) - the lower the better

Graph - thousands of BTU Per Square Foot (kBtu/sq ft)

FY2008

53% of total CO2e emissions



Appendix 2.15

Greenfield: Municipal Operations Summary

Buildings 2001 & 2008 Comparisons

FY2001 & FY2008 (by department)

53% of total CO2e emissions

	FY2001			FY 2008			FY2008, Change from FY01		
Building Department & Name	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Shool Department									
Davis Street Sch-Admin bldg	1,647	201	$26,154	1,820	199	$46,683	173	-2	$20,529
Elementary School- Fed St N&S	4,091	433	$62,149	4,529	511	$104,501	438	78	$42,352
Four Corners School	3,956	329	$51,308	4,307	359	$82,437	351	30	$31,129
Green River School -Meridian St	2,565	279	$44,145	2,528	250	$61,210	-37	-29	$17,065
High School Modulars	175	18	$3,436	181	27	$5,700	6	9	$2,264
High School- Lenox Ave	12,903	1,536	$216,576	11,160	1,351	$292,760	-1,743	-185	$76,184
Middle School - Federal St	8,439	906	$125,385	9,714	1,253	$256,048	1,275	347	$130,663
Newton St, Modulars	137	15	$2,687	137	15	$4,014	0	0	$1,327
Newton Street School - Shelburne Rd	2,718	335	$46,317	2,210	263	$60,873	-508	-72	$14,556
North Parish School/Early Learning	2,142	221	$32,098	1,721	189	$39,625	-421	-32	$7,527
Vet's Field House @ High School	449	42	$6,871	415	39	$9,995	-34	-3	$3,124
TOTALS - School Dept	**39,222**	**4,315**	**$617,126**	**38,722**	**4,456**	**$963,846**	**-500**	**141**	**$346,720**
DPW (see water/sewer for other bldgs)									
Town Yard - Wells St	2,717	233	$35,645	2,338	208	$41,796	-379	-25	$6,151
Transfer Station, Cumberland Ave	1,548	139	$20,339	1,569	170	$31,030	21	31	$10,691
TOTALS - DPW	**4,265**	**372**	**$55,984**	**3,907**	**378**	**$72,826**	**-358**	**6**	**$16,842**
Town - Other									
Council on Aging	257	69	$11,303	300	81	$16,476	43	12	$5,173
Fire Station	1,697	183	$28,125	1,164	152	$33,785	-533	-31	$5,660
Industrial Museum - PettyPlain Rd	42	4	$705	48	4	$1,202	6	0	$497
Library - 402 Main St.	1,043	140	$19,845	1,068	148	$22,529	25	8	$2,684
Police Station	1,753	260	$32,384	1,402	237	$44,302	-351	-23	$11,918
Teen Center - Sanderson St	534	58	$8,898	629	82	$18,856	95	24	$9,958
Town Hall & Annex	2,106	261	$36,470	1,344	200	$43,801	-762	-61	$7,331
Town Pool - Nash's Mill Rd	1	0	$205	18	5	$1,369	17	5	$1,164
TOTALS - town other	**7,433**	**975**	**$137,935**	**5,973**	**909**	**$182,320**	**-1,460**	**-66**	**$44,385**
GRAND TOTALS	**50,920**	**5,662**	**$811,045**	**48,602**	**5,743**	**$1,218,992**	**-2,318**	**81**	**$407,947**

Conclusion: There was substantial energy savings in several of the buildings between FY 2001 & FY 2008
This was balanced, however, by increased use most notably by the Middle and Federal Street Elementary School
Of particular note are the following buildings that reduced their energy use.

High School
Town Hall and Annex
Fire Station
Newton Street School, Town yard, and Police Station

#3 Appendix

Community-Wide Energy Audit Charts

Table of Contents

Appendix 3.1

Greenfield: Community-wide Summary
Energy, Climate Change Emissions, and Cost
Base Year: FY2001

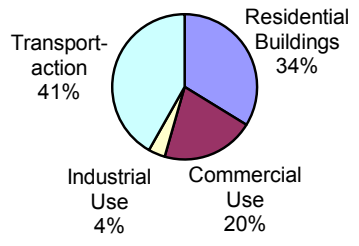
Sector	Energy Equivalent (million Btu)	Climate Change Emissions (CC) (tons CO2e)	% of total CC Emissions	Estimated Cost ($)
Residential Buildings	910,445	105,498	33%	$15,745,231
Commercial Use	557,304	93,189	29%	$13,397,283
Industrial Use	100,819	19,856	6%	$2,866,872
Transportation	1,132,145	97,490	31%	$15,716,779
Waste	n/a	1,435	0%	$334,991
TOTAL	**2,700,713**	**317,468**	100%	**$48,061,156**

Energy Equivalent: All energy use, such as oil, natural gas, electricity, has been converted to millions of BTUs (MMBtu), so that we can add them all up. ONE BTU (British Thermal Unit) is equal to the burning of one match or technically it can raise one ounce of water one degree Fahrenheit.

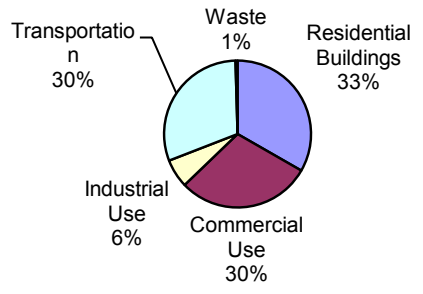
CO2e or eCO2 refers to "Carbon Dioxide equivalents" In other words, the effect of other climate change emissions, such as methane, nitrous oxide etc, have been converted into the effect of carbon dioxide. Methane, for example, is 20 times more potent than CO2.

Greenfield government share is 3.7% of the community total

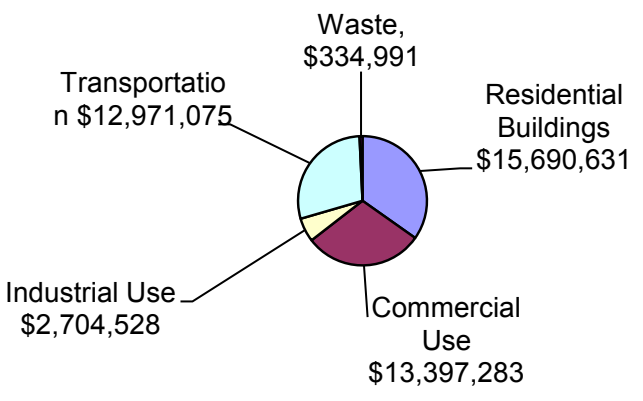
Energy Equivalent (million Btu)



Climate Change Emissions (tons CO2e)



Estimated Cost ($)



Appendix 3.2

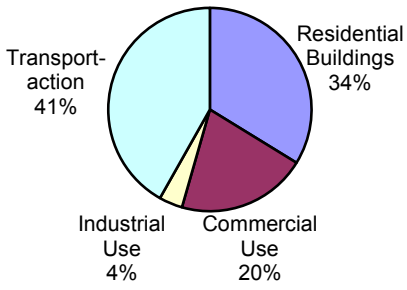
Greenfield: Community-wide Summary
Energy, Climate Change Emissions, and Cost
FY2008

Sector	Energy Equivalent (million Btu)	Climate Change Emissions (CC) (tons CO2e)	% of total CC Emissions	Estimated Cost ($)
Residential Buildings	841,386	100,472	33.7%	$28,332,681
Commercial Use	513,331	82,370	27.6%	$20,847,546
Industrial Use	100,819	20,083	6.7%	$3,770,207
Transportation	1,099,094	94,130	31.6%	$32,518,089
Waste	n/a	952	0.3%	$334,991
TOTAL	**2,554,630**	**298,007**	100%	**$85,803,514**

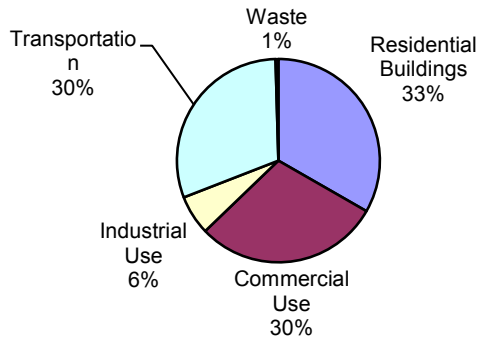
Energy Equivalent: All energy use, such as oil, natural gas, electricity, has been converted to millions of BTUs (MMBtu), so that we can add them all up. ONE BTU (British Thermal Unit) is equal to the burning of one match or technically it can raise one ounce of water one degree Fahrenheit.

CO2e or eCO2 refers to "Carbon Dioxide equivalents" In other words, the effect of other climate change emissions, such as methane, nitrous oxide etc, have been converted into the effect of carbon dioxide. Methane, for example, is 20 times more potent than CO2.

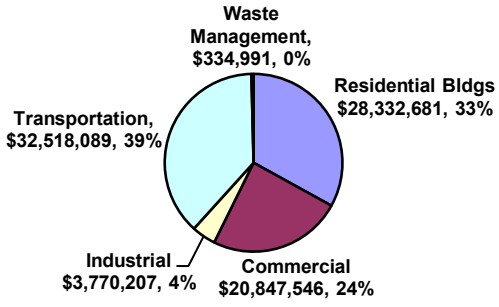
Greenfield government share is 2.8% of the total community-wide energy use
Greenfield government share is 2.7% of the total community wide energy costs



Energy Equivalent (million Btu)



Climate Change Emissions (tons CO2e)



Estimated Cost ($)

Appendix 3.3

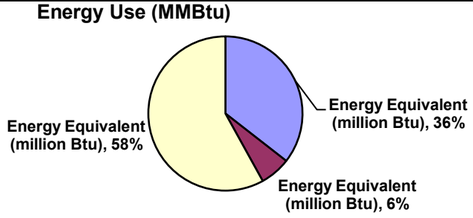
Greenfield: Community-wide Summary

Buildings Detail: Energy Use, Climate Change Emissions, and Cost

Base Year: FY2001

What	number of customers	Average Energy units / customer	sq ft	Elec use (Mwh) ($0.13/kwh)	Oil use (gallons) ($1.85)	Natural Gas (Therms) ($83)	Propane (gallons) ($1.03	Wood (cords) ($120)	Coal ($125/ton) & Misc	Solar	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Population (2000 Census)	18,666												
Households	7,905												
Residential - 33% of Climate change Emissions													
Electricity (2008)	7,931	7,162 kwh		56,830							193,959	51,342	$7,387,900
Coal & other misc	50	2 tons							100		1,921	209	$15,000
Oil (2000)	4,025	870 gal			3,501,750						490,095	40,514	$6,478,238
Natural Gas (therms)	3,058	656 therms				2,005,340					200,534	12,389	$1,664,432
Propane (gal)	265	531					140,720				13,130	950	$144,942
Wood cord)	114	4 cords						456			10,805	95	$54,720
Solar, Wind, etc	n/a	n/a											n/a
Sub-total Residential				**56,830**	**3,501,750**	**2,005,340**	**140,720**	**456**	**100**	**0**	**910,444**	**105,499**	**$15,745,231**
Commercial-30% of CO2e	352		3,395,333										
Electricity (2008)	1,014	70,642 kwh		82,467							281,457	75,503	$10,720,710
Oil	197	.30 gal	1,901,386		562,279						78,695	6,505	$1,040,216
Natural Gas	381	5,500 therms				1,971,514					197,151	12,180	$1,636,357
Solar, Wind, etc	n/a	n/a											
Sub-total Commercial				**82,467**	**562,279**	**1,971,514**	**0**	**0**	**0**	**0**	**557,303**	**94,188**	**$13,397,283**
Industrial -6% of CO2e	39		880,715										
Electricity	33	582,030 kwh		19,207							65,553	17,352	$2,496,910
Oil	22	9,190 gal	200,403		112,226						15,707	1,295	$207,618
Natural Gas	4					195,595					19,560	1,208	$162,344
Sub-total Industrial				**19,207**	**112,226**	**195,595**	**0**	**0**	**0**	**0**	**100,820**	**19,855**	**$2,866,872**
TOTAL USAGE (per unit noted above)				**731,335**	**5,668,859**	**2,005,340**	**140,720**	**456**	**100**	**n/a**			
TOTAL USAGE (MMBtu)				**540,969**	**584,497**	**3,463,133**	**144,942**	**10,805**	**1,921**	**n/a**	**1,568,567**	**219,542**	
TOTAL COSTS				**$20,605,520**	**$7,726,072**	**$3,463,133**	**$144,942**	**$54,720**	**$15,000**	**n/a**			**$32,009,386**

Energy Use (MMBtu)



Notes

Electrical data from WMECO 2008 data. Cost based on average kwh in 2001
Coal - usage and cost from local anecdotal information
Oil: Number of households and gallons per household based on 2000 Census. Cost based on average cost in 2001
Natural gas based on Berkshire Gas company 2002 data
Propane: Number of households based on 2000 census. Usage is a wild guess. Cost based on cost in 2001
Industrial & commercial oil and propane use based on Square footage of buildings from the Greenfield Assessors office, and USDOE information on % using oil etc.

Appendix 3.4

Greenfield: Community-wide Summary

Buildings Detail: Energy Use, Climate Change Emissions, and Cost

Base Year: FY2008

What	number of customers	Energy used / customer	sq ft	Elec use (Mwh) ($0.17/kwh)	Oil use (gallons) ($4.50)	Natural Gas (Therms) ($2.18)	Propane (Gallons) ($4.25	Wood (cords) ($275)	Coal & Misc ($265/ton)	Solar (MMBtu)	Total Energy Use (MMBtu)	Climate Change (Tons CO2e)	Cost $$
Population (2000 Census)	18,666												
Households	7,905												
Residential - 33% of Climate change Emissions													
Electricity (2008)	7,931	7,162 kwh		56,803							193,867	51,988	$9,656,510
Coal & other misc	50	2 tons							100		1,921	209	$26,500
Oil (2000)	4,025	750 gal			3,018,750						422,496	34,926	$13,584,375
Natural Gas (therms)	3,074	648 therms				1,991,668					199,167	12,305	$4,341,836
Propane	265	531					140,720				13,130	950	$598,060
Wood	114	4 cords						456			10,805	95	$125,400
Solar, Wind, etc	n/a	n/a											n/a
Sub-total Residential				**56,803**	**3,018,750**	**1,991,668**	**140,720**	**456**	**100**	**0**	**841,386**	**100,473**	**$28,332,681**
Commercial-30% of CO2e	352		3,395,333										
Electricity (2008)	1,095	71,000 kwh		82,467							237,485	63,684	$14,019,390
Oil	197	.30 gal	1,901,386		562,279						78,695	6,505	$2,530,256
Natural Gas (therms)	381	5,767 therms				1,971,514					197,151	12,180	$4,297,901
Solar, Wind, etc	n/a	n/a											n/a
Sub-total Commercial				**82,467**	**562,279**	**1,971,514**	**0**	**0**	**0**	**0**	**513,331**	**82,369**	**$20,847,546**
Industrial -6% of CO2e	39		880,715										
Electricity	33	582,000 kwh		19,207							65,553	17,579	$3,265,190
Oil	22	.23 gal	493,200		112,226						15,707	1,295	$505,017
Natural Gas (therms)	4	4,883 therms				195,535					19,560	1,208	$426,266
Sub-total Industrial				**19,207**	**112,226**	**195,535**	**0**	**0**	**0**	**0**	**100,820**	**20,082**	**$4,196,473**
TOTAL USAGE (per unit noted above)				**158,477**	**3,693,255**	**4,158,717**	**140,720**	**456**	**100**	**0**			
TOTAL Energy Use (MMBtu)				**496,905**	**516,898**	**415,878**	**13,130**	**10,805**	**1,921**	**n/a**	**1,455,537**	**202,924**	
TOTAL COSTS				**$26,941,090**	**$16,619,648**	**$9,066,003**	**$598,060**	**$125,400**	**$26,500**	**n/a**			**$53,376,701**

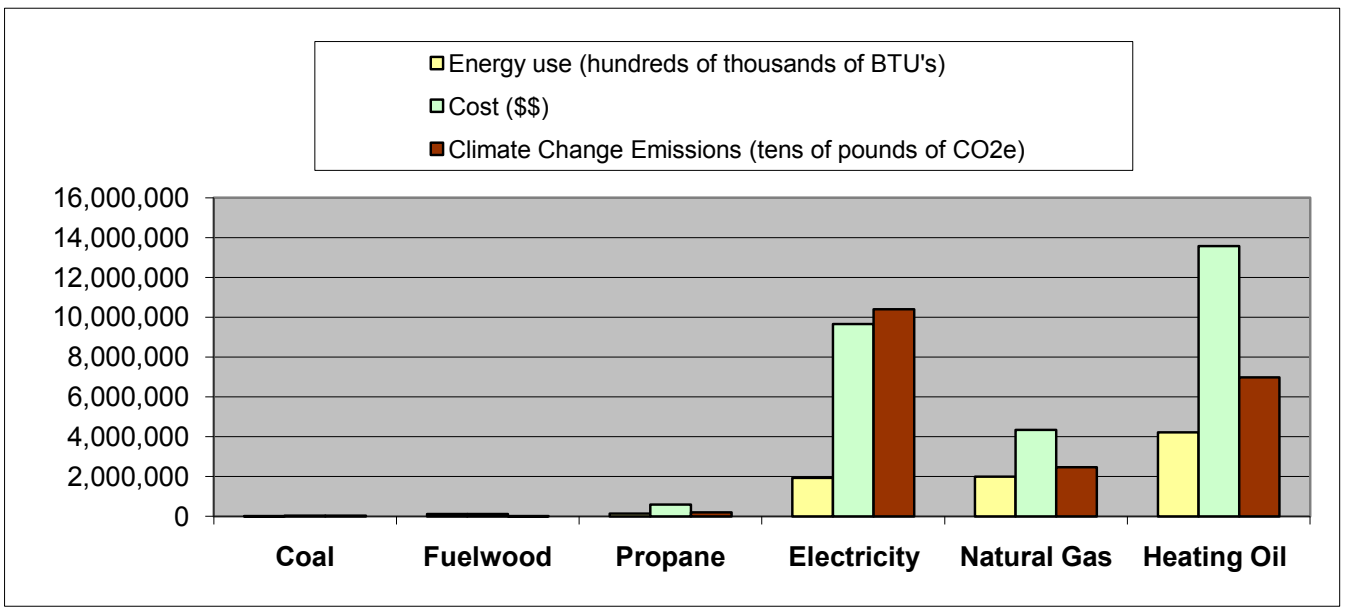
Notes:

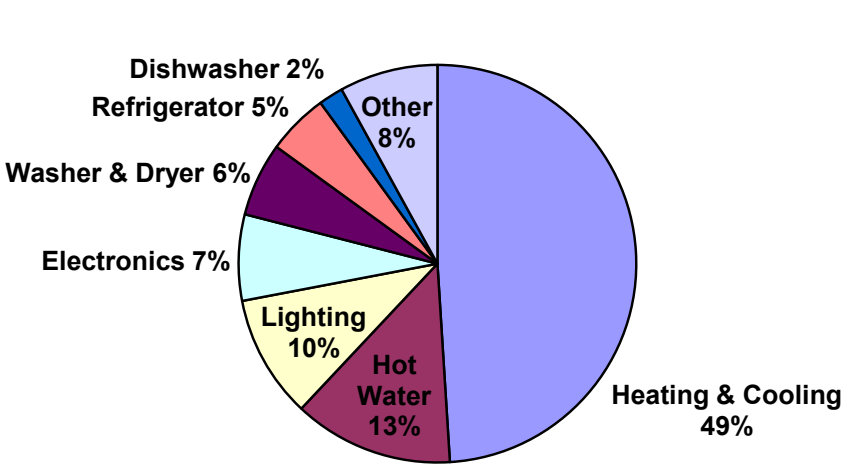
Electrical data from WMECO 2008 data. Cost based on average kwh in 2008
Coal - usage and cost from local anecdotal information
Oil: Number of households and gallons per household based on 2000 Census. Cost based on average cost in 2008
Natural gas based on Berkshire Gas company 2007 data
Propane: Number of households based on 2000 census. Usage is a wild guess. Cost based on cost in 2008
Industrial & commercial oil and propane use based on Square footage of buildings from the Greenfield Assessors office,
and USDOE information on % using oil etc.

Appendix 3.5

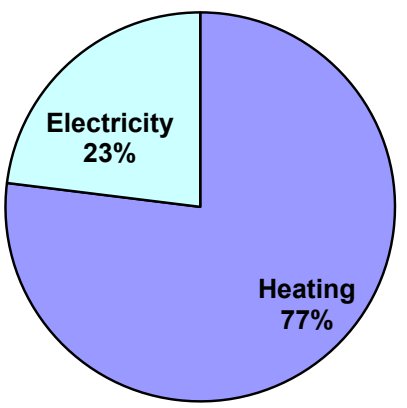
Greenfield Community-Wide Summary
Residential Building Analysis by Fuel Type
Energy Use, Cost, and Climate Change Emissions
Year: FY2008
34% of Total Climate Change Emissions

Fuel Type	Energy use (hundreds of thousands of BTU's)	Cost ($$)	Climate Change Emissions (tens of pounds of CO2e)
Coal	19,210	$26,500	41,800
Fuelwood	108,050	$125,400	18,919
Propane	131,300	$598,060	190,000
Electricity	1,938,670	$9,656,510	10,397,600
Natural Gas	1,991,670	$4,341,836	2,461,000
Heating Oil	4,224,960	$13,584,375	6,985,200
TOTALS	**8,413,860**	**$28,332,681**	**20,094,519**
Totals (note units)	**841,386 MMBtu**	**$56,638,862**	**100,473 tons**





Typical Residential Energy Use (National)
Source: US Department of Energy (DOE

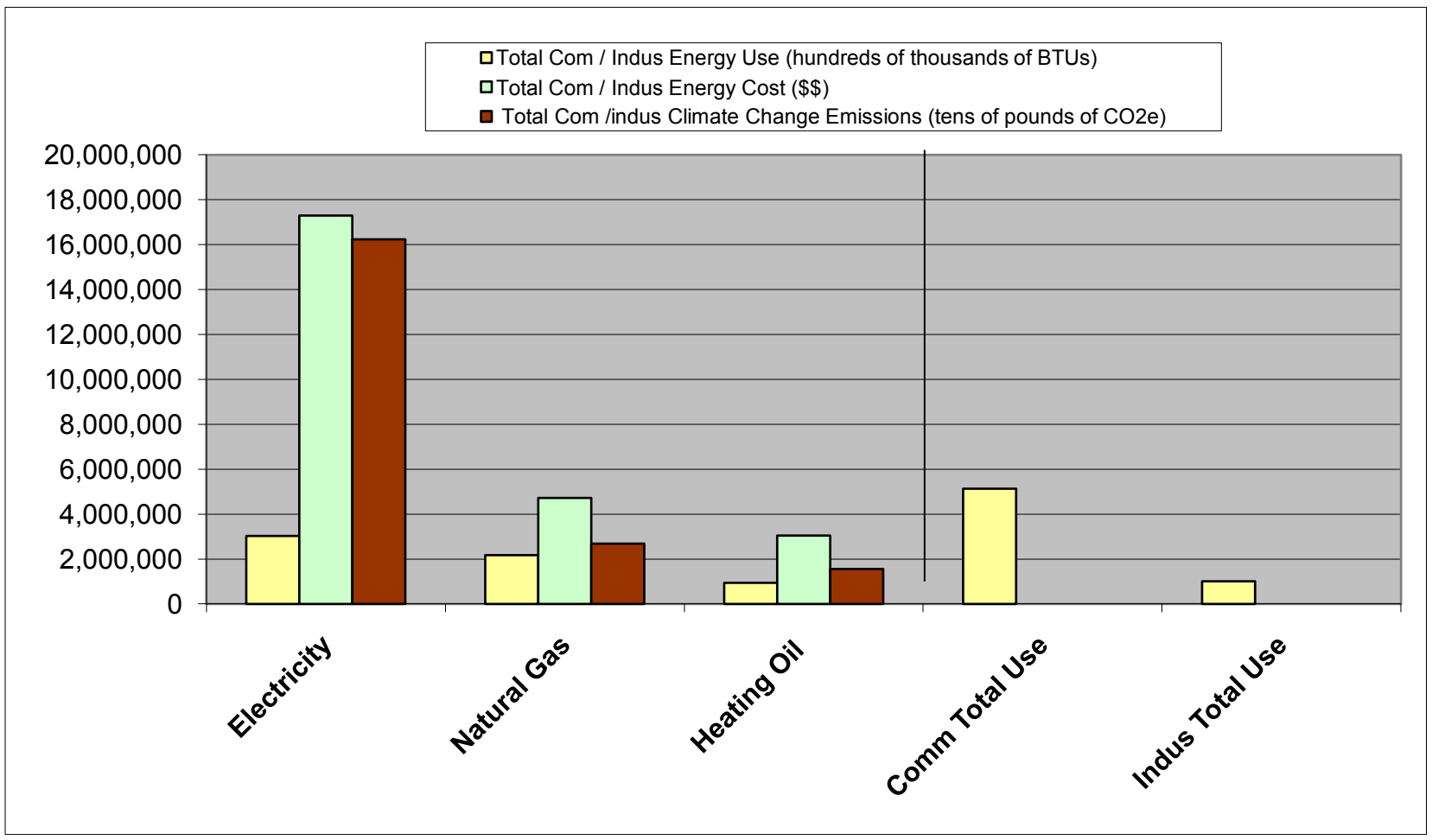


Greenfield Energy use: Heating & Electricity

Appendix 3.6

Greenfield Community-Wide Summary
Commercial & Industrial Analysis by Fuel Type
Energy Use, Cost, and Climate Change Emissions
Year: FY2008
36% of Total Climate Change Emissions

Fuel Type	Commercial Energy Use (included Gov. buildings) (hundreds of thousands of BTUs)	Industrial Energy Use (hundreds of thousands of BTUs)	Total Com / Indus Energy Use (hundreds of thousands of BTUs)	Total Com / Indus Energy Cost ($$)	Total Com /indus Climate Change Emissions (tens of pounds of CO2e)
Electricity	2,374,850	655,530	3,030,380	$17,284,580	16,232,600
Natural Gas	1,971,510	195,600	2,167,110	$4,724,167	2,677,600
Heating Oil	786,950	157,070	944,020	$3,035,273	1,560,000
Propane	n/a	n/a	n/a	n/a	n/a
TOTALS	**5,133,310**	**1,008,200**	**6,141,510**	**$25,044,020**	**20,470,200**
Totals	**513,331 MMBtu**	**100,820 MMBtu**	**614,151 MMBtu**	**$25,044,020**	**102,451 tons**



Total Commercial & Industrial Energy use, Cost, and Climate Change Emissions
With Total Commercial and Industrial Energy use to the right

Appendix 3.7

Greenfield: Community-wide Summary
Transportation Analysis: Part 1
Energy Use, Climate Change Emissions, and Cost
Years: FY2001 & FY2008
30% of total Climate Change Emissions

YEAR: 2001

Vehicle type	# of vehicles	estimated miles/yr per vehicle	Total Miles/year (VMT)	est. MPG	estimated gal/yr	Energy Use (MMBtu)	Climate Change Emissions (Tons CO2)	Cost ($1.72/gal)
car	9,004	11,000	99,044,000	23	4,216,433			$7,252,264
SUV & Pick-up	3,728	11,000	41,008,000	13	3,069,461			$5,279,923
Motorcycle	158	3,550	560,900	50	11,218			$19,295
Heavy Truck	438	16,007	7,011,000	4	1,752,750			$3,014,730
Buses-FRTA**(gas& diesel)	42	7,209	302,774	8	37,847			$65,096
Buses-School (gas & diesel)	22	8,288	182,350	5	36,470			$62,728
Misc	119	1,000	119,000	9	13,222			$22,742
bike & walk**	n/a	n/a	3,285,000	0	0			$0
TOTALS	**13,511**		**151,513,024**		**9,137,401**	**1,132,145**	**97,409**	**$15,716,779**

YEAR: 2008

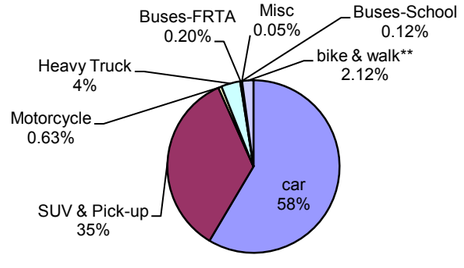
Vehicle type	# of vehicles	estimated VMT/yr per vehicle	Total Miles/year (VMT)	est. MPG	estimated gal/yr	Energy Use (MMBtu)	Climate Change Emissions (Tons CO2)	Cost ($3.45/gal)
car	8,249	11,000	90,739,000	23	3,862,878			$13,326,928
SUV & Pick-up	4,906	11,000	53,966,000	13	4,039,371			$14,081,659
Motorcycle	279	3,500	976,500	50	19,530			$67,379
Heavy Truck	344	16,077	5,530,488	4	1,382,622			$4,770,046
Buses-FRTA**(gas& diesel)	42	7,209	302,774	8	37,847			$130,571
Buses-School (gas & diesel)	22	8,288	182,350	5	32,794			$113,139
Misc	74	1,000	74,000	9	8,222			$28,367
bike & walk**	n/a	n/a	3,285,000	0	0			$0
TOTALS	**13,916**		**155,056,112**		**9,383,264**	**1,099,094**	**94,130**	**$32,518,089**

Notes on data sources and cost assumptions

Number of vehicles based on Registry of Motor Vehicles for Greenfield
VMT = Vehicle Miles Traveled. Annual VMT for cars based on Pioneer Valley Planning Commission data
Car annual miles traveled is based on Pioneer Valley Planning Commission
Motorcycle and Heavy truck VMT based on ICLEI data
*FRTA data - VMT based on 2008 data, and statement that service has not changed much since 2001
** biking/walking: assumes 0.5 mi per person per day
COST of fuel: Based on USDOE averages for the year

Observations

Cost of transportation doubled between FY2001 & FY2008 primarily due to fuel cost increases
See next page for analysis of shift from cars to SUVs and Pickups
FRTA reported that South and East bus routs doubled their ridersh8p



Miles Traveled by vehicle type each year (FY2008)

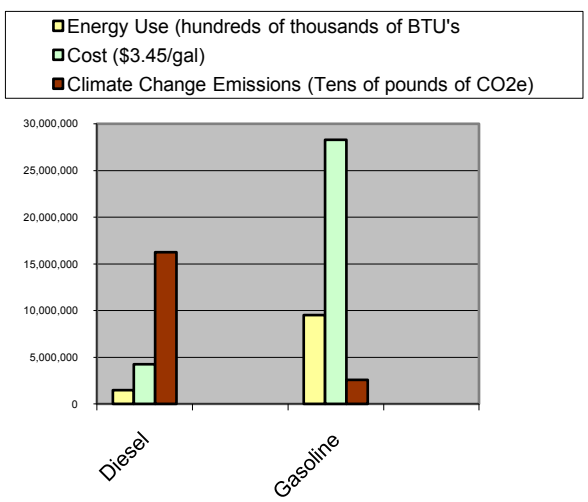
Appendix 3.8

Greenfield: Community-wide Summary
Transportation Analysis: Part 2
1. 2008 by Fuel Type
2. Car & SUV/Pickup Trends FY2001 & FY2008

30% of total Climate Change Emissions

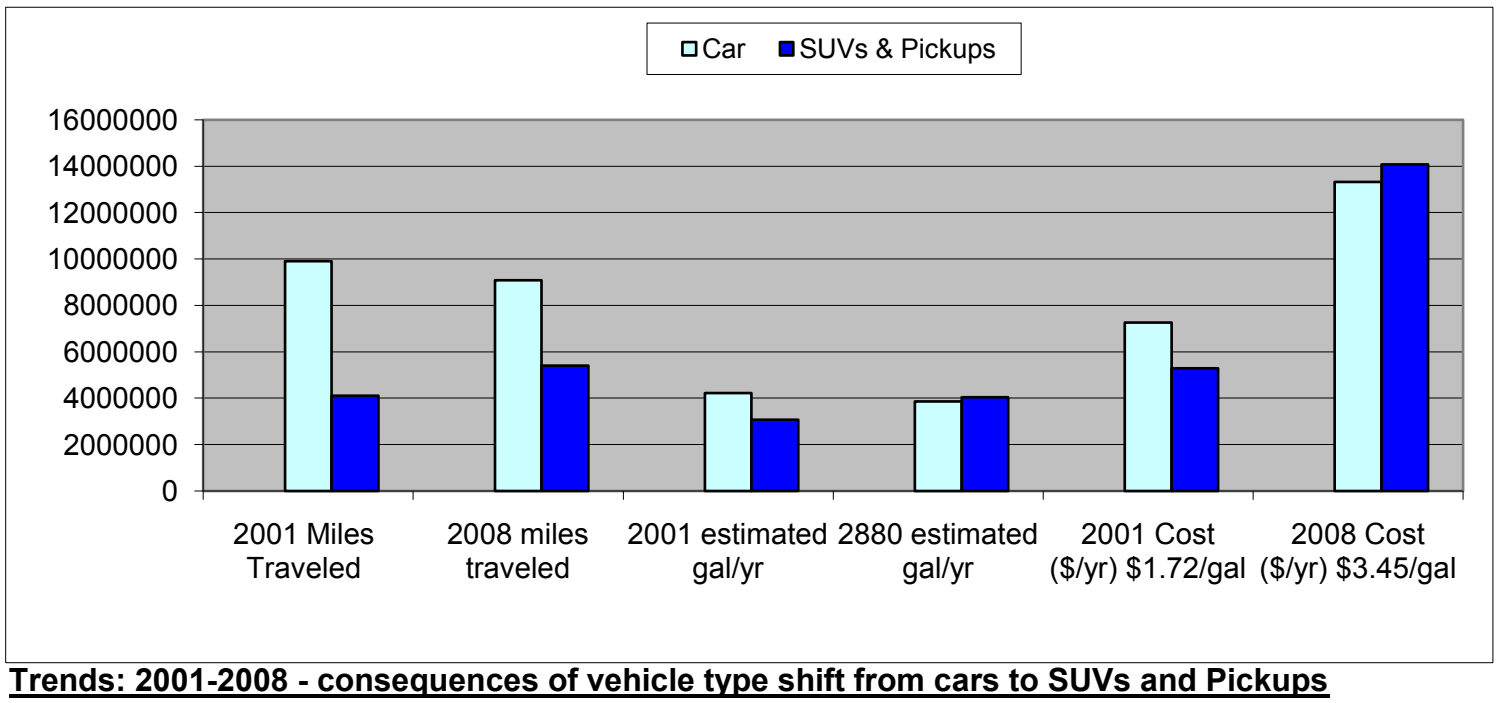
1. 2008 by Fuel Type

2008 Fuel Use by Fuel Type (below)	Energy Use (hundreds of thousands of BTU's	Cost ($3.45/gal)	Climate Change Emissions (Tens of pounds of CO2e)
Diesel	1,480,690	$4,244,205	16,254,800
Gasoline	9,510,250	$28,273,884	2,571,200
TOTALS	**10,990,940**	**$32,518,089**	**18,826,000**
Totals as noted	**1,099,094MMBtu**		**94,130 tons**



2. Car vs. SUV & Pickup Analysis

Vehicle Type	2001 Miles Traveled	2008 miles traveled	2001 estimated gal/yr	2880 estimated gal/yr	2001 Cost ($/yr) $1.72/gal	2008 Cost ($/yr) $3.45/gal
	hundreds of thousands of miles					
Car	9,904,400	9,073,900	4,216,433	3,862,878	$7,252,264	$13,326,928
SUVs & Pickups	4,100,800	5,396,600	3,069,461	4,039,371	$5,279,923	$14,081,659
TOTALS	**14,005,200**	**14,470,500**	**7,285,894**	**7,902,249**	**$12,532,187**	**$27,408,587**



Trends: 2001-2008 - consequences of vehicle type shift from cars to SUVs and Pickups

By 2008, SUVs & pickups used more than half of the gasoline, but drove only 37% of the miles

Appendix 3.9

Greenfield

Waste Management

Years: 2002 - 2007

(This information is the same as that reported in appendix 2.9)

what	where goes	2002	2003	2004	2005	2006	2007	Recycled outcome
Trash -tons	Spfld incinerator	6,469	6,189	6,225	5,344	4,537	4,289	Electricity generated
COST of Trash disposal		$334,991					$316,571	
COST /Ton - disposal		$52					$74	
CO2 from trash (Tons)		1,386					952	
Recycled Tons	see below	2,494	2,695	2,885	2,890	2,988	3,069	make new products
recycled- % of total waste		28%	30%	32%	35%	40%	42%	
CO2 avoided by recycling (tons)		7,038					8,644	
DETAILS of Recycling								
Materials tracked by Tons	**where goes**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Recycled outcome**
Paper - Tons	MRF	1,253	1,154	1,189	1,348	1,431	1,318	paper products made
comingled-Tons	MRF	367	398	403	441	518	545	new products made
Cardboard-Tons	cardboard place	223	168	130	129	84	103	new cardboard made
Construction Waste	F&G via Dave Wickles	22	n/a	n/a	n/a	n/a	188	recycled in Connecticut
scrap metal-Tons	Kramers recycle	21	364	553	359	341	301	new products made
CRTs-Tons	Viola - recycle	16	19	19	21	22	23	recycle raw materials
Fluorescent lights-Tons	Viola - recycle	0.76	0.58	0.19	1.25	0.82	0.15	recycle raw materials
Yard waste	composted	591	591	591	591	591	591	Compost used by town
Trash - Tons	Spfld incinerator	6,469	6,189	6,225	5,344	4,537	4,289	Electricity generated
Total - Tons		**8,963**	**8,884**	**9,110**	**8,234**	**7,525**	**7,358**	
Other Materials being Tracked -- note UNITS below								
Fluorescent (Linear Ft)	Viola - recycle	9,830	7,498	2,456	16,207	10,616	1,932	recycle raw materials
Crank case oil (gal)	DPW heat &*Envirosave	3,600	2,695	2,800	2,950	2,700	165	Heat DPW bldgs OR recycle
Paint (gal)	*Envirosafe	n/a	n/a	n/a	n/a	220	185	"safe disposal"
Propane gas tanks (#)	Interstate Refrigeration	135	485	543	556	387	387	recycle metal**
Auto Batteries (#)	Sullivan	480	435	350	107	n/a	115	new batteries made
Mercury	*Envirosafe	n/a	n/a	n/a	n/a	n/a	n/a	08- shed acquired-recycle
	* put out to bid annually!							**cannot refill…new safety regs

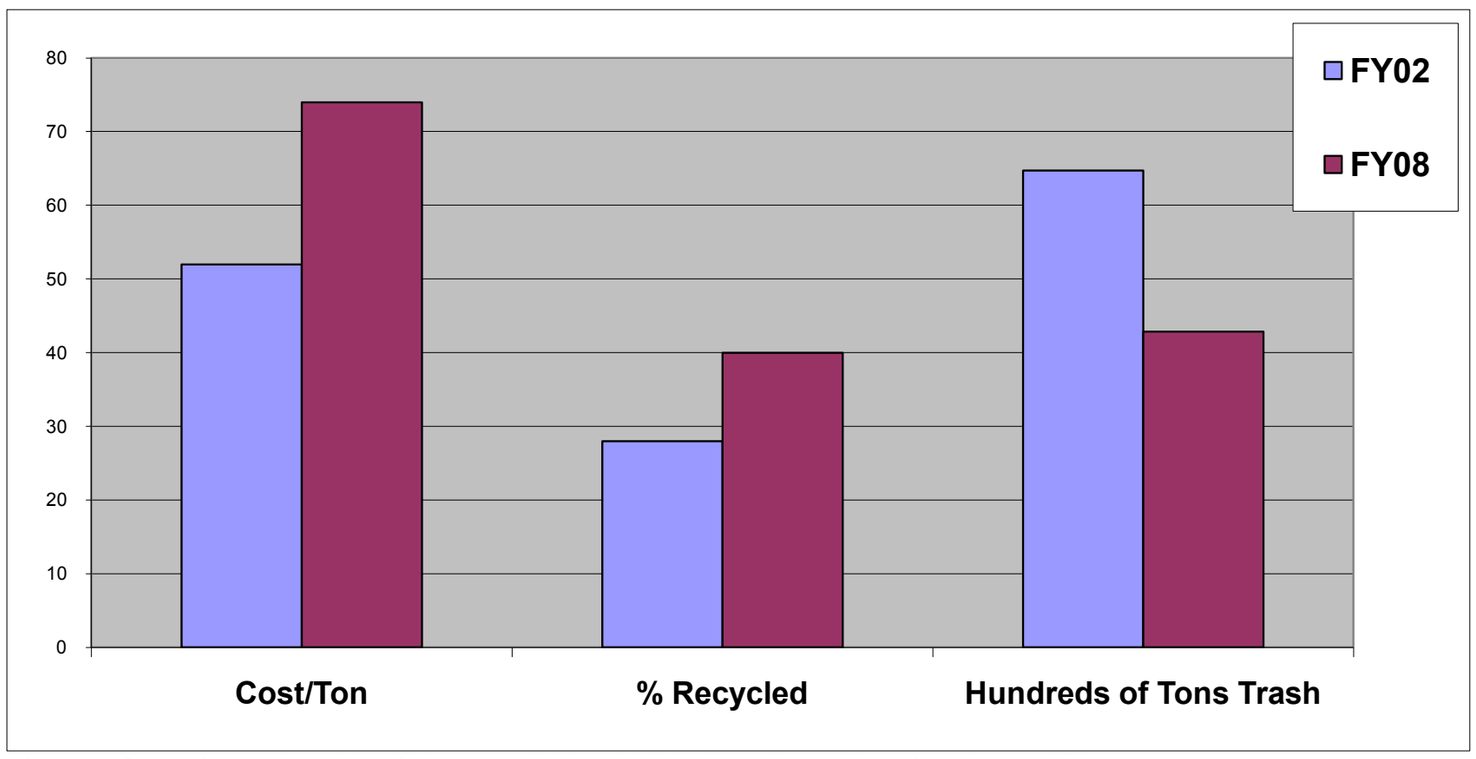
Notes:

Note units under WHAT

Co-mingled includes plastic, glass, aluminum bottles etc.

CRT: Cathode Ray Tubes - such as TVs and computer Monitors

fluorescent light conversion from linear feet (LF) to tons 0.1547 lbs/ln ft div by 2000= Tons



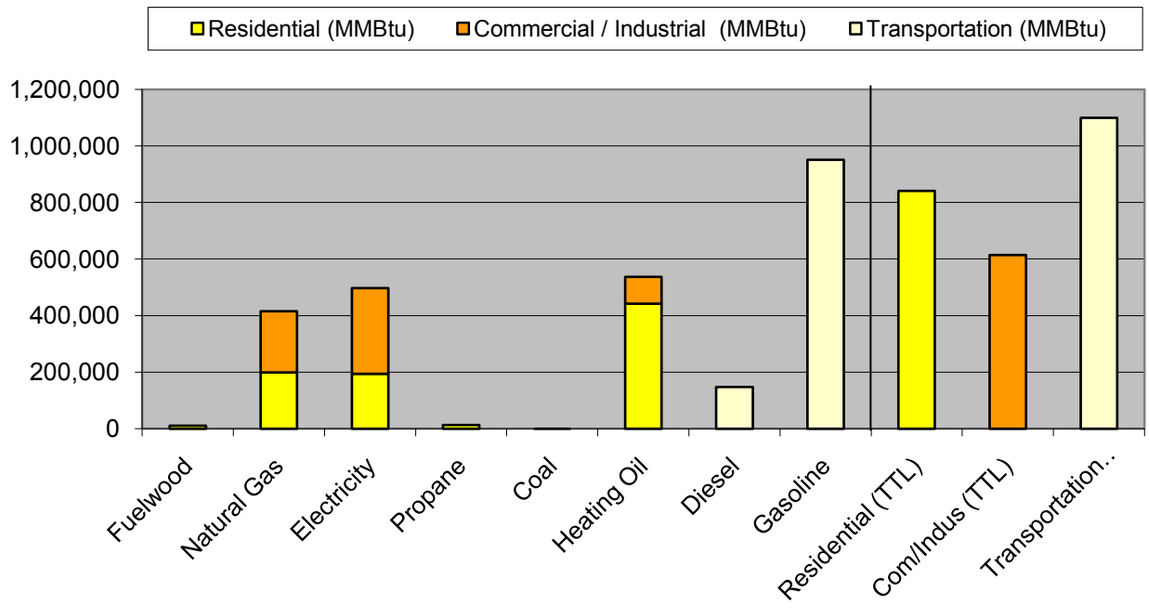
Success Story: Cost reduced by 5% between 2002 and 2008 although cost/Ton of trash went UP!

Appendix 3.10

Greenfield Community-Wide Summary
Report by Fuel Type and Sector
Year: 2008

Total Energy Use by Sector and by fuel type/unit noted	Residential (use per unit)	Commercial / Industrial (use per unit)	Transportation (use per unit)	Total Energy use (per unit noted)
Fuelwood (Cords)	456	0	0	456
Natural Gas (therms)	1,991,668	2,167,049	0	4,158,717
Electricity (Mwh)	56,803	101,674	0	158,477
Propane (gal)	140,720	n/a	0	140,720
Coal (tons)	100	0	0	100
Heating Oil (gal	3,018,750	674,505	0	3,693,255
Diesel (gal)	0	0	1,152,296	1,152,296
Gasoline (gal)	0	0	8,269,774	8,269,774

Total Energy Use by Sector and by fuel type (MMBtu)	Residential (MMBtu)	Commercial / Industrial (MMBtu)	Transportation (MMBtu)	Total Use (MMBtu)
Fuelwood	10,805	0	0	10,805
Natural Gas	199,167	216,711	0	415,878
Electricity	193,867	303,038	0	496,904
Propane	13,130	0	0	13,130
Coal	1,921	0	0	1,921
Heating Oil	442,496	94,402	0	516,898
Diesel	0	0	148,070	148,070
Gasoline	0	0	951,024	951,024
Total	**841,386**	**614,151**	**1,099,094**	**2,554,630**

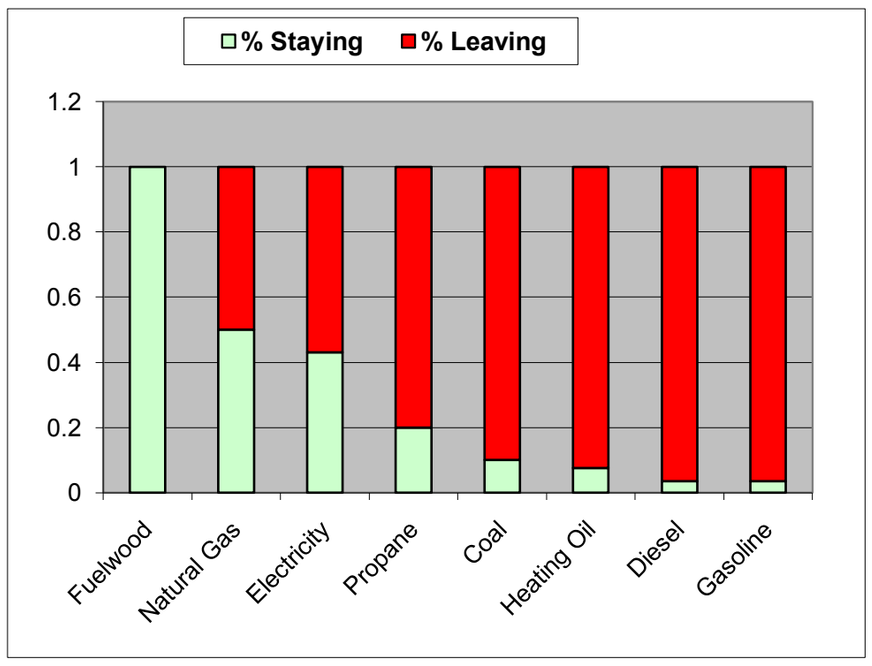


Total Fuel Use by Sector and Type (MMBtu)

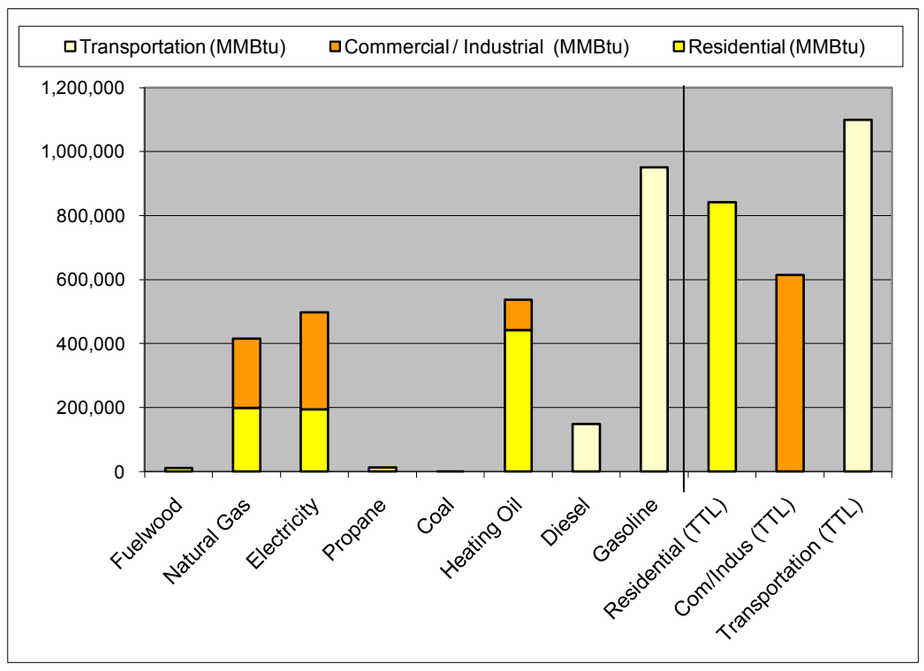
Appendix 3.11

Greenfield Community-Wide Summary
$$ Staying or Leaving the Community - Analysis SUMMARY
by Fuel Type and Sector
Year: 2008

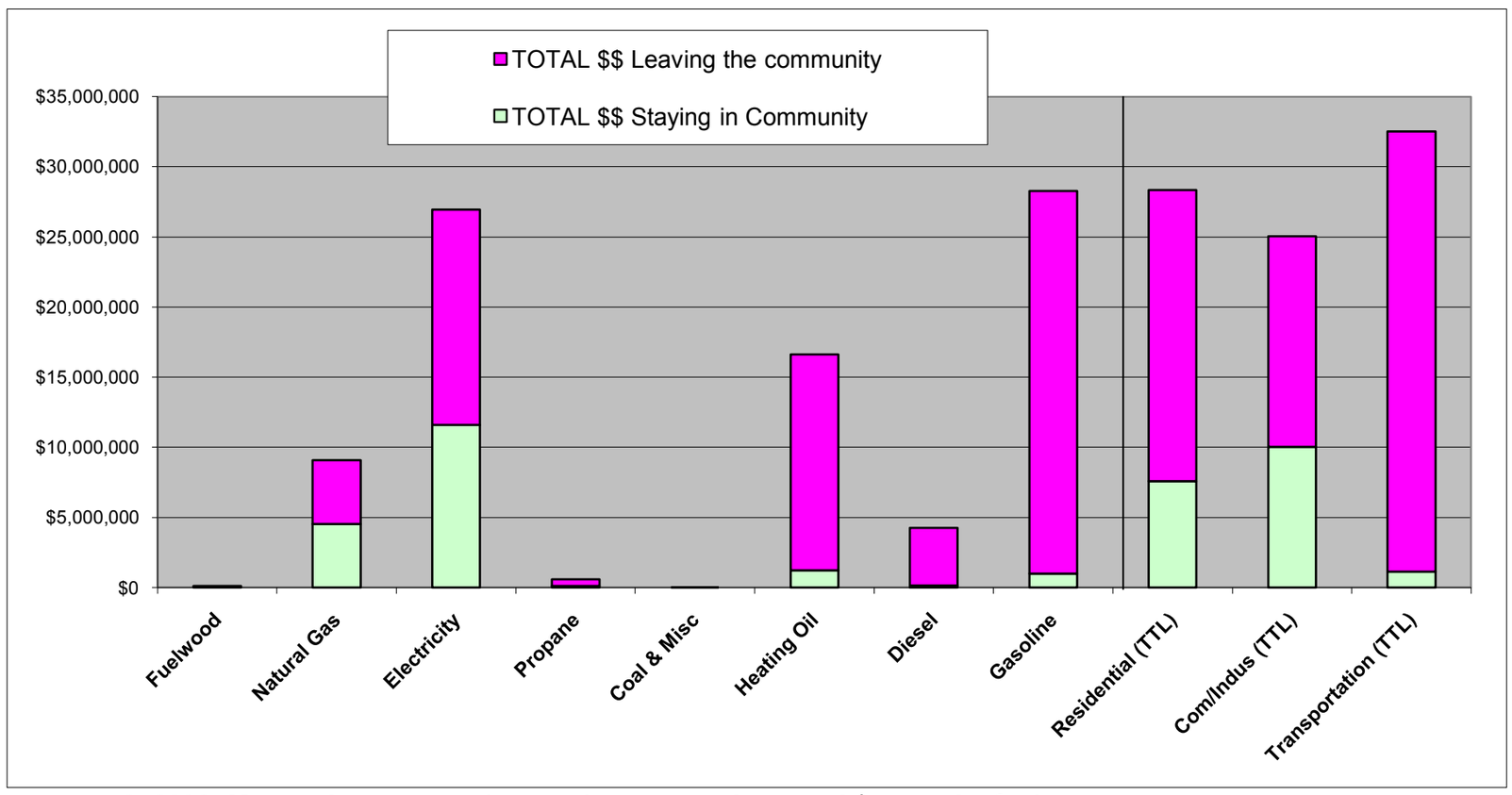
2008 Fuel Use (fuel type below) Sectors to right	Energy Used (per unit noted)	Energy Used (MMBtu)	Total Cost	$$ staying in the community (Industry Standard)	$$ Staying in community Percentage)	TOTAL $$ Staying in Community	TOTAL $$ Leaving the community	cost assumptions/ unit
Fuelwood (cords)	456	10,805	$125,400	100%	100%	$125,400	$0	$275/cord
Natural Gas (therms)	4,158,717	415,878	$9,066,003	40-65%	50%	$4,533,001	$4,533,001	$2.18/therm
Electricity (Mwh)	158,477	496,904	$26,941,090	42-44%	43%	$11,584,669	$15,356,421	$0.17/kwh
Propane (gal)	140,720	13,130	$598,060	20% guestimation	20%	$119,612	$478,448	$4.25/gal
Coal (tons) & Misc	100	1,921	$26,500	10% guestimation	10%	$2,650	$23,850	$265/ton
Heating Oil (gal)	3,693,255	516,898	$16,619,648	5-12 cents/gal	7.5%	$1,246,474	$15,373,174	$4.50/gal
Diesel (gal)	1,152,288	148,069	$4,244,205	2-5 cents/gal	3.5%	$148,547	$4,095,658	$3.45/gal
Gasoline (gal)	8,269,783	951,025	$28,273,884	2-5 cents/gal	3.5%	$989,586	$27,284,298	$3.45/gal
Total		**2,554,630**	**$85,468,523**			**$18,749,939**	**$67,144,850**	



1. Industry Averages:
% of revenue that stays or leaves the community



2. 2008 fuel use by type per sector (millions of BTUs)



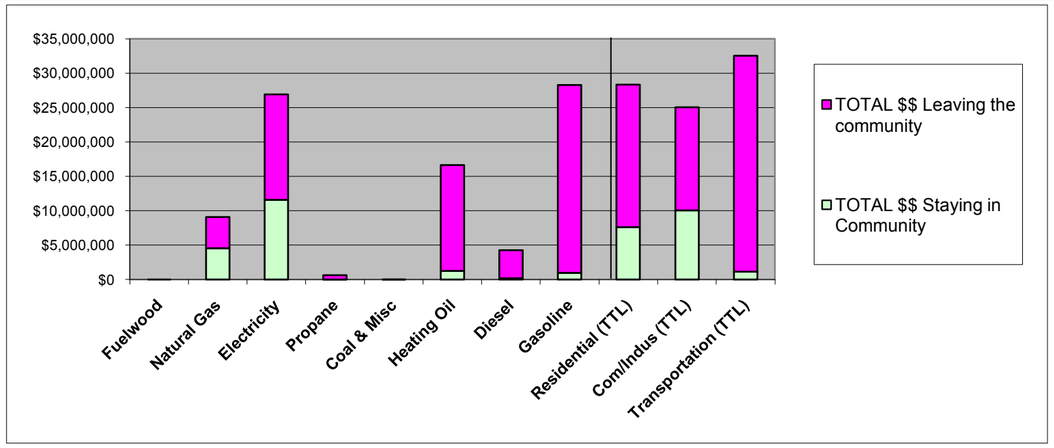
3. 2008: Money that stays or leaves the community…total $ spent by fuel type

Appendix 3.12

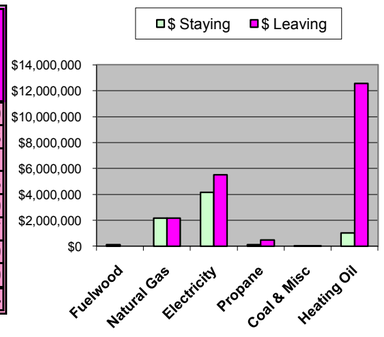
Greenfield Community-Wide Summary
$$ Staying or Leaving the Community - Analysis DETAILS by Fuel Type and Sector
Year: 2008

	ENERGY USE (MMBtu)			COST ($$)					STAY	LEAVE	STAY	LEAVE	STAY	LEAVE	STAY	LEAVE	
2008 Fuel Use (fuel type below) Sectors to right	Residential	Commercial / Industrial	Transportation	Residential	Commercial / Industrial	Transportation	$$ staying in the community (Industry Standard)	$$ Staying in community Percentage)	Residential	Residential	Com/Indus	Com/Indus	Transportation	Transportation	TOTAL	TOTAL	cost assumptions/ unit
Fuelwood	10,805	0	0	$125,400	$0	$0	100%	100%	$125,400	$0	$0	$0	$0	$0	$125,400	$0	$275/cord
Natural Gas	199,167	216,711	0	$4,341,836	$4,724,166	$0	40-65%	50%	$2,170,918	$2,170,918	$2,362,083	$2,362,083	$0	$0	$4,533,001	$4,533,001	$2.18/therm
Electricity	193,867	303,038	0	$9,656,510	$17,284,580	$0	42-44%	43%	$4,152,299	$5,504,211	$7,432,369	$9,852,211	$0	$0	$11,584,669	$15,356,421	$0.17/kwh
Propane	13,130	0	0	$598,060	n/a	$0	20% guestimation	20%	$119,612	$478,448	$0	$0	$0	$0	$119,612	$478,448	$4.25/gal
Coal & Misc	1,921	0	0	$26,500	$0	$0	10% guestimation	10%	$2,650	$23,850	$0	$0	$0	$0	$2,650	$23,850	$265/ton
Heating Oil	442,496	94,402	0	$13,584,375	$3,035,273	$0	5-12 cents/gal	7.5%	$1,018,828	$12,565,547	$227,645	$2,807,628	$0	$0	$1,246,474	$15,373,174	$4.50/gal
Diesel	0	0	148,070	$0	$0	$4,244,205	2-5 cents/gal	3.5%	$0	$0	$0	$0	$148,547	$4,095,658	$148,547	$4,095,658	$3.45/gal
Gasoline	0	0	951,024	$0	$0	$28,273,884	2-5 cents/gal	3.5%	$0	$0	$0	$0	$989,586	$27,284,298	$989,586	$27,284,298	$3.45/gal
Total	**841,386**	**614,151**	**1,099,094**	**$28,332,681**	**$25,044,019**	**$32,518,089**			**$7,589,707**	**$20,742,974**	**$10,022,098**	**$15,021,921**	**$1,138,133**	**$31,379,956**	**$18,749,938**	**$67,144,851**	

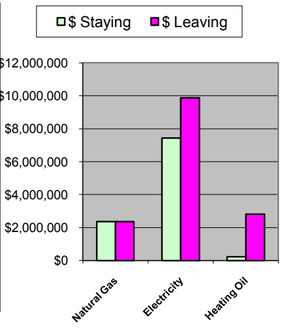
Summary Cost Analysis	TOTAL $$ Staying in Community	TOTAL $$ Leaving the community
Fuelwood	$125,400	$0
Natural Gas	$4,533,001	$4,533,001
Electricity	$11,584,669	$15,356,421
Propane	$119,612	$478,448
Coal & Misc	$2,650	$23,850
Heating Oil	$1,246,474	$15,373,174
Diesel	$148,547	$4,095,658
Gasoline	$989,586	$27,284,298
Residential (TTL	**$7,589,707**	**$20,742,974**
Com/Indus (TTL	**$10,022,298**	**$15,021,921**
Transportation (	**$1,138,133**	**$31,379,956**



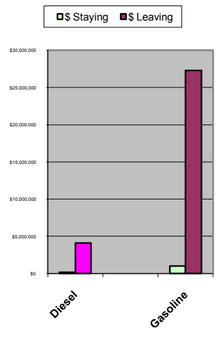
Residential Cost Analysis	$ Staying	$ Leaving
Fuelwood	$125,400	$0
Natural Gas	$2,170,918	$2,170,918
Electricity	$4,152,299	$5,504,211
Propane	$119,612	$478,448
Coal & Misc	$2,650	$23,850
Heating Oil	$1,018,828	$12,565,547
Diesel	$0	$0
Gasoline	$0	$0
Total	**$7,589,707**	**$20,742,974**



Com/Indus Cost Analysis	$ Staying	$ Leaving
Fuelwood	$0	$0
Natural Gas	$2,362,083	$2,362,083
Electricity	$7,432,369	$9,862,211
Propane	$0	$0
Coal & Misc	$0	$0
Heating Oil	$227,645	$2,807,628
Diesel	$0	$0
Gasoline	$0	$0
Total	**$10,022,098**	**$15,021,921**



Transportation Cost Analysis	$ Staying	$ Leaving
Fuelwood	$0	$0
Natural Gas	$0	$0
Electricity	$0	$0
Propane	$0	$0
Coal & Misc	$0	$0
Heating Oil	$0	$0
Diesel	$148,547	$4,095,658
Gasoline	$989,586	$27,284,298
Total	**$1,138,133**	**$31,379,956**



Appendix 3.13

Greenfield Community-Wide Summary

1. Analysis by Energy Use Type: Electricity, Heat & Transportation Fuel

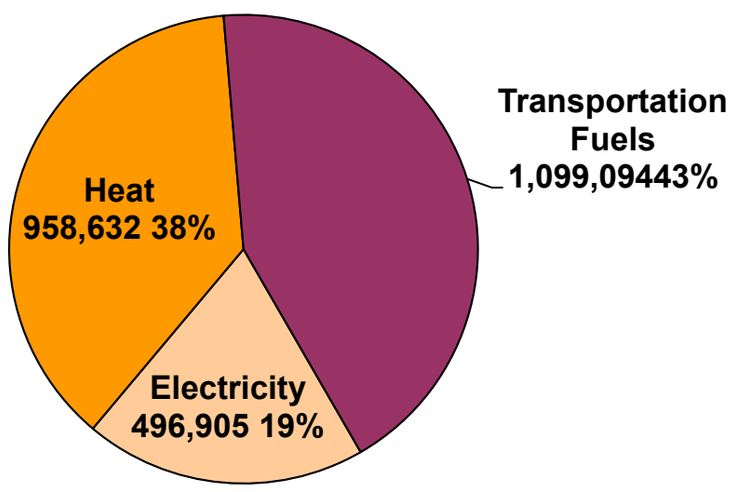
2. Back of Envelope Strategy

Energy, Climate Change Enissions and Cost

Year: 2008

Energy Type	Energy Use (million Btu)	Climate Change (CC) Emissions (tons CO2e)	% of total CC Emissions	Estimated Cost ($)
Electricity	496,905	133,251	44.9%	$26,941,090
Heat	958,632	69,673	23.5%	$26,009,344
Fuels for Vehicles	1,099,094	94,103	31.7%	$32,518,089
TOTAL	**2,554,631**	**297,027**	100%	**$85,468,523**

Energy Use (MMBtu)



2. Back of Envelope Strategy: Reduce Energy use, switch to electricity and biomass

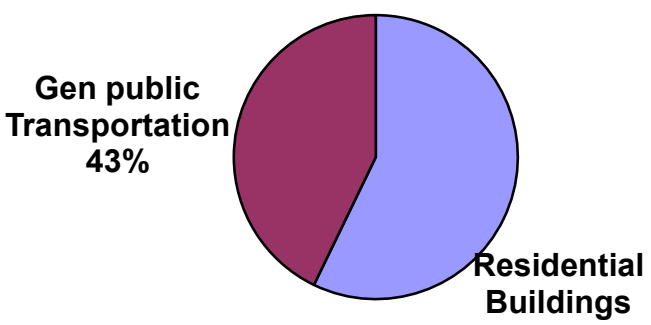
Energy Type	Use (MMBtu)	Cost ($)
Electricity	496,905	$26,941,090
Heat	958,632	$26,009,344
Fuels for Vehicles	1,099,094	$32,518,089
TOTAL	2,554,631	$85,468,523
Strategy - 50% reduction		
ELEC-lights, power switch, appliances-need 9MW		
HEAT-insulate/air seal, solar, use elec and wood - 18MW?		
TRANSP-cut in half , move closer, walk, bike, mass transit more efficient car, smart growth, use electric - 18 MW?		
45 MW of electricity would meet our needs we have 110 MW of hydropower + add solar etc.		

Appendix 3.14

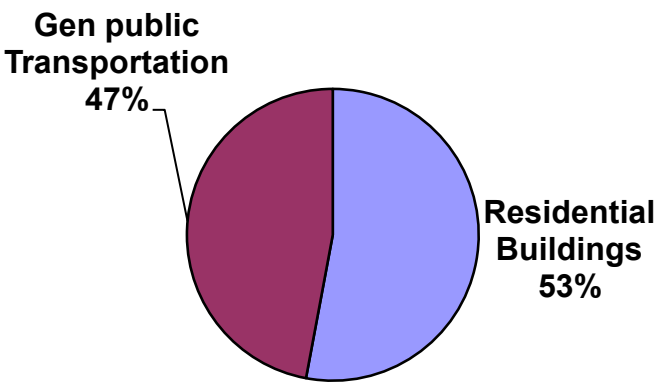
Greenfield: Community-wide Summary
General Public: Energy Use, CO2e, and Cost
2001 & 2008

Assumption: General public transportation accounts for 75% of total Transportation energy use;

2001 Energy Use



2008 Energy Use



2001	2001	2001	2001	2001
Sector	**Energy Equivalent (million Btu)**	**Climate Change Emissions (CC) (tons CO2e)**	**% of total CC Emissions**	**2001 Estimated Cost ($)**
Residential Buildings	910,445	106,169	64%	$15,690,631
Gen public Transportation	681,906	58,720	35%	$7,843,885
Waste	n/a	1,435	1%	$334,991
TOTAL	**1,592,351**	**166,324**	100%	**$23,869,507**

2008	2008	2008	2008	2008
Sector	**Energy Equivalent (million Btu)**	**Climate Change Emissions (CC) (tons CO2e)**	**% of total CC Emissions**	**2001 Estimated Cost ($)**
Residential Buildings	841,386	100,437	57%	$28,332,681
Gen public Transportation	747,892	72,827	42%	$16,909,765
Waste	n/a	1,435	1%	$316,571
TOTAL	**1,589,278**	**174,699**	100%	**$45,559,017**

Appendix 3.15

Greenfield: Community-wide Summary
Trends: Energy Use, Climate Change Emissions & Cost
Years: FY2001 & FY2008

Year		2001	2008		Variance from 01 change 2008-2001	% change change/2001
Residential						
	Energy (MMBtu)	910,445	841,386		-69,059	-8%
	eCO2 (tons)	105,498	100,472		-5,027	-5%
	Cost ($)	$15,745,231	$28,332,681		$12,587,450	80%
Commercial						
	Energy (MMBtu)	557,304	513,331		-43,973	-8%
	eCO2 (tons)	93,189	82,370		-10,819	-12%
	Cost ($)	$13,397,283	$20,847,546		$7,450,263	56%
Industrial						
	Energy (MMBtu)	100,819	100,819		0	0%
	eCO2 (tons)	19,856	20,083		227	1%
	Cost ($)	$2,866,872	$3,770,207		$903,335	32%
Transportation						
	Energy (MMBtu)	1,132,145	1,099,094		-33,051	-3%
	eCO2 (tons)	97,490	94,130		-3,360	-3%
	Cost ($)	$15,716,779	$32,518,089		$16,801,310	107%
Waste						
	Energy (MMBtu)	n/a	ma		n/a	n/a
	eCO2 (tons)	1,435	952		-484	-34%
	Cost ($)	$334,991	$316,571		-$18,420	-5%
Total						
	Energy (MMBtu)	**2,700,713**	**2,554,630**		**-146,083**	**-5%**
	eCO2 (tons)	**317,469**	**298,006**		**-19,463**	**-6%**
	Cost ($)	**48,061,156**	**85,785,094**		**37,723,938**	**78%**

This report has been generated for Greenfield, ma using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith Associates Inc.

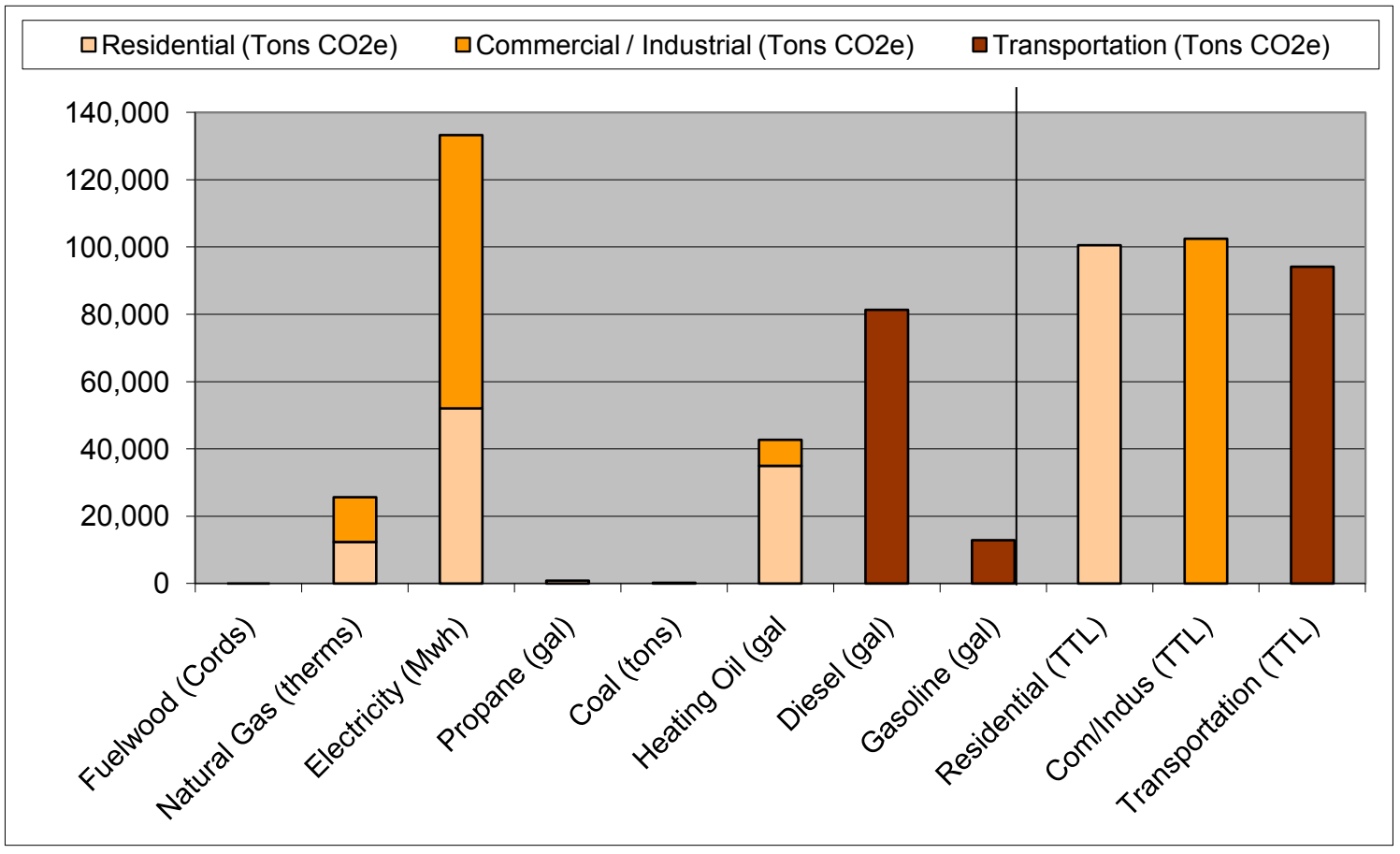
Appendix 3.16

Greenfield Community-wide report

Climate Change Emissions by Fuel Type and Sector

Year: FY008

Total Climate Change Emissions by Fuel Type and Sector	Residential (Tons CO2e)	Commercial / Industrial (Tons CO2e)	Transportation (Tons CO2e)	Total (Tons CO2e)	Percentage of Total
Fuelwood (Cords)	95	0	0	95	0%
Natural Gas (therms)	12,305	13,388	0	25,694	9%
Electricity (Mwh)	51,988	81,263	0	133,251	45%
Propane (gal)	905	0	0	950	0%
Coal (tons)	209	0	0	209	0%
Heating Oil (gal	34,926	7,800	0	42,726	14%
Diesel (gal)	0	0	81,274	12,856	4%
Gasoline (gal)	0	0	12,856	81,274	27%
Total	**100,473**	**102,451**	**94,130**	**298,006**	100%



Climate Change Emission by fuel type and Sector

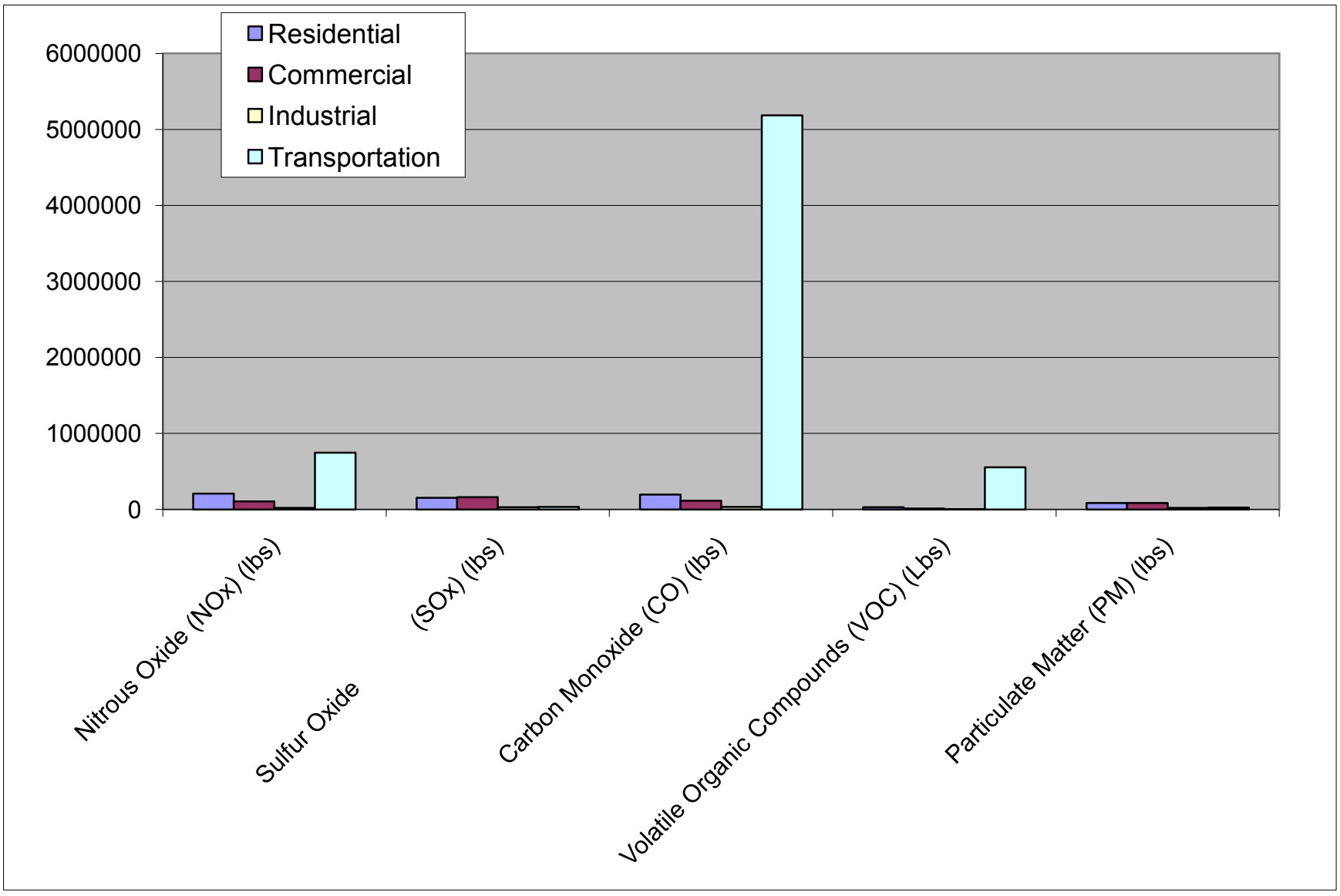
Appendix 3.17

Greenfield: Community-wide Summary
Criteria Air Pollutants by Sector
Base Year: FY2001

Sector	Nitrous Oxide (NOx) (lbs)	Sulfur Oxide (SOx) (lbs)	Carbon Monoxide (CO) (lbs)	Volatile Organic Compounds (VOC) (Lbs)	Particulate Matter (PM) (lbs)
Residential	207110	151754	194403	30436	84464
Commercial	107930	162992	115027	13915	83982
Industrial	20643	30313	33480	4590	19127
Transportation	744730	35066	5183561	553469	23245
Waste???	n/a	n/a	n/a	n/a	n/a
TOTAL	**1,080,413**	**380,125**	**5,526,471**	**602,410**	**210,818**

Notes:

NOx & VOCs- causes smog-related health problems - lungs, heart etc.
SOx - causes acid rain
CO - asphyxiate
PM - lung irritant causes lung disease



Appendix 3.18

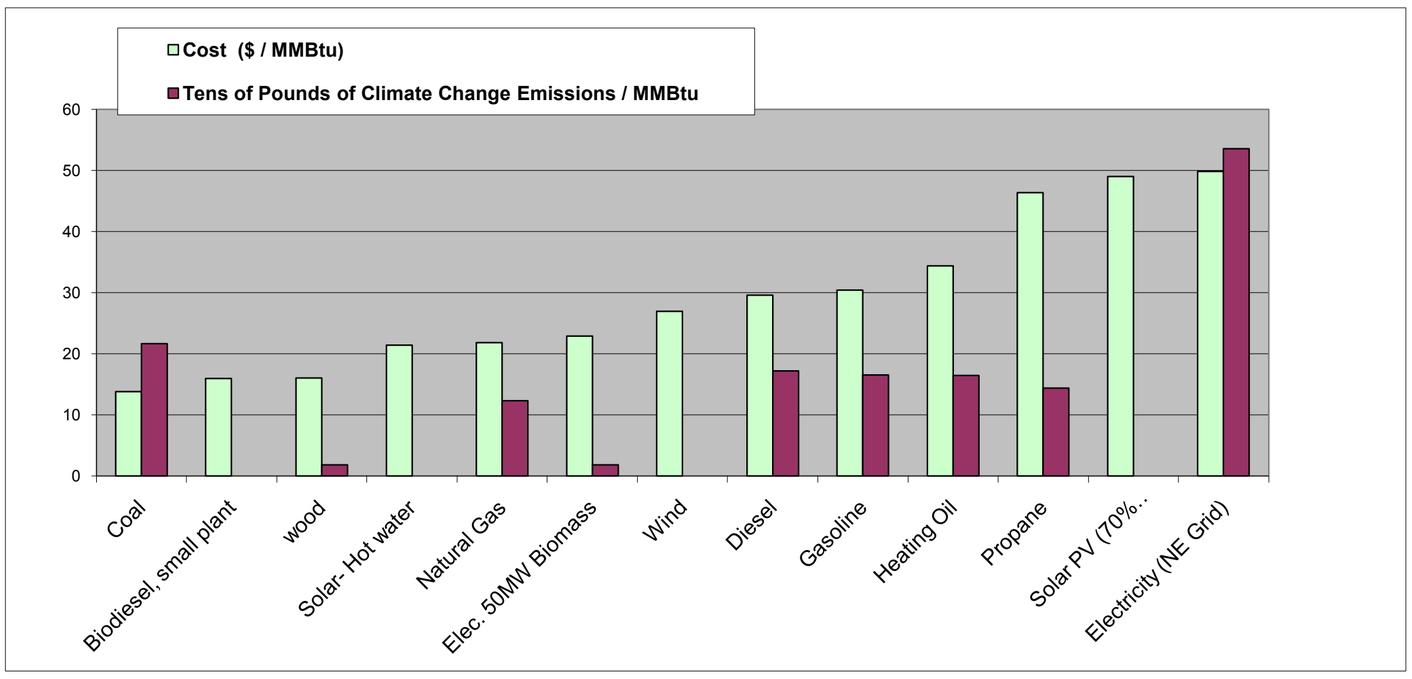
Understanding Fuels - Fuel Crazies
1. Finding a Common Unit, Cost & Climate Change Emissions

`

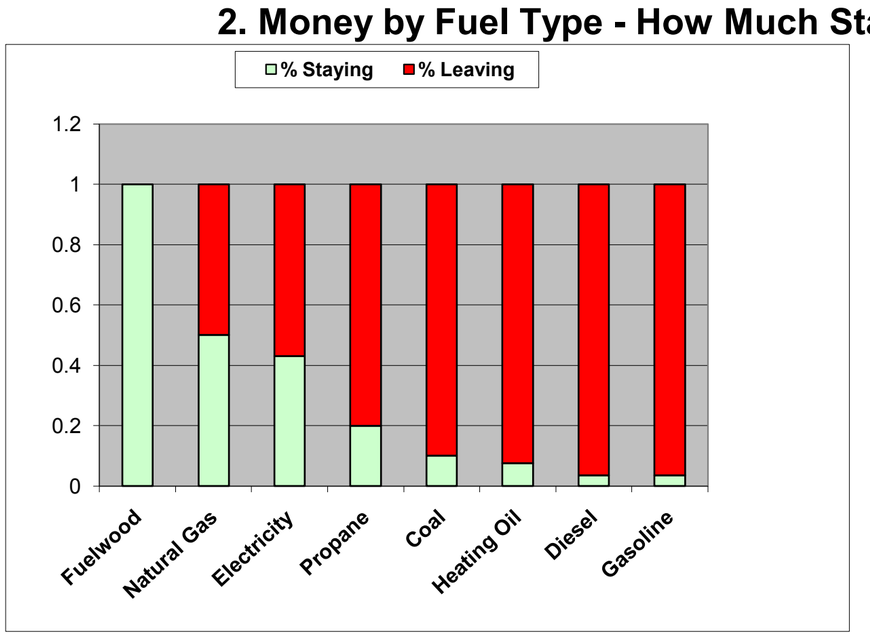
Renewable fuels costs based on MA DOER 2007 numbers in the 2007 Pioneer Valley Clean Energy Plan (PVCEP). It assumes a 20 year life at a 5% discount rate. For biomass plants, it assumes a fuel cost of $25/ton for green wood, and O&M es[emdiroe pof 4% pf the capitol cost. For the biodiesel plant, it assume $2/gal feestock and operational cost.

Fuel type and unit	BTU/unit	Climate Change Emissions (lbs CO2/MMBtu)	Cost/MMBtu	Cost Assumptions $/unit	Source	COST/btu	MILLION
Biomass (1 dry cord)	23,696,000	18	$14	$275.00		0.00001161	1000000
Coal (1 ton)	19,214,000	217	$14	$265.00		0.00001379	1000000
Diesel (1 gallon)	128,500	172	$30	$3.80		0.00002957	1000000
Electricity (Mwh) (NE Grid)	3,412	536	$50	$0.17		0.00004982	1000000
Gasoline (1 gallon)	115,000	165	$30	$3.50		0.00003043	1000000
Natural Gas (1-CCF)	100,000	123	$22	$2.18		0.00002180	1000000
Oil (1 gallon)	130,869	164	$34	$4.50		0.00003439	1000000
Propane (1 gallon)	91,600	145	$46	$4.25		0.00004640	1000000
Solar - passive solar heating	n/a	0	$0	$0.00			
Solar- Hot water	n/a	0	$21	$8,000 to install	PVCEP	0.0000213942	1000000
Solar - Elec. (Photovoltaic)	n/a	0	$163	$17,000 to install	PVCEP	0.0001629475	1000000
Solar - PV with 70% rebate	n/a	0	$49	$17,000 to install			
Wind	n/a	0	$27	$7.5 mil to install	PVCEP	0.0000269625	1000000
Elec. from 50MW Biomass plant	n/a	n/a	$23	$135mil to build	PVCEP	0.0000228595	1000000
Elec. From 5MW biomass plant	n/a	n/a	$31	$17.5 mil to build	PVCEP	0.0000313586	1000000
Biodiesel, small: 10mil gal/yr	n/a	n/a	$16	$8.5mil to build	PVCEP	0.0000159138	1000000
Ethanol	n/a	depends on source	n/a	n/a		#VALUE!	1000000
Hydro	n/a	depends on source	n/a	n/a			

Notes: PVCEP: Pioneer Valley Clean Energy Plan



2. Money by Fuel Type - How Much Stays Here - How Much goes Away



Fuel type	$$ Staying	% Staying
Fuelwood	100%	100.0%
Natural Gas	40-65%	50.0%
Electricity	42-44%	43.0%
Propane	20% guestimation	20.0%
Coal	10% guestimation	10.0%
Heating Oil	5-12 cents/gal	7.5%
Diesel	2-5 cents/gal	3.5%
Gasoline	2-5 cents/gal	3.5%

Notes
Nat Gas & Electricity have labor intensive infrastructures
for delivery & billing - wires and pipes, individual meters etc.

Propane, coal, heating oil - delivery by truck

Gasoline & Diesel - Tiny infrastructure - the customers to them

#4 Appendix

Department of Public Works

Town of GREENFIELD, MASSACHUSETTS
Town Hall, 14 Court Square, Greenfield, MA 01301 Phone: 413-772-1528 Fax: 413-773-9593

To: Mayor Forgey
From: Sandra Shields
Date: August 11, 2008
Re: Annual Energy Report

Please find below actions taken by the Town and DPW to accomplish the Town's energy reduction goals and promote a "greener" Greenfield. My intent is to make this an annual report in order to track work accomplished and progress made toward that goal. This report is divided into two sections:

A. Concrete steps the DPW has taken to reduce energy usage and costs in its buildings.
B. Steps the Town and DPW have taken to reduce emission, greenhouse gases and its carbon footprint.

A. Concrete steps taken to reduce energy usage and costs.

Operations:

- DPW has switched to synthetic oil in town vehicles. This will improve gas mileage cutting fuel usage and improving engine efficiency, decreasing emissions.

- June 2008 - Vehicle Maintenance Division upgraded preventative maintenance software with a superior program. Proper preventative maintenance increases efficiency, cuts fuel consumption and emissions.

- Traffic flow improvements within town, including the Commonwealth's work to the I91 rotary. This will improve traffic flow, reduce congestion, idling time etc.

- All traffic signals have been changed to energy efficient LED lights.

- Yearly the Water Division of the DPW conducts an extensive leak survey on the Town's water system. In addition, the department provides free leak checks for all users, commercial and private, in order to reduce the amount of water lost in system due to leaks. Leaks not only waste water, but other resources such as electricity used in treatment and distribution of water. Less water creates less demand for electricity and items such as chemicals which can be very energy intensive to produce and transport to point of use.

- Lined over 800 ft of sewer line in order to correct the inflow and infiltration of ground and storm water into the sewer system. This excess water in the system increases electrical and chemical demands at the Water Pollution Control Plant.

- Working toward elimination of the practice as using large "hand-me-down" police cruisers for other departments. For example, this year the Assessor's vehicle will be replaced with a small fuel efficient car.

- DPW is pursuing permission to move its winter snow depository site from Murphy Park to the former Wedgewood Gardens site. This will significantly decrease the number of miles the trucks must travel during downtown snow removal operations reducing fuel costs and emissions.

Energy Audits:

- January 2008 – Comprehensive energy audits were conducted through a grant from the Mass Dept of Energy Resources (DOER). Unlike many previous audits which focused on one or two particular aspects of a building (ie lighting, heating), these audits looked at the buildings as a whole. The buildings audited were the Town Yard, Transfer Station, Water Pollution Control Plant, Green River Pump Station, Oak Hill Filter Plant, Town Hall, Library and Fire Station. We are now working on a plan of action in order to execute recommendations outlined in the report.
  July 2008 – Applications were submitted to DOER to perform audits on the school buildings. To date we have not heard from DOER.

Town Yard:

- Enclosed large open stairwell that allowed heat upstairs into a mostly unused space. Ceiling fan installed at top of stairwell to redirect heat downward.
- Extensive repair and chalking of windows
- New motorized louvers and exhaust fans in bay areas to insure proper closure of louvers.
- Replacement of energy inefficient air conditioners, refrigerator.

Transfer Station:

- Installation of programmable thermostats. The Town Hall also installed programmable lockable thermostats.
- General "buttoning up" of building

Water Facilities Division:

WPC Plant Operations Bldg.

- Wet Well Levels. Operating levels were changed to 11 feet to reduce head. Electrical use per million gallons of flow has been tracked and Plant has seen demonstrated savings.
- Heating. Other than the main floor, thermostats are set at 50 to 55 degrees F. Truck bay single pane windows were converted to double pane and the overhead door weather stripping was supplemented with rubber material and frame gaps were silicone caulked. In the winter, plastic is used to seal remaining windows. The oil fired furnace nozzle was downsized from 6 to 4.5 G.P.H. The furnace was originally oversized and with thermostats set lower, the smaller nozzle is

adequate. The larger nozzle was also causing excessive service calls for misfires and soot buildup.
- Sealed pipe passages between floors with expandable foam.

WPC Pump Bldg.
- Covered ventilation ducts with removable panels for the winter, door weather stripping replaced.
- Top story, large single pane windows were covered and sealed with ½ " plywood which will remain in place year round for added insulation.
- Trane 2-ton heat pump installed 2005 was the exclusive building heat source last winter.

WPC Blower Bldg.
- Installed second pane of 3 ½ ' by 4' glass over west facing window. Sealed with silicone.
- Installed covers over the ventilation system for the winter.

WPC Disinfection Bldg.
- Closed all 4 ceiling vents using foil backed bubble wrap insulated steel covers previously fabricated and installed.
- Turned up Trane 4-ton heat pump to heat the entire building. Turned down the 4 electric heaters so that they would not be called on.
- Sealed hole through concrete block wall left from eliminated piping, and gap around new chemical line through concrete block wall with expandable foam.

Green River Pump Station
- Weather stripping and sealing of various joints, doors windows etc.
- Install precut 2" rigid insulation in all windows for the winter.
- The old 60" ceiling fan was replace with a new unit. It is run all winter at low speed to keep the heat well below the high ceiling.
- New conduit and switches installed along with new 48" ceiling fan in analyzer room.

Oak Hill Filter Plant
- Rigid insulation was installed in generator air inlet vent.
- A fan was installed in the stairwell to enable the furnace heat to move upstairs better, where the thermostat is located.
- Sealed up old chimney flue.
- Five of the buildings windows were bricked up. Four small ones and one large.
- Two new large windows were installed (approx. 3 ½ ' by 4 ½ ') on the upper floor.

Millbrook Corrosion Control and wellhouses
- Weatherstripping and sealing of doors, vents, etc.
-
-

B. Climate Action Plan – Steps taken by Town to reduce emissions, greenhouse gases and its carbon footprint:

1. **ICLEI –** In February 2008 the Town joined ICLEI which is an international membership association of local governments working to reduce greenhouse gas emissions. They provide programs, tools, software assistance and technical expertise towards this goal.

2. **Intern to work on energy issues:** Summer 2008 – Hired a student intern to work specifically on climate protection issues. Intern is compiling energy consumption data and community information. This is being used with conjunction with ICLEI software and the Energy Star Portfolio Manager software which will help the Town determine and then track its carbon footprint.

3. **Greening Greenfield Energy Committee:** Working collaboratively with the GGEC on many common issues. Committee has been very helpful with bringing forth ideas, etc. and has and will play significant role in public education, partnering, etc.

4. **Recycling**: Due to continued public education and emphasis by the Town's Recycling Coordinator, Town's recycling rate is continually improving. This reduces amount of trash that must be transported to Springfield and incinerated. Current recycling rate is 43%.

5. **PAYT Program:** In 2005 the Town instituted a Pay-As-You-Throw trash program. This program continues to significantly reduce trash volumes and increase recycling rates.

6. **Household Hazardous Wastes Program:** The DPW continues to operate this award winning Household Hazard Waste Program which is open to the public 250 days per year. Certain wastes, if not disposed of properly, can have serious negative impact on the environment including emission of toxins such as mercury from fluorescent light bulbs. Having a program that is open so many hours facilitates proper disposal. In addition to collections sites at the Water Pollution Control Plant and Transfer Station staff will go to homes of the elderly/disabled to pick up any hazardous waste for them. For more information please call the DPW at 772-1539. In addition, the Town collects button batteries and periodically runs programs such as a mercury thermometer swap program.

7. **Tree Program:** In conjunction with the Greening of Greenfield Committee the Town has an active tree planting and maintenance program. This includes a Memorial Tree Program whereby with contributions from the Walker and Kostanski funeral homes we are able to plant of 12-15 more large trees per year than we would otherwise be able to afford. In addition to aesthetics, the goal is to increase the urban forest to provide shade thereby reducing need for AC units etc. This fall the DPW will be planting trees in the empty grates on the sidewalks in the Main Street area. The Greening of Greenfield Committee will be assisting the DPW with professional advice regarding what species of trees and the selection of trees that would be best suited for these sites.

8. **Wedgewood Gardens**: In 2006, with funding from the Commonwealth, purchased this former trailer park which had been flooded in 2005. This 15 acre site has now been "returned to nature" – all structures and the majority of paved surfaces have been removed. This provides green space very close to the Town center, reducing heat from pavement and structures. The DPW maintains the area.

9. **Parks**: The Town, with assistance of funding from the Commonwealth, is in the process of making significant improvements to two parks – Hillside Park and the Green River Swim Area. The swim area includes as impoundment of the Green River which provides a swimming setting for residents of Greenfield and surrounding towns. The very unique feature of this site is that is provides a natural and low energy demanding swimming and recreation site for many. Unlike most municipal swimming facilities, there are no pumps, filters, chemical usage etc.

10. **Community Gardens**: The Town provides land at the Davis St School Administration Bldg for community gardens. Community gardens help "green" urban space and promote "grow/buy local" options.

11. **Anti- Idling Campaign** - July 2008 – DPW announced anti-idling campaign to reduce vehicle emissions, especially near school grounds. This program will educate the public about the dangers of emissions and the importance of turning off your engine.

12. **Transportation:** The Town is working with FRTA on plans for construction of new transportation center that may eventually include rail travel.

13. **Fuel Efficient Vehicles:** The town has started a program to change the past practice of using "hand-me-down" police cruisers for other departments such as Health, Assessors etc. The Town will be purchasing a small, fuel efficient vehicle for the Assessor's Office this year.

14. **Rain barrel distribution program.** To date approximately 120 barrels have been sold. This program is run in conjunction with April Earth Day events.

15. **Composting bins:** To date DPW has sold approximately 300 composting bins.

16. **Methane recovery system.** The Town continues to maintain and operate a methane recovery system at the Town's capped landfill. While the capped landfill does not generate enough methane to make it economical feasibility to burn and generate electricity, capturing and treating the methane decreases greenhouse gases by treating methane that would otherwise escape to the atmosphere.

17. **Demand Response Program**
    This is a program created and overseen by ISO-NE in order to meet power demands during peak usage periods (typically July and August) by entering into agreements with large power users who have standby electrical generators such as the town's Water Pollution Control Plant. When an incident is anticipated the plant switches from "street" power to standby power thus dropping its electrical demand from the grid. The Town is compensated for participation in this program (approximately $4000 per yr) but the real benefit of participation has more global ramifications. By meeting peak demand loads in this fashion the need to build more power plants is negated.

18. **Solar Powered Light on Viet Nam War Memorial**
    The Town has applied for a grant to install a solar powered light on the Viet Nam War Memorial in the Vets Mall. In addition to providing illumination it will be used for public education.

Pledge to Save $$$ on Your Energy Bills...

and Reduce Carbon Emissions, the Major Cause of Global Warming and Climate Change

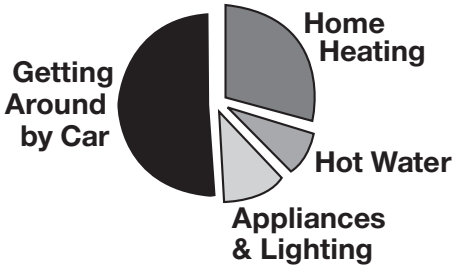
If you are concerned about paying your bills, global warming and climate change, shipping in food from 1500 or more miles away, loss of local farmers and farmland, access to clean water, and other impacts that we are having on the planet... join your friends and neighbors and use this list of things we can do!

Participate in the Greening Greenfield Campaign!
See your actions make a difference.

- *Reduce the cost of running your household!*
- *Reduce carbon dioxide emissions, the major cause of the climate change crisis!*
- *Reduce toxic pollution emitted from our power plants!*

Join your Greenfield neighbors in building a vital and sustainable future.

TYPICAL HOUSEHOLD ENERGY USE



Did you know that 84% of the climate change emission is caused by burning fossil fuels?

INSIDE ARE THREE LISTS OF CHALLENGES!

1. **The top 16 things you can do.**
2. **Low cost and lifestyle changes.**
3. **Big savings with one-time investments.**
   Often overlooked and underappreciated, the most valuable energy you save is the energy you don't use.

✔ Check off the actions you pledge to act on in your household or with your neighbors.

✔ Check off the actions you do now.

Greening Greenfield Campaign

The Greening Greenfield Energy Committee (GGEC) is a group of citizens that is working to build a sustainable Greenfield so that current and future generations can enjoy life in this beautiful abundant valley. The Greening Greenfield campaign is a collaborative effort of the GGEC and the Town of Greenfield. We invite you to join us!

Revitalizing Greenfield, Building Community
Saving $ and the Environment

www.GreeningGreenfield.org

P.O. Box 726, Greenfield, MA 01302

1. Top 16 things you can do

I do this now	I pledge to take this action	Your Action	Your Savings Each Year	Reduction of CO_2 Each Year (in lbs.)
☐	☐	**Use energy efficient lights** such as LEDs and compact fluorescent light bulbs. When compacts need to be replaced in 7-10 years, dispose of them properly.	$148 per year	1152 lbs
☐	☐	**Turn off** appliances, computer, TV, etc. with a power strip when not in use to avoid "phantom loads."	$36 per unit	280 lbs. per unit
☐	☐	**Dry** two loads of wash each week on a clothes line	$44 per year	345 lbs.
☐	☐	**Buy** local – food and other goods	varies	varies
☐	☐	**Drive** fewer miles this year with your car – walk, bike, carpool, take mass transit; bundle your errands, etc.	$ ___ /gal. x ___ gal. saved	20 lbs. x ____ gal. saved
☐	☐	**Drive** 55 mph, avoid quick starts, maintain tire pressure	25% of your gas $	20 lbs. x 25% of gal. used per year
☐	☐	**Hot water heater:** A. **Lower** to 120° B. **Install** blanket	depends on fuel use	A. 150 lbs. B. 175 lbs.
☐	☐	**Recycle** and buy recycled	varies	varies
☐	☐	**Buy energy efficient** appliances, TV, computer, and car when old equipment fails. (see section 3 for details)	10 – 75% reduction in cost of electricity or fuel	10 – 75% reduction
☐	☐	**Green electricity:** Invest $5/month or more in the New England Wind Fund. It will help build renewable energy capacity in the region, and bring matching funds to Greenfield.	Each $1 invested buys 20kwh of green electricity and raises $1 for Greenfield	Each $1 invested reduces CO_2 emissions by 22 lbs.
☐	☐	**Your house:** A. Heating **tune-up** B. Free energy **audit** and **rebates** for insulation, etc. 866-527-7283 (see section 3 for details)	4% – 80% of heating bill	A. 60 lbs. B. depends on action and fuel used
☐	☐	**Buy solar** electric system (also called PV or photovoltaics) www.massstech.org 508-439-5700 (see section 3 for details)	Use 40% – 60% rebates plus tax credits to lower initial investment	varies with size of PV system
☐	☐	**Support legislation** that promotes climate change solutions such as energy efficiency, clean renewable energy, etc.	Priceless	10 – 100% reductions
☐	☐	**Have fun!**	priceless personal satisfaction	priceless
		TOTALS	$ _____ Saved	_____ Lbs. CO_2 Reduced

2. Low cost and lifestyle changes you can make

I do this now / I pledge to take this action	Your Action	Your Savings Each Year	Reduction of CO_2 Each Year (in lbs.)
	HOW I GET AROUND		
	Calculating your $$ and CO_2 savings depends on your car's fuel efficiency. To get started you need to learn how to calculate gallons saved. See equation at left. Note: $$ saved depends on fuel costs. Also, fill in the cost per gallon at the pump.	Miles not driven ÷ mpg of your car = gal. saved	Each gal. saved reduces carbon emissions by 20 lbs.
☐ ☐	**Make** a commitment to drive 10% fewer miles than last year.	$__/gal. x __ gal. saved	20 lbs. x ___ gal. saved
☐ ☐	**Plan** a week's worth of errands ahead of time to reduce distance driven.	$__/gal. x __ gal. saved	20 lbs. x ___ gal. saved
☐ ☐	**Set** aside one day a week with no driving of your own vehicle. (walk, bike, carpool, or take a bus or train)	$__/gal. x __ gal. saved	20 lbs. x ___ gal. saved
☐ ☐	**Sell** your car: walk, bike, use mass transit, join a ride-share or car-sharing group, move to town.	$__/gal. x __ gal. saved	20 lbs. x ___ gal. saved
	MY YARD AND FOOD		
☐ ☐	**Plant** a garden in my yard, join a community garden or a CSA (community supported agriculture). Explore organic gardening or permaculture.	30-60% of your food bill	reduces CO_2 and creates oxygen
☐ ☐	**Can, dry, freeze or store food** in a root cellar for the winter months.	30-60% of your food bill	varies
☐ ☐	**Eat** less conventionally-raised meat. Calorie for calorie, commercial meat production creates over three times as much CO_2 and up to 17 times more water pollution. Eat organic grass-fed, pasture-raised beef, lamb, goat, pork, and chicken.	varies	less methane, which is 20 x stronger than CO_2
☐ ☐	**Mow** my grass with a manual or electric mower. Reduce the amount of mowed area. FYI: In addition to carbon emissions, one hour of power mowing creates air pollution equal to 40 late-model cars driving for the same amount of time.	$__/gal. x __ gal. saved	20 lbs. x ___ gal. saved
	MY HOUSE		
☐ ☐	**Buy and use** a programmable thermostat ($30 minus $25 utility rebate). Keep house 5-8 degrees cooler at night, and when no one is at home.	10-15% of your heating bill	depends on fuel use & type
☐ ☐	**Lower** my thermostat in winter to 65-68°. (For every 1° F lower, you save 1-3% on your heating bill)	1-9% of your heating bill	1-9% less carbon
☐ ☐	**Use insulated** curtains on your windows to reduce need for heating and cooling.	varies	varies
☐ ☐	**Use fans** instead of air conditioning (AC). Ceiling fans use about 100 watts.	30-70% less than AC costs	30-70% less carbon
☐ ☐	**Raise** your thermostat in summer to 78°, if you have whole house air conditioning. (it will cost 10% more if you set it at 75°)	1-10% of your cooling bill	1-10% less carbon
☐ ☐	**Use** cold water in my washing machine and use cold-water detergent.	varies with usage	varies with usage
☐ ☐	**Add** a timer to my hot water heater to turn it off during hours not needed. (Only if hot water heater is separate from boiler or when boiler is otherwise off.)	30% of cost of heating water	varies with fuel
☐ ☐	**Seal** ductwork in my forced hot air heating system.	$63	525 lbs.
	REDUCE GARBAGE		
☐ ☐	**Reduce** what you need to throw away by reducing packaging materials coming into your house: buy bulk items with less packaging, take your own bags to the grocery store, bring your own containers for take-out or left-overs.	More than you'd expect!	More than you'd expect!
☐ ☐	**Compost** - Save 15% of the total discarded solid waste from your home.	15% of cost of garbage disposal	15% of the carbon emissions
	WATER		
☐ ☐	**Install** low flush toilet (1.5 gal or better) that has "small" and "big" flush options.	save 30% on your water bill	some reduction
☐ ☐	**Install** low flow showers and faucets.	varies with usage	save water and heating CO_2
☐ ☐	**Install** quick shut-off on faucet and use it for tooth brushing, dish washing, etc.	varies with usage	save water and heating CO_2
☐ ☐	**Take** a 5-minute shower. Take fewer showers.	varies with usage	save water and heating CO_2
☐ ☐	**Drink** tap water. Get a water purifier. Don't use bottled water and other bottled drinks	varies with consumption	
☐ ☐	**Join or organize** a group of your neighbors to read the *Low Carbon Diet* action study guide. Contact Greening Greenfield to sign up.	More than you'd expect!	More than you'd expect!
	TOTALS	$ _____ Saved	_____ Lbs. CO_2 Reduced

3. Big savings with one-time investments

While the up-front costs may seem high, the returns on your investments often far exceed typical investment returns.

I do this now / I pledge to take this action	Your Action	Your Savings Each Year	Reduction of CO_2 Each Year (in lbs.)
	UPDATE YOUR HOME		
☐ ☐	**Reduce energy loss from air leaks and inadequate insulation.** Go for the "hi-test" energy audit. It is not free, but it is worth it! The best audits are done with a "blower door" and an infrared camera, so you learn about air leaks and holes in your insulation. Air leakage is the #1 cause of uncomfortable drafts and energy costs. Call MassSAVE at 866-527-7283 for discounted audits offered by utility companies and learn about rebates up to $2,500 for insulation, heating systems and more. Follow through with the recommendations for big savings! ***Energy you don't use is the best!***	20-80% savings on your heating and cooling bills	20-80% less
☐ ☐	**Windows:** Replace drafty windows with energy efficient windows; add low-e exterior storm windows; add interior storms, jamb liners and fill double hung window weight cavities; add thermal shutters. Windows and doors cause drafts and heat loss accounting for 20-40% of your heating costs. If you have storms or thermopanes, savings will be less.	5-20% of heating bill & more comfort	5-20% less CO_2
☐ ☐	**Appliances:** Replace an old appliance with an Energy Star model. (Cost $200-800 depending on appliance). Find fuel efficient appliances and compare at www.aceee.org/consumer/consumer.htm (note: new efficient front-loading washing machines save $, energy, water, soap, and drying time!)	30-80% less than using your old appliances	30-80% less CO_2
☐ ☐	**Energy-efficient heating system:** Replace your heating system with an 90% or better Energy Star certified efficient heating system. Explore geothermal, etc.	10-30% savings	varies with fuel use
☐ ☐	**Renewable fuels:** Heat your home with a renewable fuel; such as, cord wood, wood pellets, bioheat (a blend of biodiesel and home heating fuel). Note: Wood-burning is only renewable if we burn less than what grows each year. While wood-burning reduces CO_2 emissions, it produces huge amounts of hazardous particulate matter and chemicals known to be carcinogens such as PAHs and dioxin. Buy a clean-burning stove, bring in outside combustion air, and practice burning habits that reduce air pollution. ***Insulating first will greatly reduce the use of all combustion fuels.***	varies	reduces your heating emissions
	HOT WATER: ***Your water heater is the second largest consumer of energy in your home after home heating and cooling.***		
☐ ☐	**Purchase** a tankless (on demand) water heater.	Up to 50% of your hot water heating costs	varies with fuel use
☐ ☐	**Solar hot water systems** are the one of the most efficient uses of solar energy. Research and plan for adding solar hot water panels to your home. Generally, this is more cost effective than installing solar electric (photovoltaic) panels. Check out federal and state tax incentives at www.dsireusa.org.	50-80% of your hot water heating costs	50-80% less CO_2
☐ ☐	**PV:** Research and plan for adding solar electric (photovoltaic, PV) panels to your home. Explore $$ available from Massachusetts Technology Collaborative at www.masstech.org 508-439-5700 (40-60% of the cost of the installed system). Explore state and federal tax incentives at www.dsireusa.org.	up to 100% of your electric bill	1.1 lbs. per kwh replaced
☐ ☐	**New Home:** When buying or building look for the smallest house that fits your needs. Be sure it is well insulated and the longest side faces south and has windows. Windbreaks and trees will protect the home from winter winds and summer sun.	could be 100% if net-zero-energy home	up to 100%
☐ ☐	**Auto:** Replace your auto with the most fuel-efficient auto that meets your needs. Find and compare vehicles at www.epa.gov/greenvehicles.	20-70% savings on fuel	20-70% less CO_2
	HAVE FUN IT'S A GAME! See how much energy you don't have to use!		
☐ ☐	**Fix things:** don't assume that something is to be junked when it breaks. Learn how to fix it yourself or find someone who can.	varies	varies
☐ ☐	**Recycle:** Remember the recycling jingle: "***Don't use, reuse, recycle***"... everything from bottles and paper to clothing, toys and electronics so others can use them.	More than you'd expect!	More than you'd expect!
☐ ☐	**Create** additional energy steps not listed here.	____ expected savings	____ expected CO_2 reduction
	TOTALS	$ _____ Saved	_____ Lbs. CO_2 Reduced

As you make changes, be aware of unintended consequences to the environment and human health and adjust as necessary.

GREENING GREENFIELD ENERGY COMMITTEE (GGEC)

HOW TO SAVE $$$ ON YOUR HEATING BILLS

RESOURCES FOR GREENFIELD HOMEOWNERS (1/1/09)

To save money on your heating bills, the first thing you need to do is learn how your house works and what makes a home both comfortable and energy efficient at the same time. The first step is to have a professional energy audit. Next you will need to decide on the steps you want to take, and find the funds to do the project! This resource was developed to help you find the resources you need to move through this process as smoothly as possible. Don't forget, you don't have to do everything all at once, but there are time limits to utility rebates.

STEP 1: THE ENERGY AUDIT. ALSO CALLED HOME ASSESSMENT

Energy Audit / Home Assessment – If you own your home and it has not been energy upgraded recently, you can sign up for a FREE energy audit (Home Assessment), valued at $200, offered by the utility companies by going to MassSAVE.com or calling 866-527-7283. The actual audit, and what financial incentives are offered, depends on the fuel you use. So you will be directed to that information when you call or go on line. Also, if you are income eligible for Weatherization programs, you will be referred to those programs.

Enhanced Audit / Complete Diagnostic Audit,- This audit ($300 value) will be performed with diagnostic equipment including a "blower door," "infrared camera" and "duct blaster" (if you have a hot-air furnace). We recommend that you t*ake advantage of this offer if your house already has insulation.* The infrared camera is incredibly important. You can find voids in your insulation. Combined with the "blower door" the auditor can find all those pesky drafts. Please note that Enhanced Audits may not be able to be performed in your home due to safety concerns such as high moisture levels in the basement, the existence of asbestos covered pipes, or vermiculite in the attic etc.

Following is an overview of what is offered to which customers. Check with MassSAVE.com for details!

If you use oil, electric or propane to heat, you are eligible to be considered for the FREE audit, or you can pay $75 and receive the enhanced audit offered by your electric utility company, WMECO. They will interview you on the phone regarding your intention to invest in your home and make it more energy efficient, and your eligibility for the Weatherization program (see below). You can call WMECO directly at 800-666-3303.

If you use **natural gas** to heat your home, you are eligible for an audit from Berkshire Gas. A complete diagnostic audit is NOT available, but they say that "an auditor will use the diagnostic equipment necessary to diagnose the most cost-effective improvements for your home." You can call Berkshire Gas directly at 800-944-3212.

Independent Auditors: You can also purchase a enhanced audit from independent companies for $200-$500. But remember, you must have a utility audit to receive utility rebates!

STEP 2: DECIDE WHAT YOU WANT TO DO & WHAT YOU MIIGHT SAVE

The audit gives you guidance on what are the most cost effective measures you can take, and what rebates your utility company is offering. Attending a workshop on how your house works, and/or meeting with others who are working on this issue, or already been through it is very helpful. GGEC can help you connect with others and use a simple spreadsheet that we have developed to help you analyze your energy use and potential savings.

Following is a list of effective measures you can take with the most cost effective and inexpensive items listed first:

- Install a set-back thermostat
- Have your home air sealed
- Your attic – have it air sealed and insulated
- Basement – have it air sealed
- Make your existing heating system as efficient as possible
- Look at your hot water system – could it be upgraded to save $$$?
- Install a new heating system
- Windows – add thermal curtains or interior or exterior storms. Replace if necessary

more over

-

- Consider lowering your electric bill by
  - Using power strip to turn off all computers, TV etc. - Installing compact fluorescent light bulbs
  - Purchasing energy efficient appliances when old ones die

STEP 3: FINDING THE $$$

1. **IRS Tax Credits if you pay Federal taxes: for conservation and energy efficiency** - The recently passed stimulus package raised federal tax credits up to $1,500 for insulation or energy efficient windows, doors, water heaters, heating systems etc. Go to www.dsire.org for details or ask your tax accountant.

2. MASSSAVE: REBATES & LOANS

Rebates for everyone for insulation and air sealing – 75% of cost up to $2000 (new Jan 2009)

Special Rebates for all natural gas customers:
New heating systems: $100-$1,000 for systems that are 85-95% efficient (AUF rating)
Programmable Thermostat: $25; Hot water On–Demand or high efficiency: $300

0% loans for Everyone: MassSAVE *Heat Loan Program:* You must own your own 1-4 family home. In Greenfield, this program is administered by Franklin First Credit Union 774-6700. (see MassSAVE.com for full list of banks). This program offers 1-7 year loans for $2,000-$15,000. Loan can be used for insulation, windows, hot water, heating, solar hot water (It cannot be used for solar electricity also called photovoltaics or PV). The process: a) Pre-qualify with the bank (they are primarily checking that the list of things you want to do qualify for the loan, it has nothing to do with you income,) b) call MassSAVE for the audit, c) get estimates and present to MassSAVE for OK before you start the work, d) submit bills. www,MassSAVE.com

3. ENER-G-SAVE.ORG Offers $50 to anyone that insulates their attic!

4. LOAN PROGRAMS OFFERED BY VARIOUS BANKS:

a. Home Improvement loans: All banks offer home improvement loans Amount of loan and terms varies

b. Franklin First Federal Credit Union offers several unique loans 774-6700, www.franklinfirst.org
Energy Loan Program If 51% of the work to be done on a home improvement are "qualifying improvements," the loan rate is 1% below their normal personal home improvement loan. Qualifying Improvements include measures recommended by an energy auditor such as windows, storm doors, and windows, new furnace, insulation, weather-stripping, Energy Star water heater, home appliance, wood stoves, solar hot water and PV, geothermal etc. Minimum loan amount is $3,000.
Pre-Paid Fuel Loan: Rate: 2% below personal loan. $8,000 maximum. Must be paid back in 1 year.
Wood or Pellet Stove Loan: Rate: 2% below personal loan. $8,000 maximum. Must be paid back in 4 years.

c. Greenfield Cooperative Bank www.greenfieldcoopbank.com 772-0293 offers a 4% fixed rate home equity loan for energy efficiency upgrades.

5. GRANT & LOAN PROGRAMS OFFERED BY VARIOUS ORGANIZATIONS FOR INCOME ELIGIBLE PEOPLE:

These programs change frequently. www.EnergyBucks.com is the state-wide resource. Locally The Franklin County Home Care Corp maintains an up-to-date list at www.fchcc.org, 413-773-5555, email info@fchcc.org

a. Mass Housing Home Improvement Loan: www.masshousing.com - 617-854-1000. Administered by Greenfield Coop Bank 772-5000. Income must be less than $92,000/yr/household, living in 1-4 unit buildings. Total home loans cannot exceed 100% of appraised value of home. Loans are $10,000-$50,000, 5% fixed interest rate, 5-15 year payback. Any home improvements including solar.

b. Weatherization, Emergency Heating Repairs, & Fuel Assistance Program –Community Action 774-2310, www.communityaction.us (formerly known as the Franklin County Community Action Corporation.) Funds available for homeowners and renters at or below federal poverty level; size of family and income determines amount. Applicant required to complete a Fuel Assistance Program Application. Following is a short list of programs. Programs change often, so check the web site for the latest.

Fuel – assistance with a portion of your fuel costs
Weatherization – 100% of the cost (all people qualifying for fuel assistance eligible for weatherization.
Heating system – 100% of cost to purchase and install a new system if system unsafe or broken.

c. Housing Rehab Program - Franklin County Housing Redevelopment Authority (FCHRA) www.fchra.org 863-9781 – for those who live in the Greenfield Target area, with income less than $41,450 - $78,150 depending on household size. Loan from $1,0000-$35,000 with 0% interest rate to bring building up to code or for solar hot water if present water heater needs replacing. Solar electricity i.e. PV is not eligible.

GREENING GREENFIELD ENERGY COMMITTEE (GGEC)

HOW TO FIND $$$ TO BUY RENEWABLE ENERGY SYSTEMS

RESOURCES FOR MASSACHUSETTS HOMEOWNERS (1/1/09)

Renewable energy systems can be very cost effective, and becoming more so as the price of fossil fuel rises. They not only lower your energy costs, but they also cut climate change emissions caused by burning fossil fuels to heat or light your home. As for solar systems, there are two kinds: solar hot water systems (also referred to as solar thermal) and solar electric systems (also referred to as photovoltaics or PV systems).

As for support from Massachusetts, we have one of the most progressive programs for PV in the nation! We are also fortunate to have Coop Power based in Greenfield. Please see below for details

To learn about, and stay up to date on all the rebates for renewables and energy efficiency go to http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=MA&RE=1&EE=1

To find an installer, look in the Yellow Pages under "Solar Energy"

1. Tax Credit: IRS (Federal) – You are eligible for this tax credit. The solar tax credit was recently renewed and expanded as part of the $700 billion bailout bill!
You can receive tax rebates of 30% of the cost of the system. You can spread the claim over 2 years. Following are caps or limits to the federal tax rebates for various systems:

- Solar electric (PV): the 30% tax credit is calculated AFTER the MTC rebated has been subtracted from the system cost. There is no maximum limit (New in 2009. Will run through 2016)
- Solar water heating: $2,000.
- Fuel cells: $500 per 0.5 kW.
- Small wind: $500 per 0.5 kW, up to $4,000.
- Geothermal heat pumps: $2,000.

2. Tax Credit: Massachusetts – You are eligible for this tax credit if you pay Massachusetts taxes. Ongoing program: You can receive a tax credit of 25% of the cost of the system up to $1,000 each year. The credit may be used for hot water or PV system. Credit may be carried forward for 3 years.

3. Commonwealth Solar Initiative (CSI) administered by Massachusetts Technology Collaborative (MTC). www.commonwealthsolar.org 508-439-5700.
Rebate varies with income level: $2/watt up to 30% of the cost of a PV system up to 5kw in size.
Additional rebates for "income eligible people." if your property value is under $300,000 and household income is less than $76,291, you are eligible for a 50% rebate! If your income is less than $91,552 you are eligible for a 40% rebate.
Process: Calculate likely system cost after MTC rebate and federal and state tax credits at www.masstech.org/SOLAR/three.html Get estimates, install the system, and them apply for your rebate by emailing as directed or calling 508-870-0312. Most solar installers will fill in the rebate paperwork for you.

4 **Co-op Power:** www.cooppower.coop 772-8898 (Non-members also welcome to purchase thru Co-op Power to get consumer advocacy services, but with no member discounts or rebates.) Membership Cost: $25 Annual Fee plus Refundable Member Equity of $500 - $975 paid in over 2-5 years that builds community owned sustainable energy in region. Programs may change over time – please check.

- **Solar Hot Water Equipment –** Co-op Power members eligible for discount of 10% off equipment. Combine with sweat equity installation and tax credits to get 65% off the price of your system.
- **Member-to-Member Solar Hot Water Installation -** Co-op Power members eligible for sweat equity/40% off installation cost. Get free labor if you help 4 others.
- **Solar Hot Water Installation -** Co-op Power members eligible for rebate of 2% off cost of system. This rebate often pays for half of your Co-op Power membership.
- **Solar Electric Installation -** Co-op Power members eligible for rebate of 2% off cost of system. This rebate often pays for your Co-op Power membership.

Appendix 6a

Renewable Energy:
Hydro, Solar, Wind, Geothermal, Landfill

HYDROPOWER IN FRANKLIN COUNTY
ISO New England Report

Section 2.1, Appendix A.2 and B.1)

ASSET ID	CUSTOMER	GEN NAME	FIPS STATE #	FIPS COUNTY #	RSP AREA	SUMMER CLAIMED CAPABILITY 2008	WINTER CLAIMED CAPABILITY 2008	GEN TYPE ID	EIA PLANT NUM	DATE IN-SERVICE	GEN TYPE DESC	CUSTOMER NAME
766	FPRM	CABOT/TURNERS FALLS	25	011	WMA	68.200	68.200	HDP	1629	1-Jan-05	HYDRO (DAILY CYCLE - PONDAGE)	FirstLight Power Resources Management, LLC
465	TCPM	DEERFIELD 2/LWR DRFIELD	25	011	WMA	19.500	19.500	HDR	6047	1-Jan-12	HYDRO (DAILY CYCLE - RUN OF RIVER)	TransCanada Power Marketing, Ltd.
393	TCPM	DEERFIELD 5	25	011	WMA	13.990	13.990	HDR	1620	1-Oct-74	HYDRO (DAILY CYCLE - RUN OF RIVER)	TransCanada Power Marketing, Ltd.
851	CEEI	GARDNER FALLS	25	011	WMA	1.804	3.580	HDR	1634	1-Jan-24	HYDRO (DAILY CYCLE - RUN OF RIVER)	Consolidated Edison Energy, Inc
854	TTMLP	ORANGE HYDRO 1	25	011	WMA	0.145	0.150	HDR		1-Aug-87	HYDRO (DAILY CYCLE - RUN OF RIVER)	Templeton Municipal Lighting Plant
855	TTMLP	ORANGE HYDRO 2	25	011	WMA	0.112	0.120	HDR		1-Nov-93	HYDRO (DAILY CYCLE - RUN OF RIVER)	Templeton Municipal Lighting Plant
567	TCPM	SHERMAN	25	011	WMA	6.334	6.237	HW	6012	1-Dec-26	HYDRO (WEEKLY CYCLE)	TransCanada Power Marketing, Ltd.
		FRANKLIN County Totals				**110.085**	**111.777**					
14217	FPRM	NORTHFIELD MOUNTAIN 1	25	011	WMA	270.000	270.000	PS	54895	30-Nov-72	HYDRO (PUMPED STORAGE)	FirstLight Power Resources Management, LLC
14218	FPRM	NORTHFIELD MOUNTAIN 2	25	011	WMA	270.000	270.000	PS	54895	30-Nov-72	HYDRO (PUMPED STORAGE)	FirstLight Power Resources Management, LLC
14219	FPRM	NORTHFIELD MOUNTAIN 3	25	011	WMA	270.000	270.000	PS	54895	30-Nov-72	HYDRO (PUMPED STORAGE)	FirstLight Power Resources Management, LLC
14220	FPRM	NORTHFIELD MOUNTAIN 4	25	011	WMA	270.000	270.000	PS	54895	30-Nov-72	HYDRO (PUMPED STORAGE)	FirstLight Power Resources Management, LLC
359	BSP	J. COCKWELL 1	25	011	WMA	288.475	292.275	PS	8005	1-Sep-74	HYDRO (PUMPED STORAGE)	Bear Swamp Power Company LLC
360	BSP	J. COCKWELL 2	25	011	WMA	291.256	292.763	PS	8005	1-Oct-74	HYDRO (PUMPED STORAGE)	Bear Swamp Power Company LLC
		Northfield Mountain totals				**1659.731**	**1665.038**					

Potential Sources: Several old dams no longer in use, and otherscould be assessed

SOLAR POWER IN GREENFIELD

Reports of installed solar should be available from the Building Inspector and, for PV, from the Massachusetts Renewable Energy Trust
Large, Third part ownership being considered for closed Greenfield land fill, and municipal buildings

LANDFILL GAS

Landfill old and capped. Not a potential source

WIND POWER

None in Greenfield. Some in Franklin County and beyond

GEOTHERMAL

Heating and cooling potential with electrical input

Appendix 6b

Community-Scale & Institutional Biomass Resource list

Compiled by GGEC May, 2009

Proposed Projects in western Massachusetts and surrounding areas.

Greenfield, MA

- **Pioneer Renewable Energy (PRE)** project, a 47 megawatt (MW) biomass combined heat and power (CHP) plant located in Greenfield, MA. Pioneer Renewable Energy will employ low emission, advanced biomass conversion technologies to produce reliable, sustainable and renewable electricity. The facility will also have the ability to provide steam and heat to nearby homes and businesses. The Pioneer Renewable Energy project will only utilize clean wood and will use recycled water for cooling. It is a project of Madera Energy. www.PioneerRenewableEnergy.com April 2008, applied or MEPA permit. Comments due by April 14.

- **Greenfield District Heating** was formed in 2008 to provide secure, affordable heat to the community of Greenfield, Massachusetts using local, sustainably grown and harvested wood chips to heat hot water that will be distributed through the town and hooked up to building's existing heating systems. www.GreenfieldDistricHeating.org

- **Co-op Power Wood Chip and Pellet Manufacturing Plant** www.cooppower.coop

Deerfield, MA: Magic Wings- Small heat or combined heat and power system

Pittsfield, MA

- Berkshire Renewable Power is owned by Berkshire Renewable Power L.L.C. This 30-55 Megawatt plant will use either stoker or fluidized bed boiler. It will use primarily clean wood (no construction and demolition materials). It is in the planning stages of pre-permitting. The project has completed the feasibility study with ISO New England and the System Impact Study is scheduled to be commissioned on April 20, 2009. They hope to open in 2013.

Russell, MA:

- Russell Biomass. This 50-megawatt, wood-fueled power plant will produce electricity equivalent to an oil-fired plant that burns 480,000 barrels of oil per year. To be built on former papermill property, a brownfield. The planning and permitting process was initiated at the local and state level in 2005. The plant is expected to begin construction in the second half of 2008 and to commence operations in late 2010. www.russellbiomass.com

Somerset, MA: NRG Energy-100-120 MW Electric Cofired Coal/Biomass plant

Springfield, MA

- Palmer Renewable Energy, a subsidiary of Palmer Paving. David J. Callahan, manager. This 38-megawatt plant will generate electricity. It will use 900 tons of wood per day: 700 tons of recycled wood separated from construction and demolition debris, and 200 tons of "green" wood chips from forestry. "It will create 150 construction jobs, and when

completed provide up to 50 full-time jobs." 9/24/08 received town approval. Awaiting additional permits.

Brattleboro, VT: District heating system for downtown (feasibility study soon)

Watertown, CT: Watertown Renewable, 30 MW. Electric / gasification boiler. Clean wood only. Permitting in process since 2006.

Plainfield, CT: Plainfield Renewable, 38 MW. Electric plant. Mostly recycled wood. Permitting in process since 2004.

Berlin, NH: Laidlow Berlin BioPower, LLC. 58 MW cogeneration plant (steam for Fraser paper). Clean wood only. Permitting in process since 2008.

EXISTING: Examples of Biomass Plants in the area.

Institutional - heat only plants, or combined heat and power

- Acton, MA: Rex Lumber
- Athol, MA: Athol/Royalston Regional High School
- Bennington, VT: Mt. Anthony High School
- Belchertown, MA: Quabbin Administration Complex
- Gardner, MA: Mount Wachusett Community College
- Middlebury, VT: Middlebury College
- Northampton, MA: Cooley Dickinson Hospital
- Spencer, MA: St. Joseph's Abbey

Commercial / Community-scale plants:

- Westminster, MA: Pinetree Power Fitchburg. 16 MW electric plant.
- Portsmouth, NH: Schiller plant, 50 MW electric plant opened in 2006
- Burlington, VT: McNeal Station, 50 MW electric plant with heat capabilities. Built late 1980's

Resources RE: Local Studies:

Franklin County Energy Project & Task Force publications including the *Franklin County Energy Study: A Renewable Energy Study*, 1977, University of Massachusetts at Amherst, sponsored by the U.S Department of Energy

Pioneer Valley Clean Energy Plan (PVCEP), 2008, Pioneer Valley Planning Commission (PVPC), Franklin Regional Council of Governments (FRCOG) and the Pioneer Valley Renewable Energy Collaborative. www.frcog.org/pubs/landuse/Clean_Energy_Plan/PVPC-CLEAN_ENERGY_PLAN_final.pdf

Energy from Forest Biomass: Potential Economic Impacts In Massachusetts, 2007, published by the Massachusetts Division of Energy Resources (DOER). Authored by: D. Timmons, D. Damery, G. Allen. www.mass.gov/Eoeea/docs/doer/renewables/biomass/bio-eco-impact-biomass.pdf This report concludes that there is approximately enough sustainably harvestable wood that would be appropriate for wood chips in western Mass forests to support 165 Megawatts of capacity.

Greenfield Energy Audit, 2009 (www.GreeningGreenfield.org

Additional reports on bioenergy available at the Massachusetts Department of Conservation and Recreation (DCR) website. http://www.mass.gov/dcr/stewardship/forestry/utilmark/index.htm and see Technical Reports"