COOL Businesses: Cutting Costs and CO_2 on Spring Street

Environmental Planning 302
Fall Semester 2006

By

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I. ABSTRACT

The objectives of our project are two-fold. First, we provide the COOL (CO_2 Lowering) Committee with research on the current energy-use practices of Williamstown businesses, including an assessment of their efficiency and the potential to reduce their carbon dioxide emissions. Second, we use this information to develop a set of strategies for businesses and the COOL committee to reduce the commercial sector's carbon dioxide emissions and aid them in reaching Williamstown's 10% emissions reduction goal.

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II. INTRODUCTION: Global Warming, Williamstown, COOL Committee

Global climate change is a complex topic. Despite the difficulties entailed in using current and historic climatic and atmospheric data analysis to make accurate predictions about the future, scientists have come to the consensus that humans are seriously altering the atmosphere's chemistry, and that this could have dire consequences for future generations. Data from ice cores and other sources show that temperature has risen dramatically since the industrial revolution, and scientists believe this trend will continue (see figure 1[1]). In fact, it is likely that the 1990s were the warmest decade in history. Most recently, it has been predicted that the global temperature will rise 1.4-5.8° Celsius by 2100. [2]

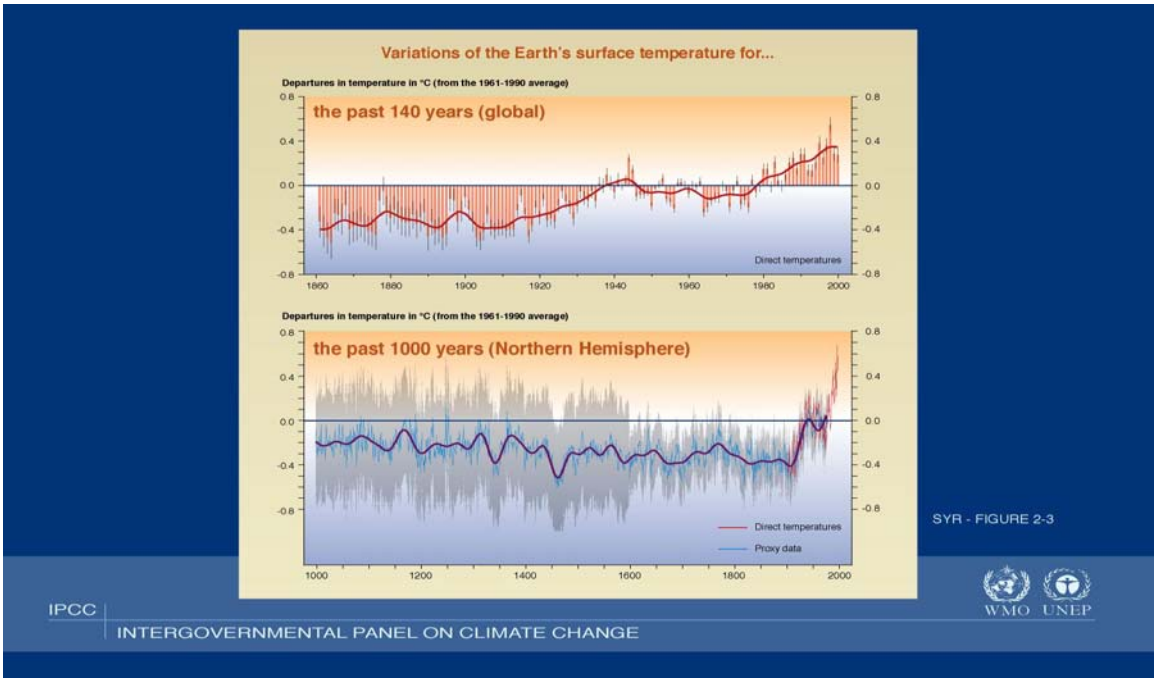
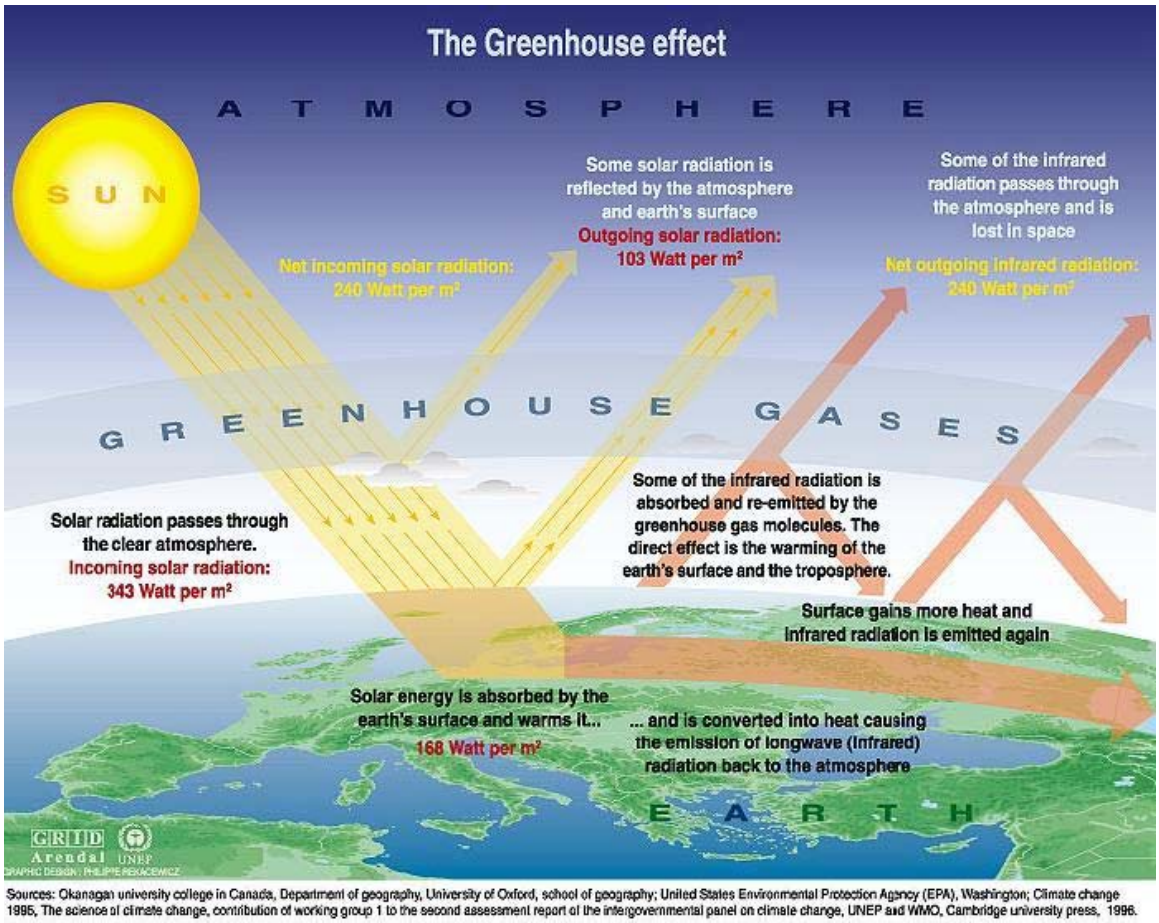


Figure 1.

[1] http://www.ipcc.ch/present/graphics/2001syr/large/05.16.jpg
[2] http://www.ipcc.ch/pub/un/syreng/spm.pdf

Global warming is the result of the "greenhouse effect", in which atmospheric gases (which include water vapor (H_2O), ozone (O_3), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_20)) act like a giant blanket in the atmosphere, trapping some of the infrared radiation (heat) that has reflected off the earth's surface in and preventing it from escaping into outer space.[3] While the greenhouse effect is a natural and necessary atmospheric phenomenon, over the last century and a half, the concentration of greenhouse gasses has increased significantly due to industrialization. It is the magnitude of this increase, particularly in CO_2, that has caused concern in the scientific community.



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Figure 2.

[3] http://williamstown.net/Action%20Plan%20-%20Web%20Version.pdf

Much of this increase in atmospheric greenhouse gas content can be attributed to increasing human emission of carbon dioxide since the advent of the industrial revolution. If emissions of CO_2 and other greenhouse gases continue at their current rate, or worse, if they continue to rise, the results could be disastrous. Increased global warming will have serious biological and geological implications, including sea level rises, increased severe weather patterns, habitat destruction, loss of biodiversity, food production and pest problems, and increased disease. All of these changes will, in turn, have serious socio-economic implications for human societies. Mitigating the consequences of global warming would be enormously expensive, and, in some cases, impossible. The only way to limit the occurrence of these problems is to limit temperature increases by reducing greenhouse gas emissions (See Figure 3).[4]

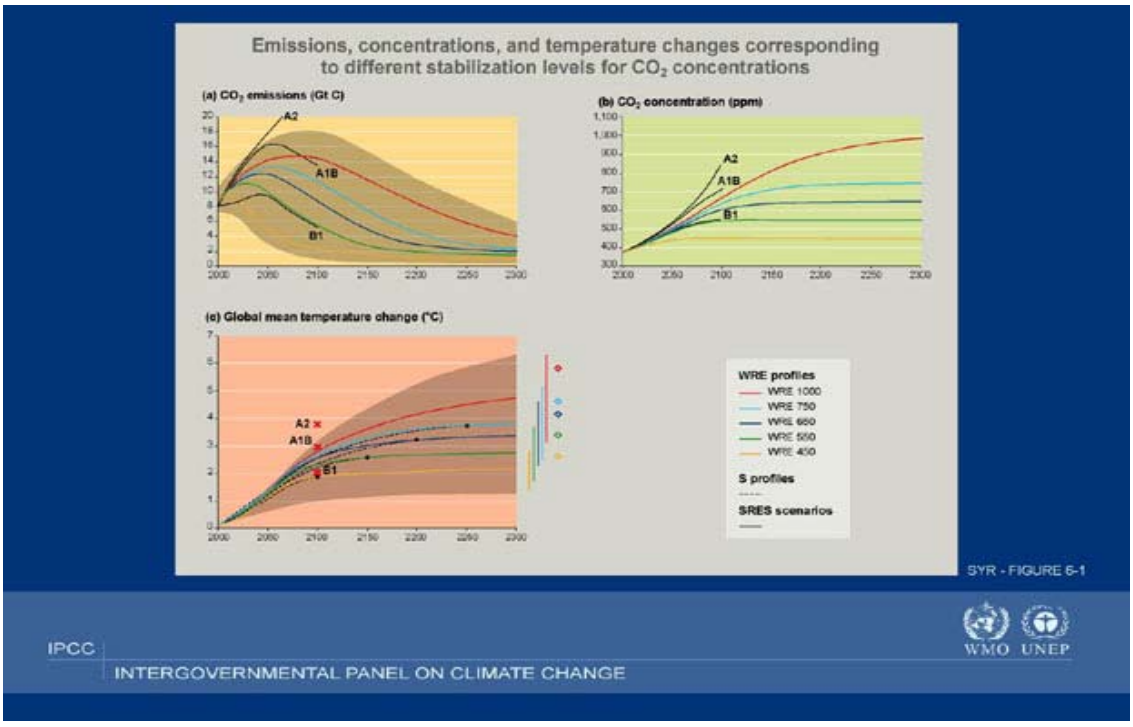


Figure 3.

[4] http://www.ipcc.ch/present/graphics/2001syr/small/02.18.jpg

At its most basic level, this is a problem of energy resource planning. While the likelihood of the country running out of electricity in the near future is extremely low given the extremely large coal reserves the country has, use of this coal would have dire effects in itself. Coal mining significantly damages water quality, and harms entire communities' health and environmental well-being. Burning of coal releases nitrous oxides and sulfur dioxide, which contribute to acid rain and smog.[5] And the combustion of fossil fuel in the form of either oil *or* coal has huge impacts in its release of carbon dioxide and other greenhouse gases.

Given all of these predicted consequences, and the fact that the federal government has refused to take a firm stance on energy efficiency, the burden of reducing greenhouse gas emissions has fallen upon state and local governments. It is important for each of us to assess our own behaviors and do our part to reduce our contribution to greenhouse gas emissions. While it is not possible for anyone to change the future of global climate change alone, cooperative efforts have the potential to make a significant difference. Reducing Williamstown's emissions will require more than individual commitments from those who are already interested in climate change: it will require community-wide action. One of the COOL committee's goals is to foster this type of change.

III. COMMUNITY PROFILE

Williamstown is the quintessential New England town located in the North-West corner of Massachusetts. Nestled in the picturesque Berkshire Mountains, the town is surrounded by natural and cultural beauty. Williamstown covers 46.86 square miles and is home to a population of 8,220 residents, including 2,000 Williams College

[5] http://www.ucsusa.org/clean_energy/coalvswind/c02c.html

undergraduates.[6] According to the 2006 census, there are currently 4,167 Williamstown citizens in the "labor force" and the number of "establishments", or businesses, in the town is 231.[7]

Williamstown, which was appropriately nicknamed, "the Village Beautiful," by Henry Tague[8], thanks in part of the liberal attitudes of the college community and other community leaders, has consistently worked towards being a leader in environmental protection according to the COOL Committee website. Environmentalist Michael Shay wrote in the 1972 Town Report:

> 1972 can easily be looked upon as the landmark year in the development of Williamstown's environmental effort, when not only did the town become a national symbol for environmental accomplishment, but when the residents demonstrated their concern and pride for the environment in concrete and far-reaching ways [such as the town's recycling and composting successes].[9]

Given this tradition of environmental activism, it is not surprising that in 2001, the town joined the *Cities for Climate Protection Campaign*. This program is sponsored by the International Council for Local Environmental Initiatives (ICLEI) and commits participants to "take steps to reduce the emissions of green house gases that are causing global climate change." The steps mentioned above include "completing a greenhouse gas emissions inventory and report, setting an emissions reduction target, completing a local climate action plan to reduce greenhouse gas emissions, implementing the local climate action plan, and monitoring the impact of emissions reduction measures."[10]

[6] http://williamstown.net/facts_and_information.htm
[7] Williamstown Chamber of Commerce. http://www.williamstownchamber.com/about.html
[8] Williamstown Chamber of Commerce. http://www.williamstownchamber.com/about.html
[9] Williamstown Climate Action Plan Report, pp 8. http://www.williamstown.net/Action%20Plan%20-%20Web%20Version.pdf
[10] COOL Committee Action Plan

Achieving these goals has become the responsibility of the COOL committee, a group of local volunteers appointed by the selectmen as an advisory committee on the town's carbon dioxide reduction efforts. Up to this point, the COOL committee has put in significant amounts of effort researching energy policy and completing an energy audit for Williamstown. The audit measured both the quantity of total emissions and the distribution of emissions among the residential, municipal and commercial sectors. They then developed Williamstown's Climate Action Plan, and since that time they have been taking steps to put it in place. In the action plan, the COOL Committee set a town-wide goal of reducing carbon dioxide emissions by 10% below 2000 levels by 2010. To reach this goal, 11,612 tons of eCO2 will have to be eliminated over the next 6 years. [11]

As a large proportion of Williamstown's commercial sector, small businesses are one of the COOL committee's target groups. A small business is usually defined in the United States as a business with less than 100 employees. The Small Business Association puts the benefit of small business in perspective:

> There are those who argue that big businesses, profiting from "economies of scale," can produce far more efficiently than small businesses. But small business is where the innovations take place. Swifter, more flexible and often more daring than big businesses, small firms produce the items that line the shelves of America's museums, shops and homes. They keep intact the heritage of ingenuity and enterprise and they help keep the "American Dream" within the reach of millions of Americans. Every step of the way, SBA is there to help them.[12]

We hope that the "innovative" small business owners of downtown Williamstown will be open to our suggestions as to how they could use energy saving behaviors and technology in their businesses.

[11] COOL Committee Action Plan
[12] http://www.sba.gov/aboutsba/history/index.html

IV. PROBLEM STATEMENT

The approach out lined in the COOL Committee's Climate Action Plan breaks down the town's emitters into three sectors: residential, municipal, and commercial. Our contribution to this product will be an in-depth report on the commercial sector and the development of a set of strategies for Williamstown's businesses to reduce their carbon emissions. Our ultimate goal is to use the businesses in the "downtown" district as models for techniques that can eventually be exported to all commercial institutions throughout Williamstown.

In the 2000 energy audit, Williamstown businesses were estimated to produce 20% of the town's greenhouse gasses, of which 81% was a result of energy consumption (not transportation or waste). Although energy use varies by business type, of the 20% of business emissions, the largest energy users, and thus, carbon emitters, were space heating (32%) and lighting (28%) followed by water heating (17%).[13] (See Figure 4).

[13] Cool Action Plan 52-53, http://williamstown.net/cool.htm

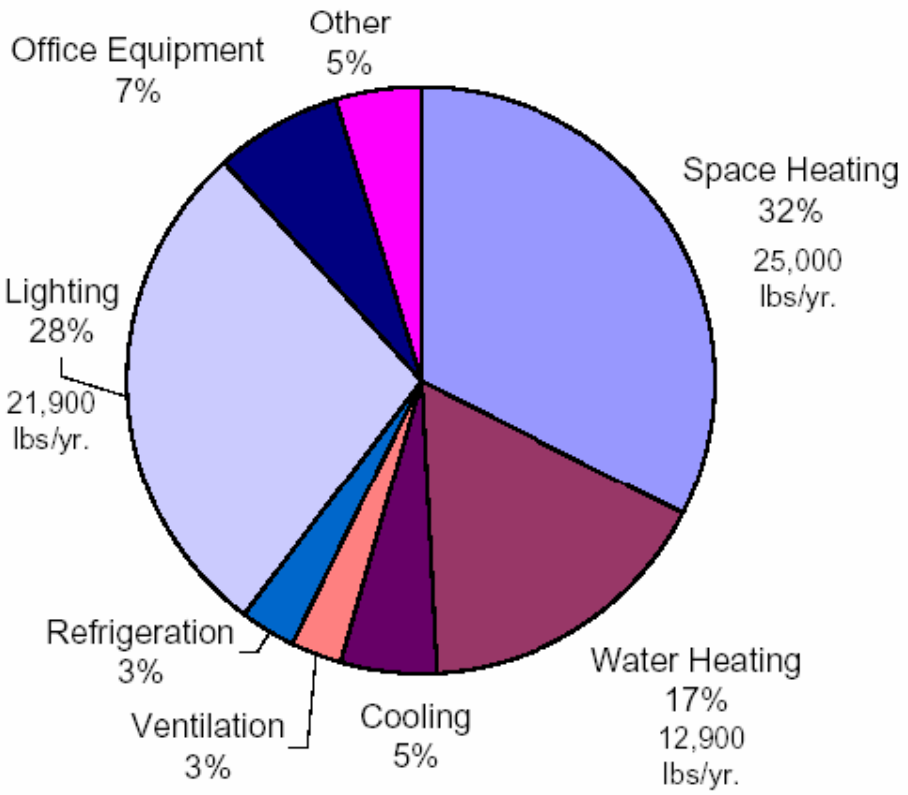


Figure 4: Distribution of Energy Use in Williamstown.

Our task is therefore to devise techniques for businesses to reduce their energy use in these areas and others. This problem is complicated because for businesses, their ultimate goal is to return a profit. Thus, we are not only looking for energy saving technologies and techniques, but also ways to educate businesses about the economic benefits of such measures and encourage business to adopt environmentally friendly practices.

Energy-saving options can logically be divided into two parts: the first is choice in technology, and second is business attitudes and practices. The first area of interest is what technology is already being used by these businesses. Are there compact fluorescent light bulbs in any of the buildings? Are any of the appliances Energy Star rated? This is an important area of research because, although appliances represent a

large up-front investment, they can represent large savings over time. The second area relates to how businesses currently do or do not consciously conserve energy in daily operations. Do business owners turn off the lights in bathrooms or limit the use of overnight heating? Changing the daily practices of businesses could potentially be a large source of energy reduction that does not involve the purchase of new technology.

V. ENERGY-SAVING TECHNOLOGY

With increasing national interest in fuel availability and global warming, the field of energy-efficient technology is progressing rapidly. Secretary of Energy Samuel Bodman recently put in perspective the importance of adapting more energy resourceful technologies: "With America now importing 60% of the oil we use and a national bill for this habit that came to $250 billion last year, there is simply no time to waste. With worldwide demand growing rapidly, and with concern about the environmental impact of greenhouse gases rising, the deployment of clean, reliable sources of energy is clearly in our national interest." [14] Businesses should be up-to-date on technological innovations in appliances and lighting that they may incorporate into their small businesses, not only to save money, but also to adapt to new energy-use habits that may become necessary if fuel shortages or global warming crises make our current energy use unfeasible.

While it is true that the effects of individual businesses reduction of carbon dioxide emissions may not be overwhelmingly apparent, each business' use of energy to run heating and cooling systems, lights, office equipment and appliances help contribute to climate change. On the bright side, all these factors present many viable opportunities

[14] http://www.eere.energy.gov/

for improvements in energy efficiency and lower costs associated with energy use. It should be made clear that "by far the biggest direct impact any climate-management program will have on [a] business is on [its] monthly energy bill."[15] According to the Energy Cost Savings Council, "the average building owner can cut energy costs up to 60% by replacing outdated, inefficient electrical equipment with new, high-tech electro-technologies, a potential savings of $1 per square foot."[16]

It is important to address the blunt fact that sometimes large up-front investments are required of a proactive small business. While many of these energy efficient investments will offer hefty paybacks over time, the overhead cost of buying and installing these technologies is too high for some businesses, regardless of their high returns. However, there are a plethora of viable options that won't empty a small business's bank account—some energy-saving technologies are more feasible than others, some offer different payback rates, and some offer a larger reduction in carbon dioxide emissions:

> Fortunately, a business not need to "start from scratch" in its search for better technology options. Companies like the Lighting Research Center based in Troy, NY and the Northwest Energy Efficiency Alliance offer cut and dry technology options that may be easily incorporated into a wide variety of small businesses. Lighting upgrades represent a good starting point because lighting contributes almost 25% of most business's energy use. [17]

[15] ClimateBiz.com
[16] ClimateBiz.com
[17] http://www.lrc.rpi.edu/researchTopics/environmentEnergyEfficiency/pdf/CompLightingEnergyConsMeasures.pdf

Lighting

When Thomas Edison invented the light bulb, he "envisioned a technology that would not only provide better lighting quality than kerosene lamps, but also eliminate the health problems associated with combustion."[18] The world has since seen wide range of light bulbs—the most common today being incandescent light bulbs, halogen lights, compact fluorescent lights (CFLs), and light-emitting diodes (LEDs). Each new generation of lighting has offers a more energy efficient alternative than the generation prior. As lighting becomes more energy-efficient, it also becomes cleaner, and thus better for human and environmental health.

Incandescent Light Bulbs

Incandescent light bulbs are widely used in domestic and commercial settings. These standard light bulbs have a very thin tungsten filament enclosed by a glass sphere. Electricity passes through this filament, and because the "pathway" is thin, it is able to resist the electricity, thereby transforming the electrical energy into heat. The heat makes the filament "white hot," thereby creating the light source. Because much of the energy is used to produce heat, a relatively small percentage of the energy used is released as light, and the bulb is thus inefficient. A typical light bulb used in businesses is the 60 watt incandescent light bulb. Table 1 shows the output, in lumens, of these light bulbs at different electrical powers, measured in watts. The more high-powered a bulb is, the brighter the light emitted.

[18]http://www.lrc.rpi.edu/researchTopics/environmentEnergyEfficiency/pdf/CompLightingEnergyConsMeasures.pdf

Compact Fluorescent Lights (CFLs)

Because of their inefficiency, many incandescent lights are being replaced with fluorescent lights. Small businesses are now able to take advantage of more energy efficient fluorescent lighting. Businesses can replace a 60-watt incandescent light bulb With a 14-watt fluorescent bulb, which emits the same amount of light with only a sixth of its energy wasted as heat.

Equivalent light output	
Incandescent	**Compact fluorescent**
25 W	5-6 W
40 W	8–9 W
60 W	11–15 W

Table 2.

The average lifetime of incandescent light bulbs is about 750–1000 hours. It would take about 6-11 incandescent bulbs to last as long as one compact fluorescent, which have an average lifetime of between 11,250 and 15,000 hours.[19] This saves not only the cost of replacing bulbs, but also the time and labor of bulb replacement.

While Williamstown's commercial lighting plays a "small" role in the town's total emissions output (only 20%), the impact of having just 1 out of every 3 small businesses change their incandescent lighting to fluorescent, the town's total emissions would decrease by over 1.7%![20] "Using fluorescent lamps makes business and environmental sense because they consume one quarter as much electricity as incandescent lighting." [21] Even better news, with rapidly changing technology, there are now many different kinds of energy efficient light bulbs currently on the market, businesses may pick and choose based on their particular needs.

[19] www.focusonenergy.com/data/common/dmsFiles/R_EP_MKFS_**Light**ingFactSheet.pdf -
[20] Cool Co. Action Plan, http://williamstown.net/cool.htm
[21] http://www.cetonline.org/FarmBusiness/flambiz-dep.doc

The Williamstown COOL Committee reported that by replacing incandescent lamps with compact fluorescent bulbs (that conveniently fit into conventional light sockets), a business can save over $40 and 60 lbs of Co2 emissions per year for every 60W incandescent bulb (on for 8 hours a day) that is replaced with a 14-15 W CFL[22] (See tables 3 and 4).

Incandescent	CFL	Lumens	Cost Savings ($.10/kWh)	Cost Savings ($.20/kWh)	CO_2 Savings
60W	15-19W	> 900	$62-$68	$124-$136	806-884 lbs.

Table 3.

Electricity Cost
(for 800–900 lumens at a rate of $0.10/kWh)*

$$60\ \text{W} \times 8000\ \text{h} \times \frac{\$0.10}{1000\ \text{Wh}} = \$48$$

$$14\ \text{W} \times 8000\ \text{h} \times \frac{\$0.10}{1000\ \text{Wh}} = \$11.20$$

Table 4.

How to calculate the total cost of electricity for using an incandescent light bulb vs. a CFL (1 kWh = 1000 Wh). *As of May 2006, the average rate for electricity in the US was approximately $0.106 per kWh.

Compact fluorescent lights (CFLs) are a hot topic in lighting and, like cell phones and portable music players, are constantly being redesigned.[23] Small business that were unsatisfied with CFLs in the past should try them out again. While these are the most feasible energy efficient light bulbs for small businesses at the present time, they are still not widely accepted in part due to their rough introduction. When CFLs first entered the market they were expensive. However, they have since been subsidized and an average 14 watt CFL costs around $1.66 at most hardware stores. Where might a small business

[22] Cool Co. Action Plan, http://williamstown.net/cool.htm
[23] http://www.fastcompany.com/magazine/108/open_lightbulbs_Printer_Friendly.html

purchase compact fluorescent lights tailored for their specific business? For the average business, Wal-Mart now stocks basic CFL designs (figure 5, left), as does Home Depot. For specialty lighting and covers to lessen the harsh light some business owners complain about, Energy Federation Incorporated in Boston and the Energy Star website offer a wide sampling.

Another misconception is that they produce a harsh light, a common complaint of many of the business owners on Spring Street. However, CFLs offer a wide variety of color options (See Figure 6). “Warm white” compact fluorescents (2700 K) are particularly appealing in that their color is closely reminiscent of incandescent bulbs. Others include “soft white” (3500 K and produce a yellowish-white light), “cool white” (4100 K and emit a pure white tone), and “daylight” CFLs (6400 K and emit a slightly bluish-white color. This shade is closest to the “harsh” CFLs that first came out on the market, but it is still suitable for a variety of settings where soft, warm lighting is not needed or desired). Many small business owners also have the delusion that CFLs flicker when turned on—however, this was due to the magnetic ballast which has since been replaced with the more efficient electric ballast, which does not flicker.

Figure 6, left.

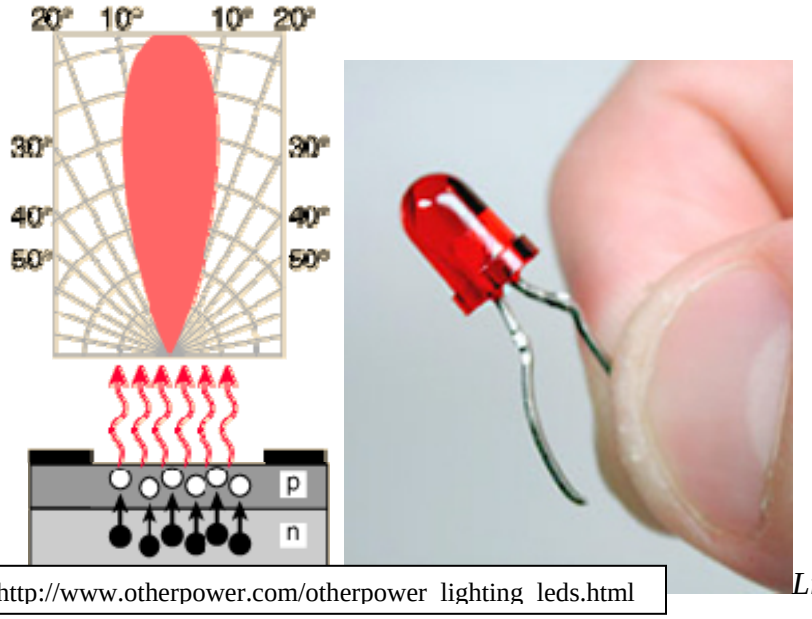
From left to right: Daylight, Cool white, Soft White, and Warm White

However, as stated earlier, technology is constantly becoming

more efficient. Light-emitting diodes (LEDs) could, according to the US Department of Energy, displace general lighting sources by 2025, “decreasing national energy consumption for lighting by 29%!” So what are LEDs?

LEDs are used in an array of devices—from the formation of numbers on digital clocks to an illuminated exit sign, LEDs are tiny light bulbs that emit most of their energy as visible light, unlike incandescent light bulbs, and are thus very efficient. They also perform well as spotlights, making them a better replacement for incandescent lights than CFLs, which can not be focused. An LED is a “directional light source, with the maximum emitted power in the direction perpendicular to the emitting surface. The typical radiation pattern shows that most of the energy is emitted within 20° of the direction of maximum light.”[24] (See figure 7[25])

Figure 7



http://www.otherpower.com/otherpower_lighting_leds.html *Light Emitting Diode*

Figure 8: light emitting diodes

[24] http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/leds.html
[25] http://science.howstuffworks.com/led.htm

Our "COOL" group traveled to the Rensselaer Polytechnic Institute's Lighting Research Center (LRC) in Troy, NY to find out more. The research center is composed of "nearly 40 researchers, designers, and educators…working to advance the effective use of lighting to create a legacy of positive change for society and the environment." Keith Toomey, a veteran researcher at the leading university-based lighting research lab, introduced us to the range of activities at the LRC, which include testing and evaluation of the quality and efficiency of various lighting products. Most of our time, however, was spent discussing LEDs—their ability to spotlight is prime for small businesses looking to enhance the way lighting focuses on their products. However, "lighting controls face a series of overarching technical, policy and market barriers that prevent them from gaining widespread use and greater perceived value." These include lamp & ballast performance, components compatibility, installation & commissioning assurance, and marketing. [26] Currently, LED lighting is too expensive to be an option for most small businesses. Accordingly, LEDs are still being tested and until they become cheaper, the next best alternative in energy efficient lighting is compact fluorescent lights.

Other Appliances

There are many other opportunities to reduce energy consumption besides lighting. For example, restaurants may take advantage of smart refrigerators that are, according to the BBC, "equipped with a special monitor that measures spikes in the electricity grid and when a spike occurs the fridge turns off for a short period to conserve

[26] LRC http://www.lrc.rpi.edu/researchtopics/reducingBarriers/barriersToImplementation.asp

electricity across the grid—first trials look promising too (as in the food doesn't seem to be affected)"[27]

To find other energy-efficient appliances including dishwashers, freezers, and air conditioners, a business owner should become familiar with the federal government's Energy Star label, which certifies products that are "significantly more efficient than minimum government standards."[28] A new Energy Star refrigerator, for examples, uses roughly 50% less energy than a regular 10-year-old one of the same dimensions and features—hence, by buying efficient replacements and recycling old appliances, small businesses will see their electric bills plummet. [29]

Now for the cost comparisons of Energy Star rated products against the conventional appliances currently in many small businesses. For restaurants, a comparison between a conventional and Energy Star commercial hot food holding cabinet (18 cubic ft), a solid door freezer (22.7 cubic ft), a solid door refrigerator (43.5 cubic ft), an electric steam cooker (food lead 96 lbs/day), and a room Air Conditioner, the long-term financial benefits of efficient appliances are clear (See table 5).

Table 5

HOT FOOD HOLDING CABINET[30]	**Energy Star**	**Conventional**
Initial Cost	**3,000**	**1,800**
Watts/cubic foot	**40**	**125**
Annual Operating Cost	**224**	**700**
Lifetime Cost (Energy, Maintenance)	**2,107**	**6,567**
Total CO2 Savings with Energy Star	**114,996**	
Total Energy Savings with Energy Star	**80,417**	
Total Cost Savings with Energy Star	**$3,265**	
Payback of Initial Cost Difference	**2.5 years**	

[27] http://digg.com/hardware/Pulling_the_plug_on_standby_power
[28] www.energystar.gov
[29] http://www.masstech.org/cleanenergy/cando/decisions.htm
[30] http://www.energystar.gov/index.cfm?c=hfhc.pr_hfhc

SOLID DOOR FREEZER[31]	**Energy Star**	**Conventional**
Initial Cost	**2,439**	**2,300**
Kwh/yr	**3,818**	**5,201**
Annual Operating Cost	**271**	**369**
Total CO2 Savings with Energy Star	**19,782**	
Total Energy Savings with Energy Star	**13,834**	
Total Cost Savings with Energy Star	**658**	
Payback of Initial Cost Difference	**1.4 years**	
SOLID DOOR REFRIGERATOR[32]	**Energy Star**	**Conventional**
Initial Cost	**1,179**	**1,000**
Kwh/year	**2332**	**4300**
Annual Operating Cost	**166**	**305**
Total CO2 Savings with Energy Star	**28,133**	
Total Energy Savings with Energy Star	**19,674**	
Total Cost Savings with Energy Star	**954**	
Payback of Initial Cost Difference	**1.3 years**	
ELECTRIC STEAM COOKER[33]	**Energy Star**	**Conventional**
Initial Cost	**10,000**	**10.000**
Cooking Efficiency	**50%**	**35%**
Idle Energy Rate (Wh)	**424**	**1,160**
Annual Operating Cost	**299**	**1,271**
Total CO2 Savings with Energy Star	**52,604**	
Total Energy Savings w/ Energy Star	**37,485**	
Total Cost Savings with Energy Star	**$7,887**	
Payback of Initial Cost Difference	**0.0 years**	
ROOM AIR CONDITIONER[34]	**Energy Star**	**Conventional**
Initial Cost	**1,170**	**1,000**
Kwh/year	**2,332**	**4,300**
Annual Operating Cost	**166**	**305**
Total CO2 Savings with Energy Star	**28,133**	
Total Energy Savings with Energy Star	**19,674**	
Total Cost Savings with Energy Star	**$954**	
Payback of Initial Cost Difference	**1.3 years**	

Table 5.

As shown above, by using energy-efficient technology alternatives, small businesses can have a huge impact on their energy costs and carbon dioxide footprint. Small businesses should also keep in mind that more energy may be saved not only

[31] http://www.energystar.gov/index.cfm?c=commer_refrig.pr_commercial_refrigerators
[32] http://www.energystar.gov/index.cfm?c=commer_refrig.pr_commercial_refrigerators
[33] http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers
[34] http://www.energystar.gov/index.cfm?c=roomac.pr_room_ac

through technology change but also behavior changes, to which we will turn in the following section.

VI. ENERGY-SAVING BEHAVIOR

Businesses may engage in a wide variety of energy-saving behavior. Some practices require more effort than others, and some have greater monetary and environmental benefits. Energy-saving behaviors include turning off light bulbs and appliances when they are not needed, maintaining equipment properly, and maximizing the use of fewer appliances rather than using more of them less intensively. Table 6 presents estimated cost and CO2 savings that could be attained by switching to energy saving practices from conventional behaviors. These do not represent the full range of energy-saving behaviors, but are meant to serve as a sample of the savings that might be achieved by changes in the practices of such businesses as retail stores and restaurants, which are common in Williamstown.

Table 6
Behavior Changes and Benefits*[35]

	Max. Annual Savings per Appliance	
Behavior	**$**	**tons CO2**
Keep newer freezers & refrigerators full; disconnect an old one	300	2.1
Clean refrigerator/freezer condenser coils every 3 months	20	0.14
Unplug average stove 16 hrs/day	277	1.94
Turn off one 60-watt bulb one additional hour/day	10	0.028

**Estimations based on Energy Star Website*

[35] Calculations based on:
Energy Star: Restaurant Management
http://www.energystar.gov/index.cfm?c=small_business.sb_restaurants
and
Night time Lighting
http://www.seleneny.org/homeowner_tips.html?5144cfc818e6be1d0ac77f214cce7511=97e82981b832d7685e1d094e62161576

Some of these behaviors are more feasible than others. For example, cleaning refrigerator coils every three months requires some labor and technical skill. Maximizing the use of newer, more efficient freezers and refrigerators requires the procurement of these new appliances, which, as we outlined above, entails large startup costs. Others, like unplugging a stove or similar appliance at night to stop its "phantom" energy use (used for appliance's clock, etc), or turning off an incandescent bulb for one additional hour a day, require hardly any work at all. We will include these considerations in our recommendations for changes in businesses' practices.

"Phantom Loads" may represent the easiest change small businesses can tackle. Phantom loads are the small constant loads in electric devices that devour electricity when they are turned off—the clocks in VCRs and plugged in microwave ovens. By keeping these appliances plugged in, not only does one decrease the appliance's life expectancy and increase the risk of fire, energy and money are literally thrown away. The United States throws away over $3 billion a year due to having to supply power to these appliances "we think are turned off."[36] This obscure number represents the total national electricity use of Greece, Peru, and Vietnam combined—12 million tons of carbon dioxide into the air. [29]

Table 7.

Appliance	Monthly Consumption (k/Wh/Mo.)	Monthly Cost ($0.10/kWh)
Computer (sleep)	**22.3**	**$2.23**
Monitor (sleep)	**6.0**	**$0.60**
Cordless Phone	**1.8**	**$0.18**
AC	**2.1**	**$0.21**
Stereo	**7.3**	**$0.73**

[36] **http://www.redwoodenergy.org/ContentPage.asp?ContentID=374**

VII. CASE STUDIES: SMALL BUSINESSES

Many innovative small businesses manage to save money on their energy bill and also decrease energy usage not only by learning about specific technology and behavior options but also by learning how other businesses have been successful. With these practices, small businesses looking to reform can look to other successful business to learn the steps to making cost and energy efficient changes. The Williams Inn, Subway, and Basil Bandwagon Natural Market are good examples for the small businesses on Spring Street due to their similar atmosphere and appeal.

The Williams Inn

Carl Faulkner's Williams Inn in Williamstown, MA was awarded a small business award by Energy Star for its energy efficiency. As an accountant for several hotels during the 1970s energy crisis, Faulkner remembers the days of buying gasoline on an even and odd day schedule and practicing conservation methods such as lowering the thermostat. After Faulkner became the owner of the Williams Inn, he became interested in the energy efficient technologies that were emerging in the 1980s. He took the initiative to contact Mass Electric to request an energy audit. From there, the hotel owner designated one of the guest bedrooms as a "light testing room" and tested out different levels of energy efficient lighting to see which the patrons liked best. He found that women preferred 27k lights, for example because it flattered their skin tone!. After deciding on the lights, Faulkner applied for rebates and his project total dropped to a mere $830 with a payback period of 1 month. Now, not only the Williams Inn saving money, it also annual saves 64,177 kWh of energy and prevents over 71,000 lbs of pollution! [37]

[37] Energy star website (success stories section)

Subway Franchise, Oklahoma City

Subway franchise owner Steve Kaplan is saving twenty thousand dollars per year by investing in energy-efficient lighting, heating, ventilation, air-conditioning, ceiling fans, and ice makers for his seven Subways around the Oklahoma City area. This cuts his energy costs by 40%! Kaplan thanks the EPA for their help in pointing him to technical information on energy-efficient lighting. He also does energy-efficient equipment upgrades "where he will get a 3-year simple payback or better." Because he leases the space for his chain of restaurants, he only upgrades "when he plans to renew a lease that is at least three to five years in length, ensuring a 3-year payback." [38]

Kaplan now uses 32-watt T-8 lamps with electronic ballasts instead of his old 40-watt T-12 lamps with magnetic ballasts. Customers tell him they think "the produce looks fresher and more appealing," which is due to the higher color rendering index in the T-8s Kaplan uses. The Subway franchises are obligated to have a high light level and the upgrades Kaplan uses maintain this level with only two bulbs instead of four. [39]

The Subway owner also takes advantage of energy-efficient air conditioning units with double capacity due to the phenomenal savings compared an old unit breakdown cost and repair. Ceiling fans are another necessity for Kaplan in providing customer comfort as "they increase energy efficiency in a retail food service establishment, and they are decorative." Most inspiring is that they allow him to set his air conditioning unit 3-5 degrees higher; he relies on it less as a result of the reduced heat input of his lighting. The ice maker presents another opportunity for Kaplan. He can choose between two

[38] Energy Star website (success stories section)
[39] Energy Star website (success stories section)

options to reduce the heat created from these machines: “One is a water-cooled ice maker that dumps the heat in the form of hot water down a drain. The other is an air-cooled ice maker that puts the onus on the air-conditioning unit to cool this additional heated air. Because utility rates for water and electricity vary at different store locations, Kaplan installs a water-cooled ice maker where water is less expensive to use. Where electricity is less expensive to use, he installs an air-cooled ice maker.” [40] Kaplan has also replaced electric water heaters in his subway locations with energy-efficient gas units—with a payback of only one year (partly due to decreases in gas cost). He also has installed heavily tinted windows to keep the pesky sun’s heat out of the building.

Basil Bandwagon

The Basil Bandwagon Natural Market in Flemington, NJ is “an example of energy efficiency for the neighborhood” according to the owners. The organic food market has played the energy efficient game by taking advantage of LED exit signs, CFLs, ceiling fans, high efficient air conditioning units, and caulking around the windows. The windowless market also has incorporated “solatubes” into their business. These are “tubular skylights that capture sunlight from the roof of the building and redirect it down a highly reflective shaft and diffuse it throughout the room.” [41]

VIII. CASE STUDIES: TOWNS

Towns and local nonprofit organizations from across the country are currently running energy conservation programs that target their local business sectors. We looked to a wide variety of case studies to explore the range of strategies that these local

[40] energy star
[41] energy star

programs use to reduce business emissions, in order to guide our own recommendations for Williamstown's businesses and the COOL committee. In particular, we sought out business programs in towns that are similar to Williamstown in location and size, since we expected the methods used in these towns to be most applicable to Williamstown. First, we looked to towns within Massachusetts, since we knew their business programs might depend on many of the same policies and resources that are available to Williamstown. We conducted extensive internet research and interviews with representatives of town and nonprofit climate leaders to search out business sector conservation programs in Massachusetts. Although many towns address the commercial sector's emissions in their Climate Action Plans, very few have actually planned and implemented programs that target businesses as of yet.[42] Among the Massachusetts towns we researched, only two had implemented business programs: Cambridge and Newton. Both of these towns differ significantly from Williamstown in size. Cambridge's population is about 100,135,[43] and Newton's is about 83,158;[44] Williamstown's is about 8,238.[45] This is not to say that Williamstown would be the first small town in Massachusetts with a business energy conservation program (although, to the best of our knowledge, it would be). In any case, though, it would be among the first.

In addition to Newton and Cambridge, we chose to focus on the business program in the small town of Brattleboro, Vermont, (population: 11,849).[46] Although Vermont's

[42]MA Climate Action Network Site. http://www.massclimateaction.org/
[43] "Detailed Profile of Cambridge, MA". Available Online: http://www.city-data.com/city/Cambridge-Massachusetts.html
[44]"Detailed Profile of Newton, MA". Available Online: http://www.city-data.com/city/Newton-Massachusetts.html
[45] "Detailed Profile of Williamstown, MA". Available Online: http://www.city-data.com/city/Williamstown-Massachusetts.html
[46] "Detailed Profile of Brattleboro, VT". Available Online: http://www.city-data.com/city/Brattleboro-Vermont.html

resources and policies differ from Massachusetts', they are not so different as to prevent this case from serving as a worthwhile example for Williamstown.

Brattleboro, VT

Hundreds of businesses and thousands of homes in Vermont have signed on to the statewide "10% Challenge",[47] an initiative established by Burlington, VT's Alliance for Climate Action in 2002.[48] The goal of the 10% Challenge is to reduce Vermont's CO2 emissions by 10% below 1990 levels by 2010.[49] Though the challenge now involves participants from all over the state, this original organization still plays a prominent role in the campaign. They distribute newsletters publicizing the successes of 10% challenge members, and inviting members to participate in voluntary programs such as a "carpool to work" week in May.[50] However, outreach to individuals and organizations is now largely in the hands of local environmental groups in individual towns.[51]

The small environmental nonprofit organization Brattleboro Climate Protection is working to help the town of Brattleboro to meet the 10% challenge.[52] Since 2004, this group has been working on an initial goal of getting small businesses signed on to the challenge.[53] They encourage businesses to join mainly through word of mouth: Paul Cameron, the organization's director, meets with business owners to discuss their energy-efficiency, and their particular needs and concerns regarding this issue. He provides

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[47] www.tenpercent**challenge**.org/
[48] Personal Communication with Deb Sachs of Burlington's Alliance for Climate Action. Nov. 20th, 2006.
[49] The 10% Challenge Site, by Alliance for Climate Action. Available Online: http://www.10percentchallenge.org/
[50] Personal Communication with Deb Sachs of Burlington's Alliance for Climate Action. Nov. 20th, 2006.
[51] Personal Communication with Paul Cameron of Brattleboro Climate Protection. December 10th, 2006.
[52] Take the 10% Challenge – And Save. By Paul Cameron http://www.ibrattleboro.com/article.php/20060525122159291
[53] Brattleboro Interview with Paul Cameron, Monday, June 19th. http://www.ibrattleboro.com/article.php/20060619142102619

advice to businesses on how to become more energy efficient; often, he recommends that businesses contact Efficiency Vermont, the state's energy-efficiency utility, which provides free energy audits and free technology upgrades. Cameron and Brattleboro Climate Protection also work to encourage businesses to join the 10% challenge, through word of mouth contact with members of the chamber of commerce and business owners themselves. In addition to private interviews, the organization also arranges seminars and meetings in which business owners hear and discuss presentations from representatives of Efficiency Vermont and other energy-efficiency experts.

To join the 10% challenge, businesses find out how much energy they use, and where they waste the most energy, by using the energy calculator available on the 10% Challenge website. Businesses then decide on a set of changes that will reduce their emissions by the target amount, individually or with the help of the 10% challenge website, or the recommendations of Brattleboro Climate Protection. Once businesses are committed to a set of changes that will allow them to make a 10% reduction in CO2 emissions by 2010, they earn the right to bear the "10% Challenge" name.[54] Since this small business initiative began in 2004, about 16 businesses have signed on.[55]

Cambridge, MA

The Cambridge Climate Leaders Program engages organizations and businesses in helping to attain the overarching goal of the Cambridge Climate Protection Plan: to

[54] Brattleboro Interview with Paul Cameron, Monday, June 19th.
http://www.ibrattleboro.com/article.php/20060619142102619

[55] Brattleboro Interview with Paul Cameron, Monday, June 19th.
http://www.ibrattleboro.com/article.php/20060619142102619

reduce emissions by 20% below 1990 levels by 2010.[56] The program is not run by a nonprofit organization; rather, it engages the joint effort of the town's Commercial Development Department and the Public Works Department.[57] The city's environmental staff give participants assistance, through energy audits and whatever advice businesses and organizations seek. Insofar as this program depends on city staff, it is not directly applicable to Williamstown, where such staff members do not exist. The program also points businesses and organizations to other sources of services, like the National Grid Small Business Program, and grant sources like the Mass. Technology Collaborative, that can help them achieve these reductions in carbon dioxide emissions.[58]

The Cambridge Climate Leaders Program also runs a public recognition program for local businesses. Rather than certifying businesses based on a quantitatively measured reduction in carbon dioxide emissions, as in Brattleboro, this public recognition program qualifies businesses based on specific actions. According to their particular situation and needs, businesses choose a certain number from a list of approved actions, which includes using fluorescent lights or CFLs for at least 75% of lighting, replacing all their appliances with Energy-Star rated ones, and installing photovoltaic panels. Once they have fulfilled enough of these actions, business earn the right to display the Cambridge Climate Leaders sticker logo.[59] Since the program began in 2002, 15 businesses have

[56] Department of Community Development Site: Cambridge Climate Leader Program. http://www.ci.cambridge.ma.us/CDD/et/env/clim_leader.html

[57] Department of Community Development Site: Cambridge Climate Leader Program. http://www.ci.cambridge.ma.us/CDD/et/env/clim_leader.html

[58] Department of Community Development Site: Cambridge Climate Leader Program. http://www.ci.cambridge.ma.us/CDD/et/env/clim_leader.html

[59] Department of Community Development Site: Cambridge Climate Leader Program. http://www.ci.cambridge.ma.us/CDD/et/env/clim_leader.html

become Cambridge Climate Leaders. Most of these are large businesses, which makes them different from the majority of Williamstown's businesses, which are small (with under 100 employees).[60] However, the strategies employed by Cambridge's Climate Leaders Program are comparable to those used with small businesses in Brattleboro, with similar results; perhaps businesses of different sizes do not require significantly different approaches.

Newton, MA

The nonprofit organization Green Decade Coalition Newton is running a Small Business Efficiency Outreach Program that began in 2004. This group works in partnership with the Newton/Needham Chamber of Commerce and the NSTAR utility Small Business Conservation Program. The goal of this program is to get as many businesses as possible to have an NSTAR energy audit and retrofit (equivalent to the National Grid Small Business Program). As with Brattleboro Climate Protection, this organization conducts communication and organization largely through word of mouth. In addition to their contacts in the Chamber of Commerce, they seek out members of the business community that are interested in forming networks among the town's businesses.[61] According to the Coalition's president, Ana Zarina Solon, their success rate has been increased by inviting business owners to brief evening meetings (where they

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[60] Department of Community Development Site: Cambridge Climate Leader Program. http://www.ci.cambridge.ma.us/CDD/et/env/clim_leader.html

[61] Personal Communication with Ana Zarina Solon, President of Green Decade Coalition Newton. Oct. 27th, 2006.

enjoy wine and cheese), at which an NSTAR representative gives a brief presentation on their Small Business Conservation Program.[62]

Since 2004, the Green Decade Coalition has given an annual Environmental Leadership award to an individual and a group that had achieved great reductions in their energy impacts.[63] In 2005, they integrated this series of awards with their Business Outreach program by adding an annual business award, which they give to a business that has made an outstanding commitment to reducing carbon dioxide emissions. For example, the winner from 2006 was the Wainwright Bank's Newton Center Office. They won because of the diverse range of their environmental features: reused and renewable building materials, light dimming sensors, and buying over 50% of their electricity from renewable sources.[64]

IX. RELEVANT POLICIES AND AVAILABLE RESOURCES

Massachusetts Utility Conservation Programs

Utility conservation programs represent an important technical and financial resource for small businesses that want to reduce their energy use. All Massachusetts utility companies are required to run energy conservation programs available to private groups and individuals, as established in Section 11 of Chapter 25A of Massachusetts General Laws.[65] National Grid (formerly Mass Electric) is the utility company that

[62] Personal Communication with Ana Zarina Solon, President of Green Decade Coalition Newton. Oct. 27th, 2006.

[63] Newton Environmental Leadership Award. http://www.greendecade.org/environmentalawards.html

[64] Newton Environmental Leadership Award. http://www.greendecade.org/environmentalawards.html

[65] (http://www.mass.gov/legis/laws/mgl/25a-11.htm - Chapter 26A, Section 11. Establishment of energy programs; rules and regulations; contracts; grants

services Williamstown.[66] Like other Massachusetts energy companies, such as NSTAR, which serves Newton, they run a Small Business Conservation Program that provides both free energy audits and cost-reduced technological retrofits.[67] Businesses contact the program to arrange a free energy audit, which is conducted by the utility's regional contractor.[68] Prism Consulting provides this service in Williamstown.[69] The contractor also makes tailored recommendations to the business from a list of National-Grid approved technological options, including upgrades lighting, heating, and insulation, and installs those that the business wants.[70] The utility company covers 80% of the cost of these retrofits. The business can pay the remaining 20% for up to 2 years interest free.[71] Through reduced energy bills, the new technology is supposed to pay for itself in less than two years. According to Ana Zarina Solon, among Newton businesses, it almost always does.[72]

Massachusetts Technological Collaborative Grants

The state of Massachusetts provides a number of services and incentives to help businesses and other private entities reduce their carbon emissions through the purchase of on-site sources of clean, renewable energy. Businesses interested in installing renewable energy technology can receive grants for the design and installation of these technologies through the Massachusetts Technological Collaborative's Renewable Energy Fund.[73] The Massachusetts Technology Collaborative (MTC) is the state's Department for the Development of Renewable Technology, an initiative of the

[66] http://www.nationalgridus.com/masselectric/business/energyeff/3_small.asp
National Grid Small Business Program
[67] http://www.nationalgridus.com/masselectric/business/energyeff/3_small.asp
National Grid Small Business Program
[68] Personal communication with Joseph Mannarino of National Grid, Nov 28th, 2006.
[69] Personal communication with Joseph Mannarino of National Grid, Nov 28th, 2006.
[70] Personal communication with Joseph Mannarino of National Grid, Nov 28th, 2006.
[71] Personal communication with Joseph Mannarino of National Grid, Nov 28th, 2006.
[72] Personal communication with Ana Zarina Solon. Nov. 8th, 2006
[73] http://www.mass.gov/legis/laws/mgl/40j-4e.htm - Chapter 40J, Section 4E. Massachusetts Renewable Energy Trust Fund.

Massachusetts Technology Park Corporation (MTPC), which was established in 1982 to advance Massachusetts' technology sector.[74] Section 4E of chapter 40A of the General Laws of Massachusetts establishes the Massachusetts Renewable Energy Trust Fund.[75] It also authorizes The Massachusetts Technological Collaborative to draw upon this fund to promote the increased availability, use, and affordability of renewable energy. They accomplish this through programs that target particular sectors, including residences and small businesses.[76] The Small Renewables Initiative, for example, invites applications for rebates of up to $50,000 for the design and construction of renewable energy projects that are up to 10 kilowatts on buildings that will consume 90% or more of the renewable energy generated by the project on-site.[77] Among the renewable technologies eligible for assistance, solar photovoltaic and solar thermal electric energy are likely to be the most practical for businesses on Spring Street. Even adding small solar panels might be limited by landlords, but this is still a possibility to consider.

Renewable Energy Tax Incentives

Businesses also have the option to buy renewable energy through the National Grid's Green-Up program.[78] Both the state and federal governments offer tax incentives for the purchase of renewable energy. Under Section 38H of Chapter 63 of the Massachusetts General Laws, businesses can get a corporate income tax deduction for purchasing on-site renewable energy technology.[79] Additionally, under the federal statute

[74] MTC history - http://www.masstech.org/AgencyOverview/history.htm
[75] http://www.mass.gov/legis/laws/mgl/40j-4e.htm - Chapter 40J, Section 4E. Massachusetts Renewable Energy Trust Fund.

[76] http://www.mass.gov/legis/laws/mgl/40j-4e.htm - Chapter 40J, Section 4E. Massachusetts Renewable Energy Trust Fund.
[77] Small Renewables Initiative of MTC: http://www.masstech.org/RenewableEnergy/small_renewables.htm

[78] http://www.nationalgridus.com/masselectric/home/energychoice/3_renewable.asp
National Grid: Renewable Energy.

[79] http://www.mass.gov/doer/programs/renew/renew.htm#taxcred
Massachusetts and Federal Renewable Energy Tax Incentives

26 U.S.C.A. Section 48 (a), businesses can apply for Business Investment Tax Credit, and deduct up to 10% of the costs of investing in, purchasing, or constructing renewable energy systems.[80]

X. RESEARCH METHODS

As we have explained, our work had two main objectives: to complete a review of the energy use and conservation status of local Williamstown businesses, and to develop appropriate strategies to help businesses reach the town's 10% reduction goal. Given our time frame, we did not plan to collect information from every business in Williamstown (well over 75 establishments). Thus, we limited the scope of our research to businesses on Spring Street between Route 2 and Latham Street.

While this street only contains a small percentage of all the businesses in Williamstown, the area includes a wide enough variety of businesses to be representative of Williamstown as a whole. By focusing on Spring Street, we were able to gather information from 22 establishments including restaurants, coffee shops, grocery stores, clothing stores, toy stores, art galleries, barber shops, and a television studio. Our goal is to use our research results to suggest energy reduction strategies that are applicable not only to the businesses on Spring Street, but that are useful for businesses throughout the town.

We further limited our research pool to include only businesses that rely predominantly on walk-in business, and that thus get a lot of "foot traffic." This means that we only interviewed retail and health or food service businesses. We focused on this

[80] http://www.mass.gov/doer/programs/renew/renew.htm#taxcred
Massachusetts and Federal Renewable Energy Tax Incentives

type of business because of their high visibility. The COOL committee aims to increase town-wide awareness about energy and global warming. We hope our study will go beyond helping Williamstown's business sector reduce its emissions and act as a resource for other town sectors to become engaged in similar efforts. To this end, we have given the most attention to business we believe would be an ideal venue for this type of COOL committee campaign. Essentially, this means that we have excluded small offices from our sample. However, this is not to say that our recommendations to businesses and to the COOL committee will not be relevant to these office-based businesses. Given this second goal, we decided that our time would be best spent working to set up a more visible system of carbon reductions.

It is important to note that we also limited our inquiries to energy use within each business's walls. Businesses and members of other sectors also have carbon emission impacts resulting from the transportation of their employees and goods, from their purchasing choices, and from the amount of waste they produce, and how they dispose of it. Our project does not address these considerations in depth for several reasons. First, there is enormous variation in the materials used and disposed of by businesses on Spring Street, and each thus faces very different environmental tradeoffs. For example, how much effort should retail stores devote to supplying mainly local products to limit their transportation impacts? Should they try to avoid selling products that cost a lot of energy to produce? Should Tunnel City Coffee use ceramic cups, and spend energy washing them with hot water? Or should they use the owner's patented recycled paper cups, and increase the amount of waste they produce? And second, transportation and waste are realms over which business owners have less control than over the energy use within

their own space. Businesses can't force their employees to bike or carpool to work, and they can't force companies to provide them with environmentally-responsible products, for example. Waste and transport are factors the COOL committee may want to consider in reducing businesses' carbon dioxide emissions, but assessing the potential for these practices to change would require another, separate round of interviews and background research.

We collected data from 21 Spring Street businesses (see Appendix, part A.) using a combination of a survey and an interview. Our survey (see Appendix B) was designed to collect information about businesses' current energy usage, their willingness and motivations to participate in programs to reduce future energy needs, and how the COOL Committee could best support business in their efforts to reduce carbon emissions. On the whole, business owners were very receptive to our questions, despite their tight schedules. Only a few were unwilling to speak with us at all. We found that businesses were more willing to discuss energy use and the subtleties of their business's practices and choices in person than when filling out the survey on paper, so we administered the survey in person and used it to guide our conversations.

At this point, it is important to note a few things that may have biased our results. We tried to frame our interest in energy use as economic, and not merely environmental, for two reasons. First, we wanted to encourage businesses to participate in our project regardless of whether or not they believe climate change and global warming are serious problems that should be addressed. Second, we wanted to avoid pressuring them to give us "environmental" answers. However, this conscious effort was partially undermined by

the fact that the letter of introduction from the COOL committee introduced us as students from Environmental Studies 302: Environmental Planning.

Another potential source of error is that there were three of us who conducted the surveys individually. Because we all have slightly different styles, our information is also slightly different. While this is important to note, it should not have dramatically influenced our results or suggestions for future action because we were all working within the same framework.

XI. RESEARCH RESULTS: WILLIAMSTOWN BUSINESSES

Since we are focusing on the business sector, one of our major concerns is businesses' willingness to implement our recommendations. First and foremost, businesses are focused on their bottom line: of the businesses we surveyed, every one listed cost as the primary motivator for their business's decisions and actions, so our proposals are most likely to be accepted if they offer financial benefit. This is a very important fact to keep in mind when reviewing the following survey results and business owners' comments.

All of the businesses we sampled rent their space. This is important because it means that all of the energy saving suggestions we make for businesses need to be applicable for a renter. Specifically, this means that suggesting large capital improvements like a retrofit of the entire heating system is not practical as the tenant not only does not have the authority to do this, but also has little incentive to do so, since they may not stay in the building during the lifetime of this system. This is a trend that is

likely consistent throughout most of Williamstown. Additionally, renters often do not pay directly for all of the energy they use; in these cases, they are less likely to have a monthly financial incentive to reduce their energy use. We addressed this concern by asking businesses whether they paid either for electricity or heating, or both.

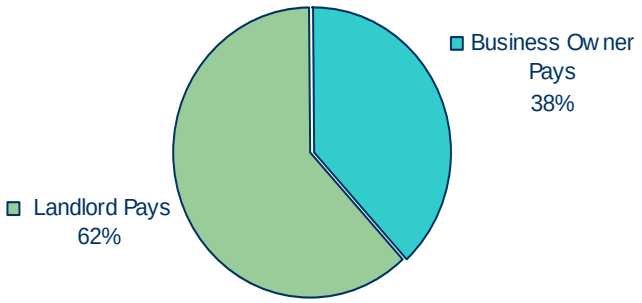
Energy Bills

Figure 9. Electricity Bills

While none of these businesses owns their space, 95% of them pay their own electrical bills. This is important because it means that businesses have an economic motivation for reducing electrical demands.

The heating bill presents a slightly different story.

Figure 10. Heating Bills



N=21

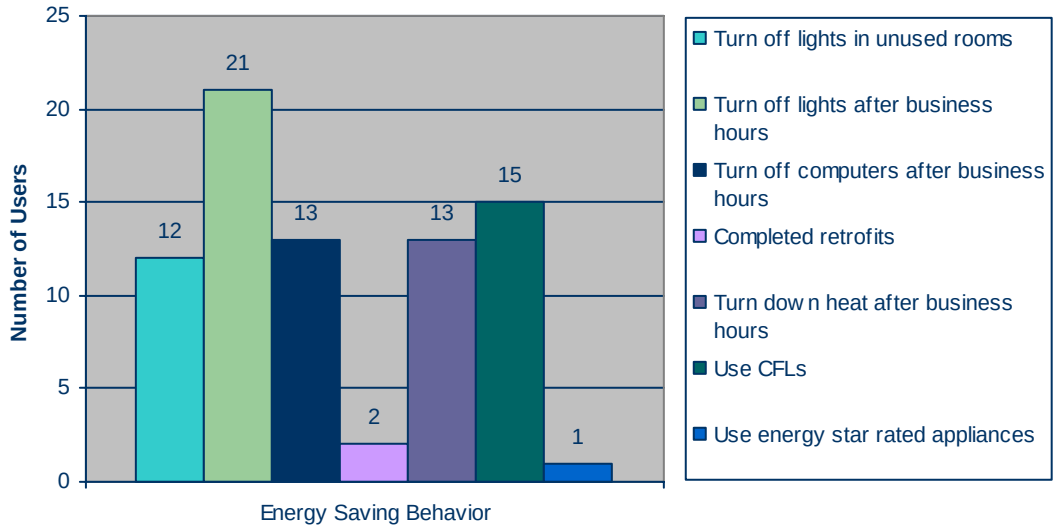
On Spring Street, 38% of business owners pay for their own heat. Thus for about 2/3 of the shops, the cost of heating is included as a percentage of monthly rent. Among both businesses that paid their heating bills and those that did not, there were a number that did not have any control of the level of heat in their space. For example, McClelland's Press, Ephporium and Goodman's Jewelers do not have functioning thermostats; rather they receive enough heat (in the case of Ephporium, too much heat for the produce!) from neighboring businesses. Thus, even if they had a financial incentive to turn down their thermostats, they have no ability to.

Current Practices

We were interested in businesses' current energy-use practices. We knew this information would be an important element to incorporate in our analysis and recommendations, since we want to address deficiencies in energy management rather than giving businesses information they already know. We asked them whether they used

certain energy-saving technologies and behaviors, and how much, or to what degree, they use them.

Figure 11. Current Energy-Saving Practices



N=21

We found that all 21 of the businesses in our sample turned off their lights after business hours. This is complicated, however, by the fact that many of these businesses (Library Antiques is one of the most striking examples) turn off most of their lights when they close, but leave on lights in a window display or in front of their store for all hours except from about midnight to 5AM.

Very few of the businesses we sampled (only two of them) had conducted energy audits and technology retrofits through the National Grid Program. Among those who had not, several expressed interest in the program because it could cover the majority of retrofit costs, and because it would provide them with solutions tailored to their specific needs. Businesses that had taken advantage of the National Grid program within the past 7 years (Subway and Library Antiques, both on Spring Street, and the Spirit Shop on

Cole Ave.) expressed a number of complaints and concerns that made them reluctant to use the program again or to recommend it to others.

We have spoken with three Williamstown businesses – the Spirit Shop on Cole Avenue, and Library Antiques and Subway on Spring Street – that had audits and retrofits from the National Grid Small Business Program (and from Mass Electric in past years). Unfortunately, these small businesses were unsatisfied with certain aspects of the program. One problem they mentioned is that the contractor does not check for the business owner's satisfaction after they install the upgraded technology. The owner of Library Antiques, for example, found some of the new compact fluorescent lighting too dim, and rather than getting help in choosing another alternative, he was left to replace it with the original incandescent bulbs. The Spirit Shop had an even larger problem: the compact fluorescent lights the contractor installed, and all of the CFLs the business owner has installed since then, have burned out in about six months rather than the estimated lifetime of several years. It seems that this represents a systemic problem beyond the bulbs themselves, and not one that the National Grid program is necessarily responsible for; but he has gotten no help from them in identifying the problem and potential alternatives. Additionally, two of these businesses (the Spirit Shop and Subway) said that the energy savings from their retrofits did not cover the up-front cost they owed within two years as they had expected. However, it sounds as though this was partially the result of rising electricity prices.

Over half of the businesses we spoke to turned down their heat after business hours; as we have explained, among those that do not turn down their heat are several that are simply incapable of turning it down.

More than half of the businesses we sampled (15 of them) use some CFLs or fluorescent lighting. However, most of these businesses complement fluorescent lighting with incandescent bulbs. Helen's Place and Spice Root, for example, light only their kitchen and work spaces with CFLs. Helen's Place was one among several businesses that said they do not use CFLs in some or all areas of their space because no dimmable models are available; we have since found that this is not correct. Library Antiques uses fluorescent tube lighting to provide ambient light, but also uses many incandescent bulbs to provide spot lighting on certain items. Similarly, Goodman Jewelers have a few CFLs for ambient lighting, but the majority of their lights are incandescent bulbs used to highlight their products. Unfortunately, CFLs can not be focused to serve as spotlights; "reflective" CFL bulbs, and "light-focusing" CFL fixtures are available, but according to members of the Rensselaer Lighting Institute, these are essentially ineffective, and less efficient than normal CFL lighting. The ideal spotlighting alternative is the LED; however, this technology is, as of yet, too expensive for small businesses. Within a few years, however, it is expected to become even more efficient and cheap.[81]

Among the businesses that did not use any fluorescent or CFL lighting, most had heard of CFLs but were unwilling to use them because they believed the lighting quality was harsh, that they flickered, and that they were expensive. Our research on CFLs has proved that these are outdated misconceptions (though, to be fair, only a few years ago they were still true; energy-efficient technology is developing fast!). CFLs now come in a variety of lighting qualities, not only the harsh blue-ish white light but in softer, warmer tones like "warm white." They no longer flicker, and while only ten years ago they could cost over eleven dollars each, they now generally cost under two dollars.

[81] Personal Communication with Keith Toomey. Dec 13th, 2006.

Among the businesses that use some CFLs, several have experimented with options that meet their particular needs. The owners of Where'd You Get That discovered that "warm white" CFLs suited their needs much more than the harsher "daylight" bulbs. The owner of Tunnel City Coffee has been experimenting with various CFL options, including CFL covers that make the lights' color and quality more like incandescent bulbs. The drawback to this technique, as Keith Toomey pointed out to us, is that these covers decrease the proportion of the bulbs' light that becomes visible. However, for this establishment, strong lighting is not a necessity.

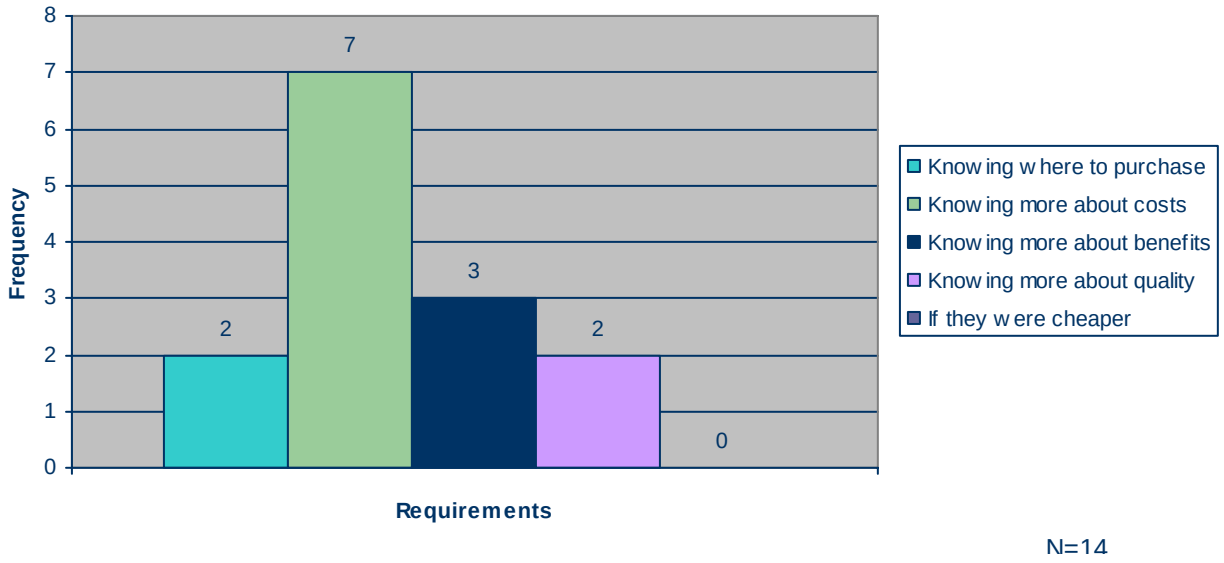
We observed that very few of these businesses (only one) used Energy-Star rated appliances. For many businesses on Spring Street, appliances do not represent a major energy drain; the retail shops typically only had a computer or a small refrigerator, and although they had heard of the energy-star label, they were not concerned about these appliances as energy drains. However, appliances are a much more significant energy consumer in food service establishments. Among those businesses that were willing to share their electricity bills with us, we noticed that the restaurants paid over twice as much as retail establishments, which we attribute in part to their use of commercial kitchen appliances. For them, switching to more efficient appliances could have large energy savings. From our discussions with business owners, we also found that one of the major reasons they don't use energy-efficient commercial kitchen appliances is that they do not know they exist. For instance, a number of food service establishments including Ephporium, Subway, and Helen's Place, did not know that Energy-Star certifies not only residential but commercial appliances. Although the owner of Ephporium had not considered Energy-star commercial kitchen equipment, he made a great investment in a

large walk-in cooler, because he knew large coolers were more energy-efficient than using smaller coolers to make up the same amount of available space. This suggests that businesses that knew about such appliance alternatives might invest in them.

These results also suggest that businesses faced a significant information barrier about available technology.

Our next set of questions asked what types of information businesses feel they need to know in order to make decisions about energy-efficient technology alternatives. (Figure 12). We think that this is important because we want to devise strategies that create the greatest amount of change in business practices with the least possible wasted time and effort on the part of the COOL committee. Giving businesses loads of information that is uninteresting and unhelpful to them would be a waste of time on both sides.

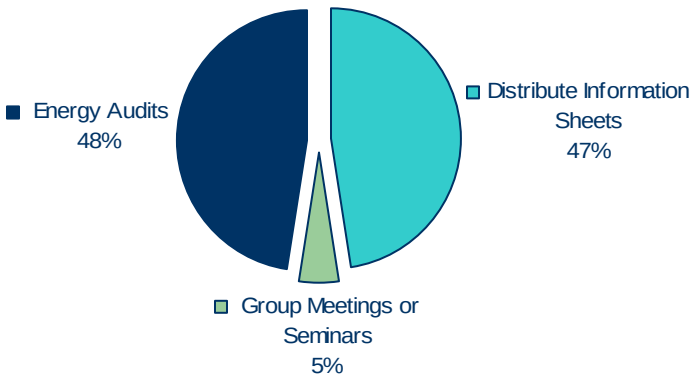
Figure 12. What Do Businesses Want to Know About Technology?



Of the suggestions we offered, including finding out more about products' quality and where to get them, we found the greatest amount of interest in information about costs of alternatives. This suggests that a thorough cost-benefit analysis of these alternatives is an important consideration to incorporate in our recommendations to businesses.

In addition to finding what businesses want to learn more about, we were interested in how we could best supply them with this information. Based on the cases of business conservation programs in Brattleboro, Newton and Cambridge, we came up with three general education methods: energy audits from utility conservation contractors or other efficiency experts, distributed information sheets, and group meetings or seminars.. We asked businesses to tell us which of these forms of information-sharing they would be most interested in.

Figure 13: How Do Businesses Want to Obtain Information?



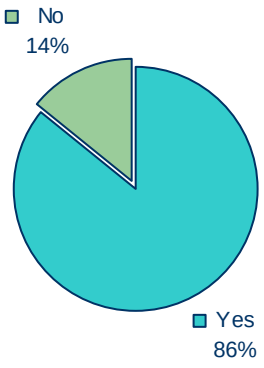
N=21

We found that about half of businesses were interested in information sheets, and half in an energy audit. Those who liked the idea of an information sheet said they would

appreciate the ability to look at energy reduction strategies on their own schedule On the other hand, those who preferred an energy audit were excited about the prospect of hearing about the specific strategies that would work for their particular business. Generally, business owners did not like the idea of information seminars because not only are they time-consuming, but there is very little flexibility about when they are offered, and there is no guarantee that the suggestions will even be applicable.

Finally, we wanted to gauge businesses' level of interest and willingness to participate in a program that would give them public recognition for energy reduction efforts, such as Cambridge's Climate Leaders Program. Our question referenced the examples of Portland and Salt Lake City's pubic recognition programs, which are similar to Cambridge's in that they recognize businesses that have reached a set level of achievement by giving them the right to display a special sticker on their front window.

Figure 14. Are Businesses Interested in Participating in a Public Recognition Sticker Program?



N=21

Businesses' responses to this proposal were, overall, positive. The majority of businesses (84%) said they would be willing to participate. The few who expressed

disinterest were mainly art galleries that were opposed to displaying a sticker in their window rather than to the idea of such a program.

Responses to this question, and to our last question, which asked whether they felt well-informed as to the relationship between energy use, carbon dioxide emissions and the environment, indicated that businesses consider Williamstown an environmentally-conscious community. Many of them thought that such a recognition program could be beneficial to both businesses and the town's environmental community. Overall, interest in making energy efficiency a town-wide concern seemed high, and interviewees were excited about participating as long as it did not hurt them financially and did not require a large time commitment.

XII. ANALYSIS OF BUSINESSES' ALTERNATIVES

With the information we have gathered about Spring Street businesses and energy-saving technology and behavior, we want to make appropriate and feasible suggestions to business owners about how to efficiently reduce their emissions by reducing energy use. There are several considerations that guide our recommendations, including business owners' concern for cost and the COOL committee's goal of maximizing carbon dioxide reductions.

Given these goals, we developed a system for rating alternatives that included four key factors: capital cost (K), time cost (T), annual monetary savings (S_m), and annual carbon emissions savings (S_c). We determined that capital cost was the most important factor in businesses' considerations of certain actions, so we weighted this the heaviest. Large upfront capital costs could represent a significant barrier for businesses so we

wanted to be sure to focus on this issue. Annual monetary savings were also important to businesses so that was given a slightly heavier weight as well, but not as strong as capital costs. Finally, time costs were important to consider because business owners are already busy so asking them to research a new technology or close temporarily to install an appliance represents a large burden. We did not give this any extra importance however because we feel that there are ways to minimize time costs through education, and thus, while it is important, it is an issue whose burdens and effects can that can be minimized. Finally, we wanted to include carbon reduction in the analysis because this is the ultimate goal of the COOL committee. So, even though it does not necessarily factor in to business decisions, we felt that it was important to include because this is the ultimate goal. Given all of this, our final equation for calculating the viability and effectiveness of alternatives came to: Total Points (or viability) = $5K + T + 3S_m + S_c$.

Once we developed a series of factors to consider and rated them based on importance in business decision making, we had to decide how we would rate the alternatives. The system we developed rates each category on a scale of 0-20 with 20 being the best. The best alternatives are those that produce the highest total points score. The one slightly confusing aspect of this system is that low costs received high point values, since they are "better."

At this point we had a system within which to work and proceeded to divide different alternatives into 3 different categories based on the level of difficulty for accomplishing each task. Level 1 involved steps that require very little extra effort and have minimal upfront capital costs. Level 2 is slightly more intensive but still very doable. Finally, Level 3 represents the most aggressive steps and involves installing new

technology. At this level, we divided the businesses into either a “retail” or “restaurant” category because the two groups have different large appliance needs. Any business handling food (traditional restaurants, coffee shops, or grocery stores) falls into the restaurant category because they have refrigeration and possibly cooking needs. Everything else falls into the retail category because they do not require food storage appliances. We did not divide the two kinds of businesses at the first two effort levels; the actions we recommend at these levels could be applicable to any types of businesses.

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Level 1 Analysis:

Table 8

ACTION	Capital cost	Time Cost	Savings ($)	Energy impact	Total Score = C*5+T+S*3+E
Replace 50% incandescent bulbs with CFLS	**18**	**18**	**15**	**10**	**163**
Turn down heat 5 degrees further overnight	**20**	**20**	**5**	**2**	**137**
Reduce display lighting by 1 hour daily	**20**	**20**	**1**	**1**	**124**

As was mentioned previously, Level 1 consists of actions that require very limited capital costs or time. This step focuses on small changes that can have significant impacts when made by a large number of people over a longer period of time. The first action to consider is replacing 50% of incandescent bulbs with CFLs. This step has minimal capital costs, but costs still exist. The businesses must buy the bulbs, which are slightly more expensive than typical incandescent bulbs. Time costs are also minimal, but arise from having to go buy new bulbs and installing these bulbs. It is important to note however that there will be time savings in the long run as CFLs have a longer lifespan than traditional incandescent bulbs. The savings of this simple action are significant both from a monetary and carbon emission standpoint.

The next recommendation is to reduce overnight heating. Turning down heat 1 degree F can save 2-3% on a heating bill so 5 degrees would be significant.[82] Also, this does not present any new capital costs or time costs as most businesses already reduce heating to some extent over night.

Another step we are suggesting at this level is the reduction of display lighting by 1 hour daily. This could mean turning off displays at 11pm rather than 12 midnight because the number of people walking around at these times is extremely limited. This action does not require new capital or time costs. Turning off appliances when leaving the business is also an easy step businesses can take to decrease their energy use. The savings for these actions are small because these steps are already in practice at a limited scale so the changes would not be large, however, over time, and when done by the entire town, the effects could be significant.

Level 2 Analysis:
Table 9

ACTION	Capital cost	Time Cost	Savings (points)	Energy impact	Total Score = C*5+T+S*3+E
Replace all incandescent bulbs with CFLS Lights	**17**	**16**	**20**	**15**	**176**
unplug appliances/turn off power strips	**20**	**18**	**10**	**5**	**153**
energy audit	**20**	**12**	**5**	**3**	**130**
Window Film or caulking	**18**	**17**	**1**	**1**	**111**
Regularly clean air filters	**18**	**16**	**1**	**1**	**110**

[82] http://www.scasco.com/installation/energy_tips.htm

Level 2 includes steps to reduce energy that require slightly more time and effort; however, as in Level 1, these actions have very small capital costs.

At this stage, we thought about the feasibility of replacing all the incandescent bulbs with CFLs and again decided that the costs in terms of time and capital are not particularly large. The savings in both energy and money are also significant. A CFL can save over 800 pounds of carbon emissions over its lifetime and nearly $70 over its lifetime, as much as $35 annually per bulb.[83]

Taking the time to unplug appliances or turn off a power strip can also be a significant source of energy savings. As we mentioned earlier, phantom loads consume large amounts of energy over time so eliminating this source of energy waste could represent significant savings in the long run.

At this stage, we also considered energy audits. An energy audit is a great resource to explore if the business has a little bit of time. The audit requires the business to be interested in exploring energy saving options and learning from the auditor what technology is available. The energy audit itself is free and we assume that the business would immediately receive a few small suggestions that could lead to minor savings and changes.

The final actions in this section are installing window films or caulking window areas to increase the insulation of these areas. This can decrease the heating bill for the business and requires relatively small capital and time costs. Finally, regularly cleaning air filters can also decrease the heating and cooling costs of a business. This is a task that is fairly easy to complete once every 3 months; it is just a matter of making it a priority.

[83] http://www.environmentaldefense.org/page.cfm?tagid=630&campaign=480

Level 3: Retail

Table 10

ACTION	Capital cost	Time Cost	Savings (points)	Energy impact	Total Score = C*5+T+S*3+E
Green Power	**10**	**10**	**0**	**20**	**80**
Install fans	**10**	**10**	**2**	**1**	**67**
Install double doors	**5**	**5**	**8**	**4**	**58**
Install efficient AC unit	**5**	**5**	**8**	**3**	**57**

While the other levels have primarily looked at behavioral changes and small technological innovations applicable to businesses, Level 3 represents the most aggressive and capital intensive strategies for reducing energy use. The first idea we looked into was buying green power. In this situation, businesses pay a small premium for buying green power and while they do not receive any savings for buying this power, the town does get a small percentage of the premium to use for other energy projects and the energy impact is huge because the energy is coming from a clean source.

The next option is to install fans. Fans are relatively inexpensive and while they run on electricity, they can reduce heating and cooling bills. During the winter, when businesses are heating their stores, a fan could reduce the amount they are heating by keeping the air circulating, and thus preventing the hot air from becoming "trapped" near the ceiling (because hot air rises). Again, this might mean being able to reduce the thermostat by 1 or 2 degrees, a step that is accompanied with modest reductions in heating bills.

A double door is another way for businesses to retain warm air during the winter and cold air during the summer. Every time the door opens, air enters and exits the store. By installing a double door, businesses would be able to minimize the amount of energy wasted on heating or cooling air. However, this represents a fairly costly endeavor, both in terms of time and upfront capital costs. Finally, installing efficient air conditioning units can be a great way to save money as was discussed above. The new machines are far more efficient than old systems.

Level 3: Restaurants

Table 11

ACTION	Capital cost	Time Cost	Savings (points)	Energy impact	Total Score = C*5+T+S*3+E
Green Power	**10**	**10**	**0**	**20**	**80**
Install fans	**10**	**10**	**2**	**1**	**67**
Install double door/curtain	**5**	**5**	**8**	**4**	**58**
Install efficient AC unit	**5**	**5**	**8**	**3**	**57**
Install efficient freezer	**0**	**5**	**12**	**5**	**46**

Level 3 for restaurants is the almost the same as level 3 for retail businesses, the only difference being that this analysis also includes the installation of an efficient freezer. The freezer requires a significant capital investment and time cost, both in terms of research and installation. The savings are fairly large, however, the capital cost could

prove prohibitive unless the business is in the market for a new freezer already. If this is the case, installing an energy efficient freezer would be a great option.

Final Suggestions for Businesses

Having analyzed an extensive list of suggestions with the findings of our business interviews in mind, we conclude that the most important action we can encourage is for businesses to begin taking small steps to reduce their energy use. While it would be great for all businesses to install new air conditioning units and only operate energy star rated appliances, at this point in time, we do not believe that this is feasible. Given this, we are encouraging businesses to seriously consider some of the Level 1 actions. To begin, changing the incandescent light bulbs currently used to provide ambient light to CFLs would be a cheap and easy way to increase energy efficiency. Also on lighting, we feel it would be a strong signal to the community if the businesses all agreed to an 11 pm "blackout" and turned off their displays. Turning down heat at night is also a modest step that would provide reductions in heating bills. Finally, minimizing phantom load consumption is also an important action businesses can take.

While none of these steps alone will bring Williamstown to its 10% reduction goal or translate into impressive savings on electric or heating bills, when done on a large scale over time, the savings can be significant. We feel very strongly that if members from all sectors adopt simple, low-input practices, Williamstown can meet its 10% goal, and that businesses can be a significant part of this effort. We are encouraging businesses to participate, even if only at minimal levels, because of the importance of attacking greenhouse gas emissions as a community. We feel that the business sector can act as a

leader in this endeavor because of its visibility to the general public. If the entire town sees the commercial sector actively reducing their emissions, we are hopeful they will be inspired to be more energy conscious in their homes as well.

XIII. RECOMMENDATIONS TO THE COOL COMMITTEE

We have made the above recommendations to Williamstown businesses in the hope that our analysis will lead them to consider how the adoption of carbon dioxide-lowering practices would be worthwhile for their businesses in addition to their environmental benefits. However, we believe there is much that the COOL committee could do to encourage local businesses to consider the options we have presented to them, and to provide help and incentives for businesses to take energy-saving measures that they might not choose to adopt of their own initiative.

The COOL committee's Climate Action Plan references a number of possible strategies for reducing commercial CO2 emissions, including the general strategies that we recommend below. Where we believe that our research and work can contribute is in identifying which of these strategies hold the most potential to change Williamstown's small businesses, and how their implementation might be tailored to the current state of energy-saving practices, awareness, and interest among local business owners.

Our discussions with the business owners on Spring Street confirmed that the leading factor in their considerations of change in business practices is cost. Thus we think that the analyses we present above, which focus heavily on cost and the rate of payback, will hold some weight for them. However, merely distributing these recommendations would fail to optimize business responses. There is great potential for

the COOL committee to cause change in business sector emissions: first, by helping businesses change their practices, by providing them with detailed information about the options available to them; and secondly, by giving them an incentive beyond cost to reduce their carbon dioxide emissions.

Share Information

We learned that many businesses on Spring Street were limited by an information barrier. Fortunately, this barrier is an easy one to eliminate, and if the COOL committee succeeds in doing so, we have high hopes that businesses will adopt new energy-efficient practices that serve their businesses' needs and save them money.

We learned from business owners that time constraints are one of their major concerns. This came up mainly during our discussions of how they would like to find out more about technology alternatives; some explained that they had little time to look into new technology options. The rate at which these technologies develop makes it difficult to keep up with the newest available options. Thus, making information on current energy-saving technology available to businesses, saving them the time and effort of researching these options, could make them more likely to use energy-efficient products.

Some businesses were aware of certain energy-saving technologies, but had not considered them because they had misconceptions that these alternatives were not available in forms that would suit their needs. For example, most of the businesses we interviewed have heard of CFLs, but some did not use CFLs, or used them only in certain areas because of misconceptions about the quality and variety of CFLs available. Similarly, some restaurant owners were unaware of the existence of Energy-Star rated commercial kitchen appliances.

Although we spent less time on energy-saving behaviors in our discussions with businesses than we spent on technology, we believe that education about these simple, low-cost practices could also make a significant difference in their energy-saving achievements. Similarly, we think that providing businesses with information about renewable energy options could make some businesses a bit more likely to consider them (though we don't expect many to take this initiative, since it has very slow payback and high cost).

Many of the businesses we spoke with also were unaware of the National Grid Small Business Program. Despite the potential pitfalls pointed out by the owners of Library Antiques, Subway and the Spirit Shop, this program represents a great source of technical assistance and financial aid for businesses that would otherwise have difficulty in assessing their needs and paying the up-front costs of technological efficiency upgrades. We suggest publicizing this program by providing businesses with a summary of its goals and logistics, and a National Grid contact phone number.

Considering local businesses' concerns about the lack of follow-up service included in the National Grid Small Business Program, we also recommend that the COOL committee remain in contact with businesses that sign up for this program, or offer to get the businesses in contact with other organizations that can offer technical advice, such as the Center for Ecological Technology in Pittsfield, MA. This would make it possible for businesses to stay up-to-date on current technological options and potential problems they might run into. This would not require the COOL committee to play a constant and time consuming role as coordinator between the program and

businesses, but it would serve as a resource for further advice and assistance when the National Grid contractor has done all they will.

According to our interviews, one of the most effective ways of sharing this information with Williamstown businesses would be through the distribution of pamphlets or handout sheets that businesses could peruse on their own schedules. Posting these resources online would likely be convenient for some businesses, and would make the information available to other members of the community. However, other business owners are not frequently online, so hard-copy educational materials would be necessary as well. We recommend this method of information distribution not only because it would give business owners flexibility, but also because it would not necessarily require a great time commitment from the COOL committee, who are currently involved in the planning and implementation of a number of other projects. We do, however, think that it would be helpful for the committee to make themselves known as a resource that businesses can call upon for help and advice. This could be done via personal visits to each business, which we found to be a very effective means of communication during our research; this method was also highly recommended to us by the directors of the Green Decade Coalition Newton and Brattleboro Climate Protection. However, since it would take a significant amount of time to reach all of Williamstown's businesses in this way, other tactics might be more feasible: for example, including a letter of introduction with the COOL members' pictures in the handouts; arranging an introduction at a Chamber of Commerce meeting; or through press releases and public service announcements.

We have drafted a sample educational handout (See Appendix C, p. 70) that the COOL committee could use as a starting point for the development of educational materials. It includes technology options that we have learned might be of interest to local businesses, such as warm-colored and dimmable CFL models and Energy-Star rated commercial kitchen equipment. We give information on up-front costs and payback periods, and about where these options are available.

These sample materials also include information on the National Grid Program, including a contact phone number. We added energy-saving behavioral tips, some of them easy (such as turning off and unplugging appliances at night) and some of them more challenging (like cleaning heating filters and refrigerator coils), and give estimations of yearly savings from several of them. Finally, we give a small amount of information on green power and how to buy it through National Grid.

Implement Public Recognition Program

In a sense, our recommendation that the COOL committee use educational materials is comparable to our recommendation that businesses take simple, low-input steps to reduce their own emissions. From our research and interviews, we believe that such an educational campaign has the potential to make a sizeable impact on Williamstown's business sector emissions without high cost to the COOL committee. Providing businesses with accurate, up-to-date information will overcome the barriers created by rumors and outdated facts about technology, which we have found represent a significant obstacle. We expect this would work largely through making businesses realize that energy efficiency can have great economic rewards.

However, we believe that sharing this information with businesses will only go so far as businesses see it in their best financial interest. Because costs are their primary concern, they are unlikely to choose options that have high up-front costs and low payback rates, such as solar panels or Energy Star appliances. But these practices would have great environmental benefits, if not immediate financial ones. Thus, the COOL committee's goals should include not only facilitating business owners' reductions of their costs through greater efficiency, but encouraging them to make greater and more challenging commitments to reduce their carbon dioxide emissions. This has been done relatively successfully in Brattleboro, Cambridge, and Newton (not to mention in larger cities like Portland and Salt Lake City) through public recognition programs.

These programs fall into two general categories: first, certification of all businesses that reach certain goals (Cambridge, Brattleboro), and second, annual awards given to one business that has made an extraordinary environmental commitment (Newton). We believe, at this point, the first option – a general public recognition program – would be more effective in meeting the COOL committee's goals. First of all, to encourage businesses to take their first large, financially challenging steps to reduce their CO2 emissions, they should be offered recognition – not merely the chance of it. And second, we think that, in Williamstown, there is great potential to foster a powerful sense of community pride in environmentalism, which will likely be more productive, at least as we start out, than competition would be. Finally, this broader recognition program would give the committee flexibility in setting the parameters of qualification, which will give them more power in directing its course. And although some businesses

expressed reluctance to display a sticker in their window, we are sure that this issue could be dodged through alternatives like plaques or framed certificates.

The public recognition programs for businesses in Cambridge and Brattleboro are based on very different certification systems. Brattleboro's 10% Challenge businesses must take steps that will reduce their emissions by 10% to qualify, but the particular steps taken are not considered. To become Cambridge Climate Leaders, on the other hand, businesses are required to take a number of specific steps, which they choose from a list approved by the Cambridge Department of Community Development. By certifying based on particular actions and not on overall reductions from the business' previous emission levels, this type of program accounts for the steps businesses had already taken before the year they applied for certification. Under a simple emissions-reductions system, it would be easier for entirely incandescent-lit businesses to become certified than for fluorescent-lit businesses, which would have to turn to more challenging methods of reduction in order to reduce their emissions 10% further.

However, we do not recommend certification based only on certain changes. Quantitative emissions reductions should be part of the qualification process, both because this will help the COOL committee to monitor the commercial sector's progress and because this will take into account behavioral changes that are difficult to measure without the energy bills, such as unplugging appliances at night.

The certification model we have proposed (See Appendix D) includes three levels of achievement: one-star, two-star, and three-star. The one-star level includes relatively simple, low input actions; we have suggested requiring half of lighting to be fluorescent or CFL, and that the business turn off display lights by 10 p.m. and unplug appliances at

night. The two-star and three-star levels require a 5% and 10% reduction from the previous three-year average (or as many years as they have been in that space, if less than three years). Note that we have recommended requiring these reductions either in emissions from electricity use or from overall emissions, including heating; though this system is not perfect, we hope that it will encourage emissions reductions in both businesses that have control over their heat (who may be able to contribute greatly to their overall emission reductions by lowering their thermostat further, for example) and those that don't (who would have greater trouble reducing their overall emissions, since they have no way of controlling heat use).

Finally, we strongly recommend that this public recognition program be used as a foundation for public education. Energy-efficient businesses provide a great venue for publicizing efficient technology and behavior, for several reasons. First, emissions reductions among businesses can provide a striking demonstration of the economic feasibility of energy-efficiency. And second, as we have already mentioned, businesses are highly visible to the public, particularly restaurants and retail stores.

In order to maximize publicity of businesses' energy-saving achievements, we suggest that the COOL committee use press releases and public service announcements. Ideally, we think it would also be very helpful to seek certified businesses that are willing to display educational visuals about "What Makes Us a COOL Business", so that the public can see more directly what particular businesses can do to reduce their emissions.

XIV. OUR OUTLOOK ON WILLIAMSTOWN'S 10% REDUCTION GOAL

To conclude, we would like to return to the COOL committee's goal of getting Williamstown to reduce its CO2 emissions by 10% below 2000 levels by 2010. Is this a feasible goal?

From our research and analysis of the resources and technologies available to the business sector, and our discussions with business owners on Spring Street, we believe it is possible for the town's commercial sector to meet this goal. We predict that this will require persistent work on the part of the COOL committee, and risk-taking for the businesses involved, but we think it can happen.

But businesses only account for 20% of the town's emissions – what about the other sectors? One of the important general findings of our research on energy efficient technology is that, for the most part, its use is limited not by availability, or quality, but by initial price. And though start-up costs are a concern for the municipal and residential sectors as well, cost is of very high concern for businesses. Thus, if even businesses are able to lessen their carbon dioxide emissions through use of these technologies, we have high hopes that the other sectors will be willing to adopt them as well. We believe that one of the most important factors in achieving this goal is a sense of community pride and mutual support in reducing Williamstown's carbon dioxide emissions.

APPENDIX

A. BUSINESSES INTERVIEWED:

Goff's
Spice Root
Lickety Split
Harrison Art Gallery
Purple Pub
A Perfect Blend
Pierre's Barber Shop
Tunnel City Coffee
Thai Garden
Willinet
The Red Herring
Goodman Jewelers
Ephporium
Library Antiques
Subway
McLelland's Press
Hart's Pharmacy
Williams Newsroom
Royal Cleaners
Helen's Place
Alley Framing Gallery
*Where'd You Get That?!
*Images Cinema

*Indicates an interview that was conducted too late to be incorporated in our results analysis, but whose comments we have considered in our discussion.

B. OUR INTERVIEW/SURVEY

Thank you for taking time to fill out this short survey. We are Williams College students working in conjunction with the Williamstown Carbon Dioxide Lowering Committee, otherwise known as the COOL committee.

We are working with COOL to develop a plan to help small businesses in Williamstown reduce their energy use to save money on their utility bills and thus, limit their carbon dioxide emissions.

We are interested in your input so that we can develop a realistic and effective plan to reduce greenhouse gas emissions for Williamstown and appreciate your help in this process.

I. Do you own or rent your space (circle one)?

II. Who pays the electricity bill (circle one)? Business Owner Landlord

III. Who pays the heating bill (circle one)? Business Owner Landlord

IV. If you pay one or both of these bills, can you estimate:

How much it costs each month:_____

How many Kilowatt Hours per month:_____

IV. Do you currently use any energy saving technologies or techniques in your business? Please check all that apply.

__Turn off lights in rooms not being used

__Turn down heat after business hours

__Turn off lights when business is closed

__Use compact fluorescent lightbulbs

__Turn off computers after business hours

__Have energy star rated appliances

__Retro fits

__Other (please specify)

A. If you checked any of the above:
How many of them do you have or how often do you do the activity?

When and whey did you decide to use them? (Environment? Cost savings?)

What do you like / dislike about them?

B. If you did not check any of the above, please rate the following in terms of what would make you more likely to try them out:

__Knowing where to get them __Knowing more about their quality

__Knowing more about their costs __If they were cheaper

__Knowing more about their benefits __ having more time to research options

V. What would be your largest incentive for increasing your businesses energy awareness and reducing electricity use? Please rank the following

__Costs __Publicity __ Environmental or Social consciousness

V. Would you be interested in finding out about how to buy these technology alternatives, their quality, and their costs and savings (please circle one)? Yes No

VI. What would be the most effective way for you to learn more? Please rank the following:

__Distributed information sheets __Public education seminars

__Energy consultants visiting your business __Other (please explain)

VII. Massachusetts utility companies have programs that help small businesses reduce their energy costs. National Grid has a Small business program that offers free energy audits, and can pay 80% of the cost of replacing your appliances with energy-saving ones. These retrofits usually pay off in about one year.

A. Have you heard of this program (please circle one)? Yes No

B. Would you be interested in coming to a short (15 minutes) evening meeting with refreshments and a presentation about this program?

VIII. Cities like Portland and Seattle recognize small businesses that reduce their energy use with a sticker or logo can be posted on their door or in the shop to show customers they've reduced their environmental impact. Would you be interested in this kind of public recognition program if we created one in Williamstown (please circle one)? Yes No

IX. Would you like to find out more about how energy use and carbon dioxide influence the environment?

X. Please feel free to include any additional comments below.

If filling this out on your own, please return to:
ENVI 302; 2043 Baxter Hall, Building B; Williamstown Ma 01267

C. RECOMMENDATIONS TO THE COOL COMMITTEE

Information we Recommend for Business Education Materials
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Introduction

Reducing energy use is good for your business because it limits your energy bills. It's also good for the environment. The burning of fossil fuels to produce heat and electricity releases chemicals that are damaging to environmental and human health. It also releases large amounts of carbon dioxide, which is causing global warming.

Here are some suggestions on how to reduce your business's energy use.

Lighting

**CFLs (Compact Fluorescent Lights) Save Money*

*Over the span of 8,000 hours of use (about two years at 10 hours per day), the electricity used to power a conventional 60-watt incandescent bulb costs about $48. A Compact Fluorescent light of 14 watts gives off the same amount of light (the same number of "lumens"), but only costs $11.20 in electricity over the same time period.

Electricity Cost
(for 800–900 lumens at a rate of $0.10/kWh)*

$$60\ \mathrm{W} \times 8000\ \mathrm{h} \times \frac{\$0.10}{1000\ \mathrm{Wh}} = \$48$$

$$14\ \mathrm{W} \times 8000\ \mathrm{h} \times \frac{\$0.10}{1000\ \mathrm{Wh}} = \$11.20$$

How to calculate the total cost of electricity for using an incandescent light bulb vs. a CFL (1 kWh = 1000 Wh). *As of May 2006, the average rate for electricity in the US was approximately $0.106 per kWh.

*The average CFL costs about $3 more than the average incandescent bulb; however, they last for about 6,000 hours compared to 750 hours for incandescents. Because of their long life and energy savings, CFLs pay back their higher cost in less than three months.

*Dimmable CFLs available

*CFLs come in a variety of colors:

Left to Right: Daylight, Cool White, White, Warm White

Available at:
*Aubuchon Hardware, Williamstown (413) 458-3000
*H.Greenberg & Son, North Adams (413) 664-4576
*Wal-Mart, North Adams

Appliances

Energy Star is an EPA program that certifies technology that meets their energy-efficient standards with this label:

The Energy Star label appears on many Compact Fluorescent Bulbs and small appliances. However, there is also a variety of Energy-Star rated commercial kitchen equipment.

The initial costs of Energy-Star certified appliances are generally higher than conventional alternatives. However, the power and maintenance costs associated with this energy-efficient equipment are much lower, and the payback of this cost difference is relatively brief. Here are a couple of examples:

SOLID DOOR FREEZER[84]	**Energy Star**	**Conventional**
Initial Cost ($)	**2,439**	**2,300**
Kwh/yr	**3,818**	**5,201**
Annual Operating Cost ($)	**271**	**369**
Over Product Lifetime:		
CO2 Savings with Energy Star (lbs)	**19,782**	
Cost Savings with Energy Star($)	**658**	
Payback of Initial Cost Difference	**1.4 years**	
ROOM AIR CONDITIONER[85]	**Energy Star**	**Conventional**
Initial Cost ($)	**1,170**	**1,000**
Kwh/year	**2,332**	**4,300**
Annual Operating Cost ($)	**166**	**305**
Over Product Lifetime		
CO2 Savings with Energy Star (lbs)	**28,133**	
Cost Savings with Energy Star ($)	**$954**	
Payback of Initial Cost Difference	**1.3 years**	

*Energy-Star rated appliances also include commercial refrigerators, steam cookers, fryers, and hot food holding cabinets.

*For information on small appliance store locations, go to http://www.energystar.gov/index.cfm?fuseaction=store.store_locator
*For information on where large appliances available, call Energy Star at (888) 782-7937

[84] http://www.energystar.gov/index.cfm?c=commer_refrig.pr_commercial_refrigerators
[85] http://www.energystar.gov/index.cfm?c=roomac.pr_room_ac

Energy-Saving Tips

Your business can save a lot of energy by making small behavioral changes.

*Unplug appliances when they are not in use! Up to 10% of your energy bill may come from "phantom" energy use – the energy that appliances draw from the socket even when they are not turned on.

*Turn off lights when they are not needed; if you have a night-time window display, try turning it off one or two hours earlier.

*Clean the filters on your heating system

*If you control your heat, turn it down at night; every degree makes a difference.

*Improve your insulation: add insulating film to your windows, and caulk the window frames. (Materials are available at Aubuchon and other hardware stores).

*Be sure that you are maintaining appliances according to the manual; for example, clean refrigerator coils every few months.

*Where possible, choose to completely fill one refrigerator or freezer instead of using two.

Small behavioral changes like these can have great savings. Here are some examples:

Behavior Changes and Benefits*[86]

	Max. Annual Savings per Appliance	
Behavior	**$**	**tons CO2**
Keep newer freezers & refrigerators full; disconnect an old one	300	2.1
Clean refrigerator/freezer condenser coils every 3 months	20	0.14
Unplug average stove 16 hrs/day	277	1.94
Turn off one 60-watt bulb one additional hour/day	10	0.028

To find out more about energy saving tips, go to:
Energy Star Website: http://www.energystar.gov/index.cfm?c=small_business.sb_restaurants

[86] Calculations based on:
Energy Star: Restaurant Management
http://www.energystar.gov/index.cfm?c=small_business.sb_restaurants
and
Night time Lighting
http://www.seleneny.org/homeowner_tips.html?5144cfc818e6be1d0ac77f214cce7511=97e82981b832d7685e1d094e62161576

Green Energy

Most of our energy comes from oil and coal combustion, which is not only polluting, but limited by the availability of these materials. Wind and sunlight, on the other hand, are both "clean", in that they do not release carbon dioxide or other chemicals when used, and "renewable" because they do not run out.

You can buy clean, renewable energy from National Grid's Green-Up program. (See http://www.nationalgridus.com/masselectric/home/energychoice/3_renewable.asp) To enroll, call one of the following providers:

Clear Sky Power
Telephone: 1-888-833-6402
Website: www.clearskypower.com
Community Energy
Telephone: 1-866-WIND-123
Website: www.NewWindEnergy.com
Mass Energy Consumers Alliance
Telephone: 1-800-287-3950
Website: www.massenergy.com
Sterling Planet
Telephone: 1-800-473-1362
Website: www.sterlingplanet.com

Both the state and federal governments offer tax incentives for the purchase of renewable energy. Under Section 38H of Chapter 63 in Massachusetts laws, businesses can get a Corporate Income Tax Deduction for purchasing on-site renewable energy technology[87]. Additionally, under the federal policy 26 U.S.C.A., businesses can apply for Business Investment Tax Credit, and deduct up to 10% of the costs of investing in, purchasing, or constructing renewable energy systems[88].

[87] http://www.mass.gov/doer/programs/renew/renew.htm#taxcred
Massachusetts and Federal Renewable Energy Tax Incentives

[88] http://www.mass.gov/doer/programs/renew/renew.htm#taxcred
Massachusetts and Federal Renewable Energy Tax Incentives

APPENDIX D. RECOMMENDATIONS TO THE COOL COMMITTEE
Our Suggestions for a Public Recognition Program

One-Star: Both of the following.

*At least 50% of lighting with CFL or equally efficient source (such as LED)
*Turn off lights and appliances when not in use; unplug appliances at night; turn off all display lights by 10p.m.

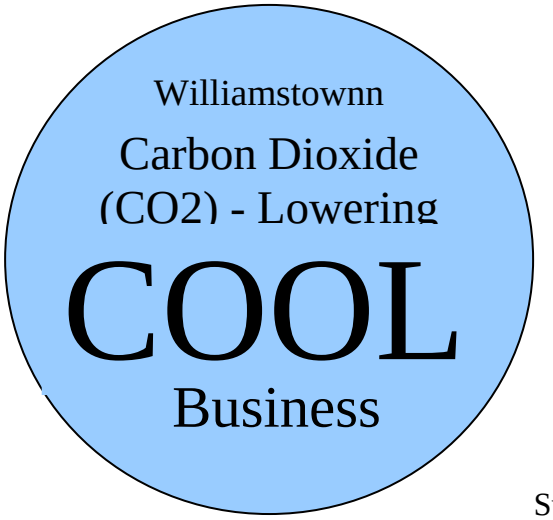
Two-Star:

Carbon dioxide emissions from electricity, or from overall energy use, reduced between 5 and 10% below average of 2003-2006, or since moved into space (if less then three years ago).

Three-Star:

Carbon dioxide emissions from electricity, or from overalll energy use, reduced by 10% or more below average of 2003-2006, or since moved into space (if less than three years ago).

Sample Sticker



Suggestion: overlay a globe image.

Public Education Component:

*Press releases, newspaper articles, Willinet Public Service Announcement

*Educational displays in willing businesses