Climate Action Plan
Ipswich, Massachusetts

Ipswich Commission on Energy Use
and Climate Protection
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Executive Summary

The world has reached a critical juncture in global energy use and carbon emissions. The global economy can either continue on with its ever-increasing appetite for energy, continue to release greenhouse gas (GHG) emissions into the atmosphere, and try and adjust and adapt to what will in many cases be the catastrophic effects of climate change. Or we can dramatically shift our energy habits and the way we think about energy; to use less energy in the first place, and for the energy we do use choose cleaner sources that create fewer GHG emissions.

While there have been piecemeal attempts to address global climate change at the international and national levels, these efforts have stalled far short of the reductions in emissions that will be needed in order to avoid the most dramatic effects of climate change. This creates a leadership gap that must be rapidly filled by the individual and concerted actions of many local communities around the world, which together can have a real effect on GHG emissions, and can help prompt national governments and international bodies into action. As a coastal community particularly vulnerable to rising sea levels and increased storm intensity, and as a Town that has already made some significant steps forward in reducing GHG emissions, Ipswich must step up its efforts and be a leader and an example for other communities to follow. With the active participation and cooperation of the entire community, Ipswich can become a shining example of a cleaner, more sustainable community, and an even better place to live and work than it is today.

The Climate Action Plan (Plan) for Ipswich, MA was prepared by the Commission on Energy Use and Climate Protection (Commission) to meet Ipswich's commitment to the Cities for Climate Protection (CCP) process, and will guide Ipswich through a transition over the next decade to a more sustainable energy future. Specifically, the Board of Selectmen unanimously adopted a GHG emissions reduction target of 10% below 1990 levels by 2020. As shown in Table 1.1., this means reducing emissions from an estimated 116,800 metric tons (mt) in 2010[1] to roughly 82,500 mt by 2020. To accomplish this will require reducing GHG emissions by at least three percent a year for the next ten years. Put in these step-by-step, incremental terms, this is a target we can achieve if everyone does their part. We will not be alone, as this same objective has been adopted by thousands of governments, businesses and communities across the globe and many are making gradual, but noteworthy, progress.

2020 Target	Total Annual Emissions (mt CO_2)	Total Reduction (mt CO_2) to Meet Target (from 2010)	Annual Emissions Percent Reduction/Yr (from 2010)
Business as Usual	128,900	None	None
Ipswich GHG Reduction Target for 2020 (10% < 1990)	83,200	34,700	3.43%

Table 1.1. Business as usual scenario and Town-adopted GHG emission reduction target

[1] See Appendix 2 for the Key Findings of the 2009 Energy Use and GHG Inventory for Ipswich.

This Plan provides a comprehensive set of GHG reduction strategy recommendations, divided into Municipal, Residential, and Commercial/Industrial (C/I) sectors, that fall under three main themes: (1) increasing energy efficiency, (2) promoting energy conservation, and (3) switching to renewable energy sources. Education and outreach, especially on the part of municipal government, will be critical to the widespread adoption of the Commission's recommendations and achieving the Town-adopted 2020 GHG reduction targets. Following the strategies in the Plan will require a major shift in attitudes and practices around energy use and GHG emissions, and a new culture of energy awareness, in which the tenets of smart energy use are broadly practiced in homes, at work, in transportation choices, and by local government.

In order to succeed, the Plan needs the full participation of municipal government, residents and businesses. While the municipal government has key roles to play in leadership, education and facilitation, it is directly responsible for only a tiny fraction of Ipswich's total GHG emissions, and cannot meet the 2020 target without the participation and cooperation of Ipswich's residents and businesses. The Plan provides detailed strategy recommendations for all three groups. In each case, the Commission has identified the most critical recommendations.

For Municipal Government (Chapter 3):

- Hire an Energy Director to develop, implement and monitor a comprehensive, Town government energy plan (Section 3.1.2).
- Hire an Energy Education Coordinator, to develop a comprehensive, Town-wide energy education and outreach program (Sections 3.1.2. and 3.2.).
- Form an Energy Team, composed of (at a minimum) the Town Manager, the heads of every Town department, the Energy Director, and the Energy Education Coordinator. (Section 3.1.2).
- Increase the proportion of renewable energy in IMLD's Electricity Portfolio (Section 3.2.2.).
- Reduce municipal government's GHG emissions by at least 3% per year on an ongoing basis.

For Residents (Chapter 4):

- Have a home audit conducted, assess your current energy use (Section 4.2.1), and where the audit reveals inadequate sealing and insulation, improve your building envelope (Section 4.2.2).
- Reduce your transportation related emissions by driving less; use public transportation, walk, bike, or carpool; and when possible, replace older vehicles with more fuel efficient models (Section 4.1.3 and 4.2.8).
- Develop short term, medium term, and long term action plans to reduce your energy use.
- Conserve energy, use energy efficiently, and support renewable energy.

For Businesses (Chapter 5):

- Contact the Ipswich Municipal Light Department (IMLD) for a free energy audit, assess current and projected future energy needs, and evaluate the (ROI) of potential energy upgrade investments recommended by the audits incorporating IMLD rebates and state and Federal incentives.

- Develop short-, medium- and long-term energy plans based on the results of the energy audit and assessment of future energy needs and use.
- Contact IMLD with suggestions on how to improve, and increase participation in, its new rebate programs.
- Consider how the costs and benefits of HVAC equipment and building envelope upgrades can be shared among both owners and tenants.

Ipswich can meet its 2020 target if the entire Ipswich community – municipal employees and volunteers, residents and businesses – all do their share. Following the GHG reduction strategies in the Plan will yield notable benefits. Not only will Ipswich's carbon footprint shrink and the health and environmental quality of life in Town improve, but reducing energy use means reducing energy costs, and municipal government, residents and businesses will all share in these savings.

1. Introduction

This Plan for Ipswich, MA was prepared by the Commission on Energy Use and Climate Protection (Commission) – a group of town officials and citizens convened by the Board of Selectmen in October 2006. At that time, the Board of Selectmen resolved to follow the Cities for Climate Protection (CCP) program of the International Council for Local Environmental Initiatives (ICLEI).[2] This Plan completes the third milestone of the CCP process, and its purpose is to guide Ipswich toward a future in which greenhouse gas (GHG) emissions are reduced to levels that are believed to be sustainable.

The CCP process specifies a sequence of five milestones, as shown in Figure 2.1. The first milestone was reached in December, 2009 with the completion of the Commission's Energy Use and Greenhouse Gas Inventory Report for Ipswich. The second milestone was achieved in April, 2010 when the Board of Selectmen unanimously adopted the Massachusetts Climate Protection Plan, which calls for reducing GHG emissions to 10% below 1990 levels by 2020.[3] The 2020 GHG reduction target is a critical first step toward lowering GHG emissions to the levels scientists believe will be necessary to limit the most catastrophic effects of climate change.[4]

Cities for Climate Protection (CCP) Process	**Ipswich Completion Date**
Milestone 1 – Conduct a carbon emissions inventory	December 2009
Milestone 2 – Adopt an emissions reduction target for the forecast year	April 2010
Milestone 3 – Develop a local Climate Action Plan (the Plan)	May 2011
Milestone 4 – Implement the Plan policies and measures	
Milestone 5 – Monitor and verify results	

Table 1.2 Cities for Climate Protection (CCP) Process and Ipswich Completion Dates

The Plan contains a set of wide-ranging GHG reduction strategy recommendations that fall under three main themes: (1) increasing energy efficiency, (2) promoting energy conservation, and (3) switching to renewable energy sources. It addresses the Municipal, Residential and Commercial/Industrial (C/I) sectors separately with specific sets of recommendations.

Education and outreach will play key roles in ensuring that the strategies contained in the Plan are sufficiently adopted to meet the GHG reduction goal. While many individuals, businesses and community organizations can help educate other people and groups in Town, the Municipal Sector can most effectively lead the way. Accordingly, the Plan's education and outreach-related recommendations focus on the Municipal Sector.

[2] See Appendix 1 for the list of 2010 CEUCP members and the text of the Selectmen's resolutions.

[3] 2008 Massachusetts Global Warming Solutions Act (http://www.mass.gov/dep/air/climate/gwsa.htm)

[4] Joint Statement of the G8 and National Academies of Science (2009)

In addition, the Plan includes examples of initiatives that have been successfully implemented in other communities – and by their municipal governments in particular –to help illustrate how Ipswich could strengthen its existing climate protection initiatives by adopting and adapting such programs to the needs and circumstances of this community.

The Commission wrote this plan with the hope that everyone – each individual in Town – will embrace a new culture of energy awareness in which the tenets of smart energy use will be broadly practiced in homes, in transportation choices, at work, and by local government. A major cultural shift in attitudes and practices around energy use and GHG emissions is imperative in order to minimize the potentially catastrophic consequences of significant climate change.

Coastal communities like ours are particularly vulnerable to ocean inundation, flooding, and beach erosion. More broadly, the impact of rapid climate change threatens public infrastructure, private property, natural resources and ecosystems, and personal and municipal finances. GHG emissions arising from human activity and energy use have also been directly linked to unprecedented changes in seasonal temperatures that influence agriculture, water supplies, energy demand, and the healthy function of natural ecosystems. Many manifestations of climate change are already being observed throughout the world. In the absence of mitigation measures, we may experience devastating climate change effects on society in the future.[5]

However, by implementing the Plan – whether as individuals determined to make simple lifestyle changes, as large companies with significant resources to invest, or at some level in between – we can be a part of the larger solution to avert some of the harm to our citizens and neighborhoods from climate change. With broad participation, we can bring about environmental, economic and social benefits that will make Ipswich an even more livable, vibrant and sustainable community.

There is much work to do in order to achieve this vision. As a Town, our task is to reduce emissions from an estimated 116,800 metric tons (mt) in 2010[6] to roughly 82,500 mt by 2020. To achieve the requisite elimination of more than 35,000 mt of carbon emissions, widespread adoption of reduction measures will be needed. Figure 1.1 illustrates the difference between "business as usual" – continuing on our present course without reduction measures – and the goal of reducing emissions to 10% below 1990 levels by 2020.

[5] The 2009 Ipswich Energy Use and GHG Inventory contains additional information and references on climate change.
(http://www.town.ipswich.ma.us/documents/Pdf/2009%20GHG%20Inventory%20Report%20%20Appendix.pdf)

[6] See Appendix 2 for the Key Findings of the 2009 Energy Use and GHG Inventory for Ipswich.

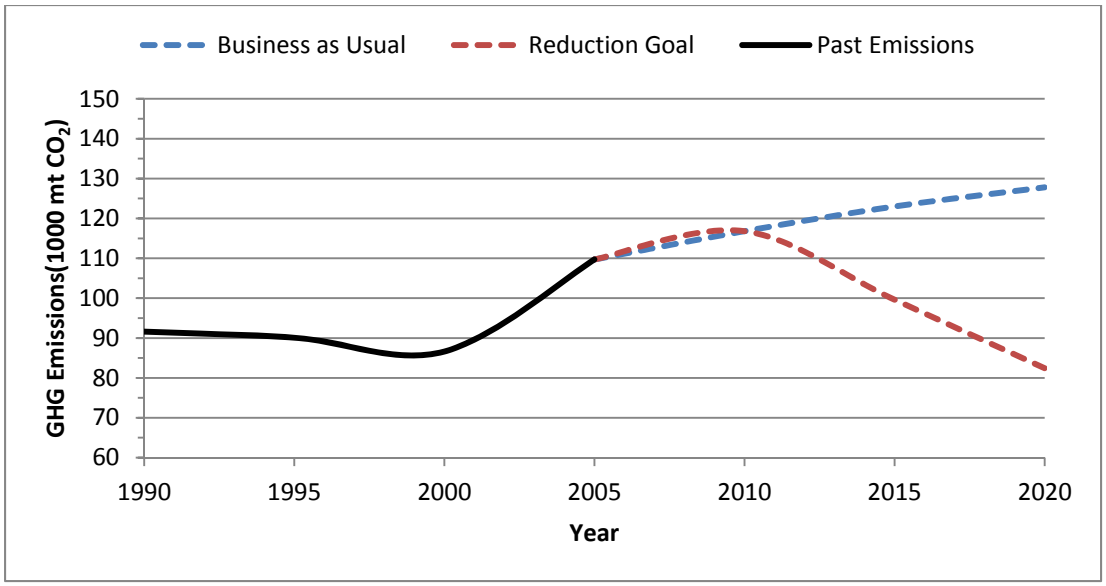

Figure 1.1 Historical and Projected GHG Emissions and the 2020 Reduction Goal for Ipswich

Although this goal is aggressive, it becomes both realistic and eminently achievable when viewed as a series of successive small steps – reducing GHG emissions by about 3 percent per year would allow the reduction target goal to be met. This same objective has been adopted by thousands of governments, businesses and communities across the globe and many are making gradual, but noteworthy, progress. Ipswich can and must be part of this worldwide mission.

"Think Globally, Act Locally" is a fitting slogan for the effort needed to address climate change – the problem far outreaches the capacity of any single community, nation or region to solve on its own, but the solution critically depends on individuals with a singular focus and a common goal. The net result of billions of decisions by people, businesses, and governments across the world will determine whether or not GHG emissions can be curbed sufficiently to avoid the most serious effects of climate change.

In Ipswich, as in most communities, the critical first step is to change the local culture of energy use. We hope that this Plan can become a source of inspiration and motivation as well as a resource and starting point for the community. Figure 1.2 illustrates the relationships of the members of the Ipswich community – its residents, businesses and municipal government – with energy education, efficiency, conservation and renewable energy. The figure highlights the central role of education and outreach, as led by municipal government, in the Town's adoption of energy efficiency, conservation and renewable energy.

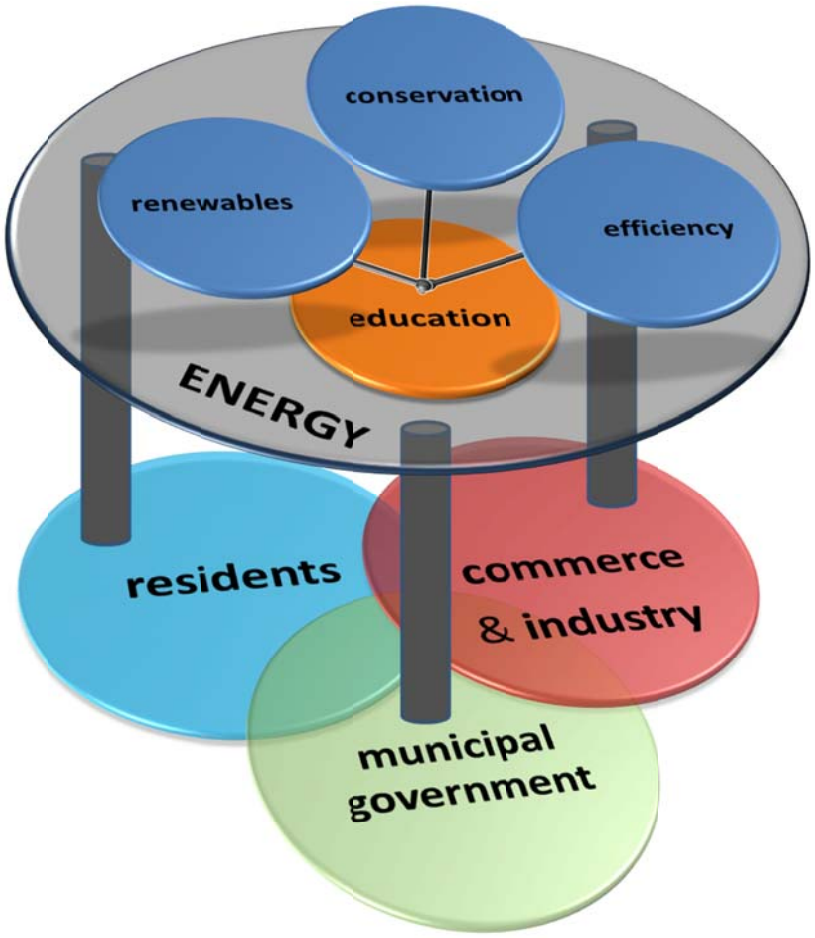

Figure 1.2 An illustration of the relationships between the Town, education, and energy use

1.1. How to Use This Document

The Plan was created specifically for Ipswich, and is intended to be a reference for all members of the Ipswich community, with individual sections addressed to town leaders, municipal boards and committees, the Ipswich Municipal Light Department, the School Department, residents, and business owners.

The Plan is comprehensive in that is not necessarily intended to be read from cover to cover. Instead, the Table of Contents and Index direct readers to the chapters and subjects that are most pertinent to them. At the beginning of each chapter, a "Call to Action" helps prioritize concrete steps that can make the biggest impact in reducing GHG emissions. The "Call to Action" contains recommendations, highlighted from each chapter's subsections, considered to be the most important and effective set of recommendations necessary to meet the Town's GHG reduction target. The recommendations found in each subsection are not intended to be comprehensive. Instead, they are a starting point for the Town to develop a coherent set of policies, initiatives, and actions consistent with the GHG reduction goal.

New or revised recommendations will likely be appropriate as the Town advances its GHG reduction efforts. In addition, many subsections contain "Success Stories" that highlights some GHG reduction efforts accomplished by the municipal government, residents, and businesses in Ipswich and elsewhere. These are meant to serve as proof that GHG reduction efforts are achievable and effective.

2. Implications of Costs and Savings in GHG Emission Reductions

Energy conservation, efficiency and renewable energy strategies for reducing GHG emissions each have different costs, payoff times, and emission effects. Most experts agree that a combination of conservation, efficiency and renewable energy is the best means of achieving long-term GHG reductions.

Conservation strategies reduce energy use through changes in behavior, for example, turning off the lights, setting back the thermostat, or carpooling. Since little or no financial investment is required, conservation strategies save money immediately and directly. Practicing good energy conservation saves money and reduces emissions, but requires personal effort, diligence and some degree of sacrifice.

Efficiency strategies use technologies and materials that deliver the same level of benefit using less energy than other technologies and materials that deliver a similar benefit. Energy efficient technologies reduce energy use without requiring any action or conscious effort on the part of the user. Examples are CFL light bulbs, Energy Star-rated appliances, and vehicles with high miles-per-gallon. The benefits of efficiency are lower operational costs and reduced emissions. Energy efficiency offers larger societal benefits as well. It enhances the economy by creating local jobs and promotes national security by increasing the energy independence of the United States. The costs of efficiency can include higher purchase prices relative to less efficient alternatives, although maturing technologies and financial incentives can lower initial costs to consumers.

Renewable Energy strategies use natural resources such as wind, sunlight, and geothermal heat to generate usable energy. Advantages include zero carbon emissions, reduced air pollution, independence from the fluctuations in fossil fuel costs, and if the energy generation is local, reduced transmission costs. Most economic analyses indicate that renewable energy projects create jobs, domestically (manufacturing facilities) as well as locally (installation and maintenance of the systems). The disadvantages are generally higher costs and longer payback periods compared to energy efficient technologies.

As a coastal community, Ipswich has always had its share of adverse weather conditions, but we will not be able to ignore the higher temperatures, increases in frequency and severity of storms, droughts, and shoreline erosion, nor the hardships (flooding, power outages, travel accidents, etc.) and additional expenses for Ipswich residents, businesses and municipal governments that will accompany these

effects of climate change. Nor will we be immune from the effects of regional food supply disruptions, including crop yield decreases from heat intolerance, droughts, flooding and pests, and the reduction in or collapse of fish stocks. Finally, climate change is expected to increase healthcare costs, through the increased spread of tropical diseases such as malaria and West Nile Disease, and heat-related illnesses.

If we choose to do nothing to try and reduce emissions to sustainable levels, we will be forced to adapt to climate change, by coping with its consequences, and reducing our vulnerability to its effects as best we can. Adaptation requires actively reacting to changes in the environment through a series of incremental, short-term defensive adjustments – and paying the associated financial and quality of life costs, which may be quite high. For Ipswich, this may mean abandoning flood-prone roads and areas, changing zoning rules for where houses can be built, and growing different kinds of crops. The fact that many of the effects of climate change are already upon us, and could remain for many generations, means that a degree of adaptation will be necessary regardless of if, and when, GHG emission levels are reduced around the world.

If, on the other hand, we can take a broader, long-term view of the problem, we can change our energy habits in ways that reduce GHG emissions, and mitigate or even prevent many of the most devastating effects of climate change. This will require significant reductions in emissions worldwide. We can achieve these reductions through conservation, efficiency, and renewable energy – the three primary strategies outlined in the Plan for Ipswich. Mitigation efforts like these require more up-front investments than reactive, adaptive responses to climate change, but mitigation increases the likelihood of avoiding many of the financial and social costs of climate change and adaptation. While there is a price tag associated with implementing this Plan, these costs will be offset by the long-term advantages to our economy and our way of life, and by our ability to inspire other communities to adopt similar strategies.

Example: Costs and Benefits of Implementing the "Stretch" Building Code
In communities that have adopted the "stretch" (energy code) appendix to the Massachusetts building code, construction costs for a typical single family home are about $3,000 greater than in other communities. However, homeowners in "stretch" code towns will save money on heating and electricity as a result of meeting the higher performance standards. Case studies show that a residential home built to stretch code regulations and purchased with a 30-year mortgage will realize a net savings – the relatively lower utility bills more than offset the increase in mortgage payments. In addition, a variety of financial incentives are available from the government and utility companies that further reduce the upfront costs of high performance buildings.

3. Municipal Sector Plan

The municipal government was directly responsible for only 4% of Ipswich's carbon footprint in 2005, yet its role in reducing town-wide emissions is a pivotal one. The extent to which the municipal government ***leads*** the effort, ***educates*** the public, and ***facilitates*** the necessary changes will influence

whether the goal is achieved by 2020. Broad implementation of the Plan in the municipal sector will set a standard for residents and businesses to follow.

Leadership
Town government is already well-established as a leader in efforts to reduce emissions. Recent Town initiatives include municipal facility energy audits, solid waste disposal limits, hybrid vehicle purchases, the Town Hall roof solar array and the Town Farm Road wind turbine. Up until now, however, these projects have taken place on an opportunistic basis. Going forward, systematic involvement from all parts of Town government – on a daily basis – will be required in order to meet the Town's emissions reduction target.

Education
Although some of the Town's energy initiatives have received a degree of publicity, more can be done to raise public awareness. Better communication by Town government about its efforts will help residents and businesses to better understand the environmental and economic benefits of reducing emissions, and as a result they will be more likely to both rally around Town government's efforts as well as follow up with energy initiatives of their own. Climate and energy education is vital to the success of the Plan in reducing GHG emissions. The Town, in conjunction with Federal, State, private, and non-profit organizations, should develop a climate change and energy education program that includes education components targeted internally to municipal departments as well as outreach to businesses and residents.

Facilitation
Various Town government departments have already begun to use their statutory, policymaking and planning authority to encourage energy conservation, efficiency, and renewable energy. For example, the Board of Selectmen joined the CCP, created the Commission, and set an emissions reduction target. The Ipswich Municipal Light Department (IMLD) and Electric Light Commissioners implemented useful demand management programs for utility customers. The Planning Board amended the Community Development Plan in consideration of the Ipswich Carbon Inventory Report. The Plan will help to open up even more opportunities for Town government to facilitate reductions in GHG emissions.

Despite these and other efforts, Town government's energy initiatives fall short of a systematic, coordinated effort around energy use and GHG emissions. All Town departments and committees should raise the priority level of energy-related matters by making efficiency and conservation a routine part of usual operations. Since energy use permeates the jurisdiction of every Town department and board, the Town should seek to make energy-related objectives a regular part of every Town employee and volunteer's ongoing work. This will help create a culture of saving energy within Town government.

Together, the many recommendations outlined in the Plan represent a systematic approach to using energy wisely and reducing GHG emissions. This is a significant change from past practice and will require persistent political will to carry out. To begin this transformation, the Plan includes specific recommendations for many Town departments and committees. These recommendations provide a

starting point; the nuts-and-bolts details of implementing specific recommendations is best left to Town employees and volunteers in the corresponding departments and committees.

Call to Action

The top priorities for the Ipswich municipal government are:

- Hire an Energy Director to develop, implement and monitor a Town government-wide energy plan. This position may be ultimately be funded by the energy savings and grant revenues created by this position (See Section 3.1.2).
- Increase the proportion of renewable energy in IMLD's Electricity Portfolio (See Section 3.2.2).
- Hire an Energy Education Coordinator, jointly funded by the Town and IMLD, to develop a comprehensive energy education and outreach program for Ipswich, with participation by the municipal departments, IMLD, and the Schools; and to promote IMLD programs (See Section 3.1.2 and 3.2).
- Form an Energy Team, composed of (at a minimum) the Town Manager, the heads of every Town department, the Energy Director, and the Energy Education Coordinator (Section 3.1.2).
- Reduce municipal government GHG emissions at least 3% per year on an ongoing basis.

3.1. Town Leadership

3.1.1. Recommendations for Boards, Commissions, and Committees

Town boards, commissions and committees will be crucial in driving the implementation of the Plan. Our local government processes are largely "bottom up" in nature; proposals are introduced at and voted on by the relevant board, commission or committee; proposals so approved are then presented to the Town Manager, Board of Selectmen, and/or voters. Since most Town regulations and bylaws originate from employees and volunteers serving the Town, these people will be instrumental in developing conservation-, efficiency-, and renewable energy- friendly policies and regulations. Therefore, it is essential that Town board, committee, and commission members commit to reducing Ipswich's carbon footprint. All such bodies should include, to the extent practicable, climate change and GHG emissions considerations as part of their bylaws and mandates.

Planning Board and Zoning Board

The regulations, bylaws, policies, plans and procedures that govern development in Ipswich have evolved over many years. Most were not written with greenhouse gasses explicitly in mind; as a result, some may unintentionally and unnecessarily contravene efforts to reduce emissions. Unintentional or unnecessary obstacles to energy conservation and renewable energy should be identified, and the pertinent statutes updated to remove these obstructions. For example, land use regulations, which currently only consider direct environmental impacts, should be updated to incorporate GHG emissions-related considerations. This could make energy conservation and renewable energy projects easier to be developed. The Planning and Zoning boards should develop the language to update such regulations, and then present the updated articles for a vote at Town Meeting.

This process has already begun. For example, the Town Planner and Building Inspector recently recognized ambiguities in the zoning bylaws that made it unclear whether or not renewable or alternative energy facilities were allowed in Ipswich. They proposed an update to the statute that would explicitly allow such facilities. The update was presented to and approved by voters at the Fall 2010 Town meeting under the "Miscellaneous Zoning Changes" warrant item. There are likely to be other such instances of ambiguities, inconsistencies, or omissions that warrant similar updates.

Additionally, although Ipswich has a wealth of open space and trails, coherent plans for walking and biking as alternatives to driving are in need of serious attention. The Planning and Zoning Boards should help ensure that Ipswich offers reasonable alternatives to driving, particularly around all of the schools and business districts.

Recommendations:

- For existing Town regulations, bylaws, plans and procedures
    - Audit to assess alignment with emissions reduction efforts. Identify potential statutory obstructions to energy conservation, efficiency, and renewable energy projects. Update and remove identified obstructions and include language that, as long as such changes are not inconsistent with existing regulations, bylaws, plans, and procedures, encourages energy conservation, efficiency, and renewable energy.
- Consider ways to make walking and bicycling to schools and shops feasible and safe alternatives to driving in Ipswich.

Success Story: Energy-Focused Land Audit in Temple, NH

In 2008, Temple, NH conducted an energy-focused land use audit to identify energy-related inconsistencies between the town's Master Plan and the Zoning Ordinances. In the words of the auditor, "The intent is to find ways to foster development patterns that use land in Temple efficiently, while protecting both local and global natural resources, and which reduce residents' reliance on energy from fossil fuels." The audit turned up numerous inconsistencies which the town went on to address.

Design Review Board

The Design Review Board sets standards for landscaping, pavement, rooftops, signs, and other features that influence the appearance of our neighborhoods, create a strong sense of place in Ipswich, and preserve our community's heritage. These standards have traditionally been concerned mainly with aesthetics. The Commission believes that the standard practices of the Design Review Board should reach beyond protecting unique, visual qualities by incorporating principles of energy conservation and sustainability without compromising aesthetics. For example, outdoor lighting should not only be in keeping with the character of the Town and promote safety, it should also incorporate energy efficient technologies and be turned off when it is not needed. Landscaping should not only preserve natural features and include vegetation plantings, it should also utilize drought-resistant, low-maintenance native species that require minimal energy and other resources compared to non-native species.

Pavement should not only be balanced with green space, when feasible it should be porous to facilitate the replenishment of ground water.

Recommendation:

- Incorporate principles of energy conservation and sustainability into Town design standards.

Success Story: Madison, WI Design Committee

In Madison, Wisconsin, in order to balance the competing goals of planting shade trees with preserving solar access, so that in the future, solar energy arrays could be installed on buildings throughout the district, the Design Committee helped to establish the following ordinance: "The installation of shade trees shall take into account solar access objectives in the selection of tree species and planting location so as to minimize future shading of the most southerly side of contemplated building locations."

Open Space Committee

Ipswich's natural landscapes are critical to the strong sense of place enjoyed by this community, and preserving these properties has been a top priority of the Town for a long time. The 2001 voter-approved $10 million land preservation bond funded the Open Space Committee's mission to preserve important properties in Ipswich. Since then, in cooperation with other land preservation groups, the Open Space Committee has acquired thousands of acres for public access, and has protected many more. The preservation of so many key parcels is an extraordinary accomplishment that will have ongoing social and environmental benefits, and will help ensure that Ipswich retains its unique character long into the future.

Although the Open Space Committee's indirect role in limiting GHG emissions in Ipswich is only rarely recognized, it is a critical aspect of its work because of the additional emissions that would otherwise inevitably result from development of the areas it has protected. The Committee could help raise public awareness and understanding of environmental and GHG issues by explicitly considering carbon impacts in making its preservation decisions, and by publicizing its successes in limiting emissions. In addition, land preservation can provide climate change adaptation benefits. For example, preserving coastal land can provide a buffer against the effects of sea level rise and increased storm frequency and intensity, as well as protect sensitive natural communities, such as salt marshes, that may be disproportionally threatened by climate change.

Finally, while these lands are protected from ordinary development, some sites may be appropriate for renewable energy installations without compromising either the value of the protected site or the Committee's overall mission. Current regulations can make renewable energy project installations difficult, if not impossible. By updating the regulations to allow renewable energy installations under certain circumstances, and by identifying potentially appropriate sites for such projects ahead of time, the Town will be prepared to discuss and move forward with vital renewable energy proposals as they arise.

Recommendations:

- Consider carbon impacts explicitly in land preservation criteria.
- Promote Committee success in limiting Town GHG emissions.
- Consider the benefits of land preservation in buffering climate change impacts and preserving sensitive natural communities threatened by climate change.
- Broaden land use regulations and land acquisition terms to include renewable energy allowances. Wind turbines and solar panels should be permitted on portions of the land where energy generation is feasible, and these parcels (or the applicable portion of them) should be placed under control of general Town government.
- Survey, map and approve land, as appropriate, for renewable energy installations.

Success Story: GreenSpace Alliance Brookline, MA

The GreenSpace Alliance is a nonprofit organization dedicated to the enhancement of open space in Brookline, MA. Their Spring 2010 newsletter included a feature story entitled "How Open Space Mitigates Climate Change." This lengthy article, written by a LEED-certified architect, concludes with these words, "Not only do our parks enhance our quality of life, they provide an important buffer to the negative impacts of climate change. So as part of making efforts to reduce our collective carbon footprint, let's renew our commitment to protect our parks and open spaces." Another article in the newsletter recaps the Alliance's land preservation over the past five years.

Conservation Commission

The Conservation Commission plays a key role in upholding state and local wetlands regulations. It has traditionally focused on the immediate local environmental impacts of development on wetland areas. Because of the threat posed to fragile wetlands by climate change, through species endangerment, sea level rise, and variable temperature and precipitation patterns, the Conservation Commission should incorporate, to the extent practicable, climate change considerations into its decision-making and permitting processes.

In the future, the Conservation Commission may review proposals for renewable energy construction projects within close proximity to regulated water bodies, such as salt marshes, streams, ponds or rivers. Such projects should adhere to local, state, and federal environmental regulations. Yet, because renewable energy projects are not typical commercial or industrial facilities that cause air pollution and water discharges, consideration should be given to the benign nature of most renewable energy technologies. For example, solar photovoltaic arrays emit neither air-nor water-borne pollutants, and require little maintenance that would lead to an increase in road traffic at the site. Similarly, wind turbines produce no emissions and require only infrequent maintenance. Although some wind generation installations have been shown to cause bird and bat mortality or disturbance, proper siting can eliminate or greatly reduce such impacts.[7] It is possible that the Conservation Commission could

[7] Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. 2001. National Wind Coordinating Collaborative.

develop standard guidance for the necessary environmental assessments and proper siting criteria that would improve both decision-making and the overall permitting processes. By setting such standards ahead of time, the Conservation Commission could proactively address the problem of climate change without compromising its central mission of protecting wetlands.

Recommendations:

- Assess decision-making and permitting processes to remove unintended barriers to renewable energy projects, without compromising regulatory safeguarding of wetlands.
- Consider the development of standards and guidance related to renewable energy installation projects that would facilitate the environmental review and permitting process without compromising regulatory safeguarding of wetlands.

Finance Committee

Although the Finance Committee generally makes financial and budgetary decisions based on estimates of dollar revenues and expenses, nearly every such decision also has a carbon impact that can be measured in terms of GHG emissions. Monetary issues will continue to be the Finance Committee's priority, however, the Town's commitment to reducing GHG emissions means that the Committee should incorporate carbon impact into its financial and budgetary decision-making process.

The Finance Committee could use the annual budget process to query Town Departments about their energy-related expenses, and set budgetary expectations for year-over-year reductions in fossil fuel-based energy use. Saving energy translates to saving money, although for many energy investments, a multi-year timeframe is needed to pay off initial investments and realize savings.

The Committee will need to decide how to handle the cost savings that result from such investments in energy efficiency and conservation. Ideally, decisions will be made in ways that incentivize the efforts of individual departments to save energy and reduce emissions. Departments that demonstrate energy cost savings should be allowed to keep the unspent funds (perhaps to be re-invested in other energy-saving initiatives) rather than simply receiving less funding in the next budget cycle. Doing so will help to propagate an energy saving culture within Town government, and provide much-needed momentum for the Town's GHG emissions reduction efforts.

The Financial Committee should also explore and consider the possibility of grant revenues. For example, the Commonwealth of Massachusetts has allocated millions of dollars for municipal energy upgrade projects through the Green Communities program for Massachusetts cities and towns. Partial state funding for Ipswich's energy efficiency initiatives would save the Town tax dollars. The Finance Committee should evaluate and then continue to monitor the Town's progress and standing compared to neighboring communities on municipal energy-related issues, as these factors affect Ipswich's eligibility for funding under energy efficiency initiatives, such as the Green Communities program.

Finally, to reach its GHG reduction target, the Town will need to invest funds in energy efficiency and renewable energy (with reasonable payback periods). The Finance Committee should evaluate and make decisions on such projects in the context of the Town's emissions target, and incorporate long-term energy cost savings into its cost-benefit analyses and budgetary decision making.

Recommendations:

- Incorporate GHG emission impacts into financial and budgetary decision-making.
- Evaluate energy efficiency and renewable energy proposals in the context of the Town's commitment to reducing GHG emissions while incorporating long-term energy savings into cost-benefit analyses and budgetary decision-making.
- Review and evaluate the Town's eligibility for energy efficiency and renewable energy grant opportunities, such as those offered through the Green Communities program.
- Create incentives to align Town departments' interests with the goal of reducing GHG emissions, such as by allowing departments to keep energy savings to invest in additional energy projects.

Electric Light Subcommittee

As the initial reviewer of proposals to manage consumer demand, investments in energy efficiency, "greening" the power portfolio, etc., the Electric Light Subcommittee will continue to be instrumental in bringing electricity-related emission reduction ideas forward. Strategies such as the Demand Management Program, Ipswich Wind Turbine, and Town Hall Solar Panels all originated in the Electric Light Subcommittee. The Subcommittee can become an even stronger champion of GHG emissions reduction by taking an even more proactive stance in germinating and advocating for new ideas that will help curb fossil fuel reliance.

Recommendations:

- Proactively solicit, initiate and advocate for innovative conservation, efficiency and renewable energy proposals.
- Review Section 3.1.3 for a list of specific strategies that should be considered for implementation by IMLD.

Recycling Committee

By diverting materials from the waste stream, recycling reduces the need for solid waste incineration, a principal cause of GHG emissions. Over the past several years, the Ipswich Recycling Committee, in conjunction with the Department of Public Works, has achieved commendable results by tightening waste disposal limits and increasing the frequency of recycling pickups. These efforts have saved the Town hundreds of thousands of dollars in tipping fees. As the Recycling Committee implements its ongoing plans to increase recycling rates, raises awareness of the benefits of recycling, and introduces a system for town-wide composting of food wastes, it will continue to be a key contributor to reducing GHG emissions in Ipswich.

At the time of this writing, certain types of recyclable materials (e.g., plastic bags) are at not collected through Town recycling. The Commission recommends the Recycling Committee consider expanding the range of recyclable materials the Town accepts for pickup. If it could be done economically, this would increase recycling rates and lower emissions. The Commission also recommends expanding efforts to increase recycling rates in all schools, public buildings, public events, and downtown locations.

Although in most cases, the carbon impact of recycling is considerably less than the carbon impact of either producing new materials or incinerating solid waste; the carbon impact of recycling is not zero. The Commission recommends that in conjunction with its efforts to increase recycling rates and reduce the volume of waste materials that are incinerated, the Recycling Committee should consider ways to encourage reducing the amount of recyclable materials produced in the first place, for example through the use of less packaging or biodegradable rather than recyclable packaging. These education and outreach efforts would further reduce Town GHG emissions.

Recommendations:

- Continue with ongoing plans to increase recycling rates and awareness by strengthening education and outreach efforts.
- Introduce town-wide composting of food wastes.
- Consider ways to reduce the volume of recycled materials by encouraging the use of less packaging in products, and use of biodegradable rather than recyclable packaging.
- Consider economic ways to expand Town recycling to include additional recyclable materials.
- Increase recycling rates in Ipswich schools and public buildings.
- Require recycling at public events in town.
- Add recycling bins to the downtown area.

Success Story: Hamilton, MA Curbside Composting Program

Hamilton, MA implemented a highly successful curbside composting program in 2009, and expanded service to Wenham, MA in 2010. Participants pay $75 for a year's worth of compost pickup and $29 for a household bucket and curbside barrel. Food scraps and yard waste are delivered to Brick End Farms in Hamilton, where they are turned into compost. About 550 families currently participate in this program, which collects approximately 17 lbs. of organic waste per household every week – waste that would otherwise be part of the garbage stream.

3.1.2. Recommendations for the Town Manager and Department Heads

The Town Manager and Town Departments are entrusted with public funds and are expected to be good stewards of the Town's financial resources. By using less energy, Town Departments can save the Town money, reinforce the trust of the public in their stewardship of tax revenues, set an example of smart energy use, and actively reduce the Town's carbon footprint.

To meet Ipswich's GHG emissions goals, the Town Manager and Town Departments must move toward a systematic approach to conservation, efficiency, and renewable energy generation. The Town Manager and Department Heads can get a head-start on this transformation by considering the carbon impact of every decision they make, and giving preference to options that will reduce Town GHG emissions when practical.

Town Manager

The current Town Manager is a strong advocate for energy efficiency and renewable energy; he has been instrumental in many town initiatives, including the purchase of hybrid vehicles, installation of solar panels, energy audits of Town facilities, and ongoing pursuit of the Green Communities designation. Because so many departments report directly to the Town Manager, he is in a unique position to strengthen the culture of smart energy use across all municipal functions.

As a next step, to ensure broad and coordination and participation in efforts to reduce GHG emissions, the Town needs to develop an energy plan for all Town government departments and functions. This plan should identify emissions reduction efforts to be pursued; set annual goals; track, monitor, and evaluate ongoing energy initiatives and programs; assign responsibility and oversight within and across departments; engage every Town employee in conservation and efficiency efforts; and include education and outreach programs to increase awareness and understanding among Town employees and volunteers. The plan should feature the explicit goal of reducing GHG emissions by at least 3 percent per year over the next ten years, and should define a clear path to achieving Green Community status. Note: At the time of this writing, 35 Massachusetts cities and towns have achieved this designation. The Town should also consider implementing a Sustainability Pledge drive for employees to help focus attention on conservation and efficiency efforts. The Commission believes that such a plan can be fully effective if the Town of Ipswich hires an Energy Director and an Energy Education Coordinator, and forms an Energy Team.

The Energy Director would be charged with the creation, implementation and monitoring of the government energy plan, and ideally would be a certified energy manager. Although this would be a new hire, the impact on the Town budget would be offset by energy cost savings and new revenue sources such as grants. Continuation of funding for this position over time should be conditional on it paying for itself. Initially, at least 20 hours per week should be dedicated for this function, but it can be expanded to fulltime contingent on creating sufficient energy savings and funding sources.

The Energy Education Coordinator would be responsible for developing and executing education and outreach efforts in support of the Town government energy plan, and would need extensive knowledge of energy-related and environmental issues, and education and training experience. Note that these are very different skills than those described above for the Energy Director. The Energy Education Coordinator would also help generate energy cost savings through his or her efforts to promote efficiency and conservation promotion. The Commission believes that this position could be jointly funded by the Town and IMLD, as the individual could split his or her time between supporting the

Town-wide energy plan, and acting in support of IMLD programs such as the demand management, rebate and audit programs.

Coordination and implementation of the Town government energy plan would be the responsibility of the Energy Team, at a minimum composed of the Town Manager, the heads of every Town department, and the Energy Director and Energy Education Coordinator. A number of other towns, including neighboring Boxford, MA, have created effective town Energy Teams (see the Success Story: Boxford, MA Energy Team below).

Recommendations:

- Develop a Town-wide energy plan that includes the appointment of a qualified Energy Director and Energy Team (including an Energy Education Coordinator) with the authority to set energy use benchmarks, monitor performance, and educate Town employees and the general public.
- Initiate a workplace Sustainability Pledge for Town employees. Sustainability pledges are checklist tools that engage a group of people in changing their behaviors (see Harvard University's Sustainability Pledge as a good example).
- Ensure that municipal sector GHG emissions are reduced by at least 3 percent per year in the municipal sector.
- Attain Green Community status for Ipswich (at this writing, at least 35 Massachusetts cities and towns already have this designation).

Success Story: Boxford, MA Energy Team

The town of Boxford, MA formed an Energy Team to address town officials' concerns over energy costs and carbon emissions. The Energy Team is comprised of department heads from town hall, the fire and police departments, the library, and school system. The team takes a performance-based approach to managing energy use, as measured against the clear objectives described in each department's annual plan. As a team, they have implemented town-wide "no idling" rules to save fuel costs and extend equipment life, improved fleet maintenance, switched to cleaner or more efficient fuels where possible, audited municipal buildings, set heating and cooling set-point standards, and, in partnership with National Grid, have installed gas retrofits to replace oil heat. By coordinating efforts across departments and measuring results, the Energy Team signals to constituents and taxpayers that Boxford is being as careful and efficient as possible with taxpayer dollars for the sake of fiscal budgets and the climate.

Facilities Department

The Facilities Department can play an important role both in meeting the Town's GHG emissions targets, and in monitoring the Town's performance in reducing emissions. As of this writing, the Department has conducted energy audits of a number of Town buildings, and made important efficiency improvements, such as replacing windows at Town Hall. By continuing the audit process for all Town buildings, identifying potential efficiency upgrades and retrofits, prioritizing such projects based on carbon impact, dollar costs and payback periods, and carrying out improvements as time and resources permit, the Department can continue to reduce Town emissions.

The Facilities Department will play a critical, ongoing role in monitoring the implementation of the Plan by tracking municipal facility energy usage. It is important for the Department to track consumption by each facility in units of energy (kilowatt-hours, gallons, etc.) as well as dollar cost so that changes in consumption can be measured over time, independent of energy price fluctuations. Collection of these data will also allow the measurement of municipal facility GHG emissions. Goals should be set to decrease municipal facility emissions over time, through some combination of conservation, increased efficiency and renewable energy usage.

Recommendations:

- Continue municipal facility energy audits, identify potential efficiency upgrades and retrofits, and prioritize implementation based on carbon impact, dollar costs, and payback periods to get the most "bang for the buck."
- Track Town facility energy usage by facility, unit of energy and dollar cost.
- Benchmark Town facility GHG emissions and set goals to decrease emissions over time.

Purchasing Department

The Purchasing Department has a significant influence on Ipswich's municipal carbon footprint, through the products and vendors it selects to meet Town needs. The Purchasing Department can make significant reductions in Town emissions by considering carbon impacts in its product and vendor selection process. In order to do this effectively, the Purchasing Department should limit its purchases to Environmentally Preferred Products (EPP), such as those that conserve energy and/or water, contain recycled materials, or minimize waste – all qualities that also help prevent carbon emissions. The same specifications can also be incorporated into the RFP requirements used in soliciting contract bids.

Preference should be given for products bearing efficiency or sustainability certifications such as Energy Star (www.energystar.gov), WaterSense (www.epa.gov/WaterSense), or Sustainable Forestry Initiative (www.sfiprogram.org). Even when such products are more expensive than the less efficient alternative, the lifetime cost of ownership may be lower for the more efficient product as a result of lower operational costs realized through energy savings. Compared to inefficient alternatives, energy-saving products help save money and reduce emissions each time they are used. For this reason, the lifetime cost of ownership should be considered when comparing product or service offerings.

Another factor that can have a significant impact on carbon footprint is the origin of products and services. For example, all else equal, local products and services are over ones that must be transported great distances, because transportation-related emissions are a principal cause of GHG emissions.

Recommendations:

- Purchase EPP, whenever possible.
- Adopt carbon emissions-related criteria for evaluating competing products and services and specify these in the Town's RFPs.

- Compare the lifetime costs when evaluating competing products and services using, to account for operational cost savings from energy efficiency.
- Choose local sources when possible.

Success Story: Massachusetts Environmentally Preferred Products Procurement Program
Massachusetts has instituted a progressive Environmentally Preferred Products Procurement Program. The Program identifies green products and contractors, and offers educational assistance, technical expertise, and case studies. Visit www.mass.gov and search "EPP" to learn more about the program. Another useful resource is the Responsible Purchasing Network (RPN) and its website, www.responsiblepurchasing.org RPN offers a useful webinar called "Purchasing for Climate Protection," about how to prevent climate change through purchasing decisions "because every purchase matters."

Management Information Systems

Many electrical devices and appliances consume electricity whenever they are plugged into an electrical socket, whether or not the device is on. Electricity consumed in this manner, often referred to as "phantom load," is responsible for a great deal of energy waste. Computer equipment is one of the most notorious sources of phantom load. The MIS Department can reduce Town emissions by taking steps to minimize phantom load; for example, by programming all devices at the most energy efficient settings, turning off and unplugging or cutting power to equipment when not in use, and encouraging staff to follow efficient technology practices such as using sleep settings and avoiding highly-animated, energy-intense screen savers. Finally, choose Energy-Star qualified or efficient models when purchasing new computer and electronics equipment.

Recommendation:

- Minimize computer equipment phantom load by instituting energy efficient technology practices.
- Purchase only energy efficient computer equipment, such as Energy Star rated personal computers and devices.
- Educate Town employees about efficient technology practices.

Department of Public Works

The Department of Public Works (DPW) can make a number of important contributions to reducing GHG emissions in its central role in the Town's garbage and recycling pickup programs and roadway maintenance.

In conjunction with the Recycling Committee, DPW has successfully increased the recycling rate in Ipswich. The resulting reduction of solid waste has saved money for the Town and has reduced GHG emissions. DPW will continue to help reduce the Town carbon footprint as it implements the plans described in Section 3.1.1. Additionally, when it solicits bids for and negotiates the next hauling contracts, DPW can ensure that the vendors chosen use trucks equipped with filters to reduce harmful

emissions, and ideally, that run on biodiesel fuel. These contracts should provide some means of verifying that Ipswich's recyclable waste is recycled properly.

In the course of its work maintaining roads and sidewalks, DPW can support reduced GHG emissions by making Ipswich a safer place for pedestrians and bicyclists. Many roads in Ipswich do not have shoulders or sidewalks. By prioritizing areas with the highest current or potential pedestrian and bicycle traffic, and incorporating these needs into its existing plans, DPW can undertake efforts to widen roads or create sidewalks, as is currently scheduled for Town Hill.

However, a number of other high-traffic areas in town have obstacles to pedestrian or bicycle access and are in dire need of improvement, such as the neighborhoods near the Doyon School and Mile Lane playing fields, as well as Crane Beach and Great Neck. Adding shoulders and/or sidewalks in the Doyon School/Mile Lane area would be particularly effective at reducing vehicle emissions. At the present time there is a great deal of vehicle traffic from families driving children to and from school and sports activities due to the lack of safe places to walk and the fact that bus service is not provided to children living within two miles of the Doyon School. The installation of shoulders and/or sidewalks in this area would eliminate considerable vehicle traffic and the resulting emissions.

Recommendations:

- Negotiate future hauling contracts to require emissions filters on trucks and provide the means of verifying that recycled materials are recycled properly.
- Assess existing bicycle and pedestrian paths and identify areas needing improvement or new paths. In conjunction with neighboring communities, develop a bicycling and pedestrian commuter master plan that can be incorporated into long-term Town road maintenance planning. State and federal grants may be available for planning and construction of bicycling and pedestrian commuting improvements.

Code Enforcement

Together, the offices of the Building Inspector, Electrical Inspector, and Plumbing Inspector are responsible for code enforcement. These inspectors are currently responsible for ensuring safety standards, structural integrity, and the appropriate functioning of electrical systems, water supply lines and drainage systems. In the future, they may also be asked to more closely scrutinize the energy efficiency of the buildings they inspect, particularly if Ipswich adopts the optional Stretch Appendix to the Massachusetts Building Energy Code or "stretch code". The "stretch code" increases the efficiency requirements for all new residential and many commercial buildings, as well as for most residential additions and renovations. As of November 2010, 65 communities in Massachusetts have already adopted the "stretch code". The adoption of the "stretch code" would require more rigorous systems for permitting, plan review, inspection, and final approval. The code enforcement department would need to evaluate the adequacy of its resources and possibly request additional personnel or equipment, but these would be small investments in return for the significant impact it would have on energy use and GHG emissions in Ipswich.

Adopting the "stretch code" would help reduce energy use and GHG emissions, because houses built to these standards use at least 20% less energy than those built to the basic energy code.[8] While "stretch code"-compliant buildings cost more to construct (about an additional $3,000 for a typical single family home)[9], the additional costs are offset over time by energy cost savings on heating and electricity.

Education is critical to gaining public acceptance of new regulations and up-front cost increases. Widespread and early acceptance of the "stretch code" may require an effective outreach campaign that will help homeowners, business owners, and building trades' professionals understanding its long-term benefits. Educational materials should explain how the "stretch" code leads to lower operating costs, reduced GHG emissions, and improved sustainability.

Recommendations:

- Work with Ipswich Town leadership and citizens to evaluate the efficacy of adopting the "stretch code" in Ipswich.
- Educate homeowners, building owners, and building trades professionals on the long-term benefits of "stretch code". Outline the monetary, operational, and environmental paybacks that arise from higher energy efficiency standards.

Police Department

The Police Department can contribute to reducing Town GHG emissions by helping to address the vehicle idling, which wastes fuel, causes unnecessary emissions, increases air pollution, shortens vehicle life, and literally "gets you nowhere." Idling is of particular concern in high traffic locations near schools and businesses, by service and delivery vehicles, and by Town maintenance vehicles. Although idling is illegal under the Massachusetts Anti-Idling Law, it is only rarely enforced.

There a number of steps, short of fining violators, the Police Department can take that may prove sufficient to control idling. For example, officers could issue warnings which would raise awareness of the problem. The Police Department could also identify areas where idling frequently occurs (e.g., parking lots) and recommend appropriate signage for those areas. Another idea is to propose an Anti-Idling bylaw as way of raising awareness in Ipswich. Finally, the Department could issue reminders to other Town departments about the Anti-Idling Law, particularly departments with maintenance vehicles that are often needlessly left running in cold weather or during repairs or other dispatches.

Recommendations:

- Enforce the Massachusetts Anti-Idling Law.
- Consider proposing an Anti-Idling bylaw for Ipswich.

[8] http://www.mass.gov/Eeops/docs/dps/inf/stretch_energy_code_qa_oct11_10.pdf

[9] Ibid

Facts and Figures: Anti-Idling Campaigns

Researchers estimate that voluntary idling wastes up to 20 gallons of gas per year and causes more than 400 lbs. of carbon emissions annually, PER CAR. The cumulative effect is staggering, as we may be uselessly burning 1.4 billion gallons of gasoline and emitting 13 million tons of carbon dioxide as a result. The detrimental impact of idling is becoming increasingly recognized and anti-idling campaigns are growing. Thirteen states have anti-idling laws, and scores of counties and cities have their own anti-idling rules.

3.1.3. Recommendations for the Board of Selectmen

The Ipswich Board of Selectmen historically has supported local climate protection initiatives, most visibly by its formation of the Commission in 2006 and endorsement of an aggressive carbon reduction goal in 2010. The Selectmen's continued leadership, support, and oversight will be essential over the next decade as Ipswich works to reduce its carbon emissions to 10% below 1990 levels by 2020.

The Board will continue to play a central role in helping to guide, support and direct emissions reduction efforts and the underlying policies driving those efforts, in members' various duties and capacities as Selectmen. The Town needs the Selectmen's continued public commitment to and support of emissions reduction, and to the Town's vision statement, which calls for fortifying the Town's environmental health by enhancing its "green infrastructure."

The Board makes many decisions that affect the Town's carbon footprint; so it is imperative that the Board consider the emissions implications in its decision-making processes. By adopting the language of climate protection and GHG emissions in its public proceedings, the Board can raise awareness among its various constituencies, and ensure that emissions-related considerations are included in all of its deliberations. Through its oversight role over Town operations, the Board can hold the various divisions of Town government accountable for contributing to the Town's overall GHG reduction efforts.

The Board's leadership on emissions issues will be particularly vital at Town Meetings, where many articles affecting GHG emissions will require voter approval; and in hearings where they serve as Electric Light Commissioners. The Board could also move forward with the creation of a process by which street lights can be selectively turned off at residents' requests. As concern about global warming rises, many people would prefer less outdoor lighting in certain circumstances, such as in places where there would still be adequate illumination with fewer lights, or in remote areas where darkness is unlikely to compromise public safety.

Obtaining aggregated heating oil consumption data directly from local suppliers would greatly improve the Town's ability to monitor GHG emissions in future years, and to assess the success of GHG reduction strategies implemented to improve the energy efficiency of residential and C/I buildings in Ipswich. The Board should consider requiring heating oil distributors that delivery to Ipswich residences and businesses to provide aggregated annual delivery data. To address privacy and competitive sales information concerns, the data reported to the public in future GHG inventory reports could be aggregated for all distributors.

In the 2009 Ipswich Energy Use and GHG Inventory, the reported emissions from combustion of heating oil was 32,600 mt of CO_2 in 2005, or nearly 30% of the total annual emissions. Approximately 70% of Ipswich homes used heating oil as their primary heating source in 2005 (only electricity generation emissions, at 36%, exceeded heating oil emissions in the Town). Unfortunately, actual heating oil consumption records were unable to be obtained because, unlike electricity and natural gas distribution systems, residential heating oil is purchased from more than two dozen, private oil delivery services throughout the area. The CEUCP contacted many of the companies that distribute heating oil in Ipswich, but was unable to obtain information that could be used to quantify the amount of heating oil consumed in Ipswich for the specific inventory years. Consequently, the Commission estimates of heating oil consumption for the residential sector were generated using data from the US Department of Energy's Energy Information Administration (EIA) and the Town of Ipswich Assessor's Office. Consumption estimates were made by adapting formulas developed for the EIA's Residential Energy Consumption Survey (RECS), which accounts for such factors as annual heating degree days (HDD) and space heating intensity.

Recommendations:

- Consider the carbon impact of all decisions and make this part of the public discourse.
- Use oversight role over Town operations to hold departments accountable for reducing GHG emissions.
- Use capacity as Electric Light Commissioners to support or sponsor energy efficiency, conservation, and renewable energy.
- Continue public support for and commitment to emissions reduction and to the Town's vision statement regarding enhancing Ipswich's "green infrastructure".
- Create a process by which residents can request having streetlights turned off.
- Consider developing reporting requirements for heating oil distributors in Ipswich, so that monitoring of heating oil consumption and the success of GHG reduction strategies can be improved.

3.2. Ipswich Municipal Light Department

Electricity generation is the single largest source of GHG emissions in Ipswich (36% of total Town emissions in 2005). Ipswich has its own municipal utility, the Ipswich Municipal Light Department (IMLD), which is responsible for sourcing electricity for the Town's needs, and managing and maintaining the town's electric distribution grid. The fact that Ipswich has a municipal electric utility should make it easier to coordinate emissions reductions efforts and priorities among IMLD, Town officials and departments, citizens and businesses. IMLD is crucial to the successful implementation of the Plan.

IMLD deserves considerable credit for promoting conservation, efficiency, and renewable energy. It has led a variety of existing programs and projects, for example: the Home Energy Loss Prevention Service (HELPS), Energy Star and solar rebates, conservation competitions, and solar and wind power installations. However, because IMLD is a lynchpin in so many of the Commission's recommendations,

this Plan includes many detailed recommendations for the Department to consider in the future. In the pages that follow, IMLD's existing conservation, efficiency and renewable energy initiatives are described, and are put into the context of the additional work that must be done in order for Ipswich to meet its 2020 emissions targets.

While IMLD offers many worthwhile programs for its customers, customers may not be sufficiently aware of these programs, as evidenced by undersubscribed programs such as the solar rebate and commercial audit programs. Consequently, among the most crucial recommendations for IMLD in the Plan are the calls for greater outreach and education for all of its customer programs, in order to increase customer awareness of and participation in them. In order to address this issue, the Commission recommends hiring a part-time Energy Education Coordinator who could carry out the specific education and outreach tasks recommended in this Plan. Because so many other areas of Town government also need added energy education, this position could be jointly funded by the IMLD and the Town (as recommended in Section 3.1.2.), with a certain number of hours per week dedicated to IMLD-related projects.

3.2.1. Manage Demand

Raise Awareness

IMLD's efforts to raise awareness of the relationship between electricity use and climate change among Ipswich citizens and businesses include a monthly customer newsletter, occasional press releases and annual school-based educational programs. The promotional materials for IMLD's consumer programs (home audits, rebates, CFL giveaways, demonstration projects, etc.) also help educate the public about the need for energy efficiency and conservation.

To help Town government, residents and businesses focus on energy and climate issues, IMLD should explore additional high-visibility ways to disseminate its conservation, efficiency and renewable energy messages. For example, banners over Central Street or County Road, announcements on Ipswich Community Access Media (ICAM), enhanced use of the IMLD website, and displays at the library and Town Hall would increase the visibility of and repeat key IMLD messages.

Sustainability pledges (checklist tools that engage a community to adopt particular actions) are another useful means of raising public awareness and promoting culture change around energy use. These pledges are increasingly common on college campuses and at businesses, and could be adapted for the Town. IMLD could help lead such a process in Ipswich by announcing a pledge drive in its newsletter, and by posting an electronic pledge form on its website.

At the time of this writing, IMLD provides an annual education program for elementary students at the Doyon and Winthrop Schools that focuses on electrical safety. Continuing this safety program with an additional conservation and efficiency component should be considered. Additionally, the wind turbine and solar panels in Ipswich provide a unique learning laboratory for older students. Science and

technology teachers at the Middle and High Schools should be invited to tour the generation facilities with their students and to use the facilities as a teaching laboratory. Energy education experiences at school will likely carry over to smart energy practices at home, and will foster a lifetime of good energy habits and values.

Recommendations:

- Hire a part-time Energy Education Coordinator. Such a person could help drive this goal of raising awareness, as well as many of the other recommendations in this Plan.
- Fund additional energy education/outreach efforts to ensure that IMLD customers understand how the Home Energy Loss Prevention Service, home audits, rebates, and other programs work, which programs for which they are eligible, and how to access them.
- Find high visibility ways to disseminate messages about conservation, efficiency, and renewable energy. Repeat the messages in as wide a range of venues as possible.
- Consider leading a Town-wide sustainability pledge drive.
- Partner with Ipswich science and technology teachers to turn the renewable energy generation facilities into learning laboratories for middle and high school students.

Offer Rebates

IMLD currently offers rebates ranging from $20 to $475 to residential customers who purchase a variety of energy efficient appliances, including clothes washers, refrigerators, central air conditioners, and programmable thermostats. IMLD's rebate schedule is comparable to rebates offered by utilities elsewhere. In many cases, the rebate nearly refunds the price difference between Energy Star-qualified appliances and less-efficient alternatives. These rebates are an important tool in the effort to reduce Town emissions by removing the barrier to purchasing lower-emission appliances, and should remain a key part of IMLD's energy efficiency initiatives.

IMLD can increase customer awareness of and participation in IMLD's rebate program, and help the program reach its full potential, both through general promotion as well as targeted efforts to reach residents at the point of their purchase decisions. For example, IMLD may be able to more effectively reach residents with imminent plans to purchase new appliances by displaying promotional materials and rebate forms at local appliance stores. Store managers could be asked to display rebate information and forms alongside Energy Star appliances. The rebate program benefits retailers since it encourages customers to purchase more expensive, energy-efficient models.

IMLD can also reach active appliance purchasers by providing rebate information and forms to local service professionals such as electrical, HVAC, and general contractors. Such service providers often recommend products for their customers, especially when installing central air conditioning or thermostats, and the rebate information and forms will help them better serve their customers. Materials provided by IMLD can help service providers improve their service quality while steering customers toward IMLD's rebate program.

IMLD introduced rebates for business customers in the Fall of 2010 as part of a new Business Energy Savings initiative. Businesses that participate in IMLD-sponsored energy audits of their facilities, will also be eligible for financial support of select retrofits, renovations, and targeted equipment upgrades.

Recommendations:

- Increase awareness of the rebate programs by expanding education and outreach.
- Measure the effectiveness of the rebate programs and the trends in participation rates.
- Collect feedback from participants in order to continuously improve the programs.

Provide Energy Audits

The IMLD offers free energy audits to homeowners and businesses. Energy audits represent an important first step in helping people understand how their homes and workplaces rate in terms of energy efficiency, and what they can do to decrease their carbon footprint. People who are educated on energy use and losses are better prepared to make informed choices about improvements that can actually make a difference.

Drawbacks of the current Residential Audit program are that participants have no obligation to follow through on the recommendations, and there is no formal method for obtaining follow-up information about residents' satisfaction with the service. For example, did they find the audits informative? And did they follow the auditor's advice? Follow-up surveys, however, are a requirement of the commercial and industrial audits, but the program is very new in Ipswich (as of Fall 2010) and its measureable track record remains to be seen.

Finally, residents and businesses may be insufficiently aware of the audit program, and even if they know about the program, they may not fully understand how the audits work or how they potentially can benefit from them. Publishing stories to demonstrate how others have benefitted from the audit program will help to raise awareness and increase participation in it.

Recommendations:

- Increase awareness of the energy audit programs through expanded education and outreach. Publish success stories to demonstrate how others have benefitted from the program.
- Develop a means of following up after home energy audits in order to evaluate the effectiveness of the program, and potentially identify ways to improve it.
- Monitor the effectiveness of the commercial/industrial audits and modify the program as necessary to achieve better outcomes.

Enact Time-of-Use Rates

Most retail electricity customers traditionally are charged for electricity usage at a single rate. At the same time, customers generally do not use electricity evenly throughout the day, and as a result, electricity demand varies fairly predictably depending on the time of day. Periods of relatively high demand (such as during business hours) are referred to as "peak," while periods of relatively low

demand (night time) are referred to as "off-peak." Because electricity for the most part cannot be stored, the generation capacity of the electrical system has to be able to meet peak demand, even though actual demand is significantly below peak much of the time.

"Peak" power relies on systems that can be turned on and off relatively quickly, and which typically burn expensive fuels, such as natural gas. "Base-load" generating capacity generally relies on less expensive fuel sources and technologies that are intended to run nearly constantly, such as coal and nuclear. Electricity is therefore significantly more expensive to produce at peak than at off peak times, because of greater demand and more expensive generation. Electricity prices in the wholesale market, which sets the price for much of the electricity acquired by utilities on behalf of their customers, are time-dependent, with electricity much more expensive at peak than off-peak times. In Ipswich, even though the utility purchases electricity from the wholesale market at variable rates, customers are charged a single, uniform rate regardless of whether they use power during peak of off-peak hours.

Time-of-use rates align retail electricity rates with wholesale prices; under this type of rate structure, customers are charged different rates at different times of the day. This gives customers an incentive to use electricity at night, when electricity demand and wholesale prices are lowest, rather than during the day, when electricity demand and wholesale prices are highest. Time-of-use rates have a number of advantages over single-rate structures:

1. Customers can lower their electricity bills by shifting power consumption from peak to off-peak times, for example, by running washing machines, dryers and dishwashers at night.
2. Shifting electricity usage from peak to off-peak times smooth demand and reduces peak load, which in turn helps utilities reduce their generation, transmission and capacity costs.
3. Especially because nuclear generation provides much of Ipswich's power off-peak, shifting electricity consumption to off-peak hours can reduce GHG emissions by reducing the demand for operating older, less-efficient electricity generation facilities that produce greater emissions.

The IMLD is moving toward time-of-use rates for residential customers. The first step is to install a two-way meter communication system – an investment that has already been planned for phased implementation between 2012 and 2016. Public rate hearings will be required in advance of rate decisions by the Electric Light Commissioners. Although rates will have to change to reflect peak and off-peak prices, the intention would be to develop a revenue-neutral rate structure that aligns retail and wholesale prices and ultimately can lower electricity costs and help to reduce emissions. Every effort should be made to keep this project on schedule and to sufficiently educate consumers about the benefits.

Recommendations:

- Install metering equipment throughout Ipswich that will make time-of-use rates possible.
- Propose a time-of-use rate structure to the Electric Light Commissioners.
- Educate the Town Departments and general public on the benefits of time-of-use rates.

Success Story: Groton (MA) Municipal Light Department time-of-use rate
The Groton, MA Municipal Light Department completed its first year of voluntary time-of-use rates in June, 2010. So far, the program appears to have been a tremendous success, as participants in the program reduced their peak electricity usage by an average of 17%. Their website (www.thegrotonline.com) provides useful information regarding customer feedback, utility observations, and adjustments to the program.

Offer Customer Competitions

Customer competitions can help encourage an instinct for conservation; when people believe their neighbors are getting better results, they may be motivated to change their own consumption habits to keep up with or beat their fellow citizens. In November 2010, IMLD initiated a Smart Energy competition called "Grounded Power" for about 50 volunteer households, with a goal to reduce monthly energy use and peak demand by an average of 10%. The program uses smart-technology meters and social-networking that lets each participant compare his or her own energy saving performance with the performance of other participants. Over time, it will be important to measure the effectiveness of this pilot program and, if it is successful, to expand it to a larger group of participants.

Going forward, the IMLD may consider other customer challenges that will help engage a broader cross section of Ipswich residents. For example, during the summer (when power demand is highest as a result of air conditioning), customers could be offered a 10% credit on their electricity bills in return for reducing their energy consumption by 10% over 90 days.

The Commission recommends adding average use data to customer utility bills. IMLD should consider printing frowning faces (sad emoticons) on the utility bills of customers whose usage is higher than average for similar buildings or homes, so they can understand their status at-a-glance. Good examples of this approach can be found at www.opower.com. Just showing customers how their electricity usage stacks up against their neighbors and fellow citizens may be enough to encourage them to be more careful about their own energy usage, especially if they are above average in energy consumption.

Recommendations:

- Use customer challenges as a means of encouraging energy conservation, and monitor the impact of each challenge in order to determine whether it should be continued or modified.
- Add average use data to the utility bills so customers can see how their consumption compares to the norm.

Success story:
OPOWER is an energy efficiency and Smart Grid software company that helps utilities meet their efficiency goals through effective customer engagement.[10] *Robert Cialdini of OPOWER is a psychologist*

[10] www.opower.com

and scientist who has spent decades researching the power of persuasion and now applies what he's learned to influence utility customers on saving energy. According to Cialdini, the key to success has less to do with messages about money and morals, and more to do with what people believe their neighbors are doing. When customers are informed by the utility that they are consuming more power than others, they realize it is feasible to do less and their usage creeps downward. However, the same principal applies for energy misers – when they learn their performance is above average, they tend to relax and revert to wasteful habits.[11] *By combining usage analytics, targeted messaging and applied behavioral science, OPOWER helps its utility customers achieve measurable savings.*

3.2.2. Change the Power Source Portfolio

Because electricity accounts for such a large proportion of GHG emissions, and because the carbon footprint of electricity depends almost entirely on how it was generated, the power source portfolio is the biggest single factor in determining Ipswich's carbon footprint. Consequently, changing that portfolio in favor of lower-emission generation sources is the fastest, most impactful way to shrink the Town's carbon footprint. A single, large renewable energy contract could dramatically reduce Ipswich's electricity-related emissions overnight.

As a member of the Massachusetts Municipal Wholesale Electric Company (MMWEC), Ipswich buys much of its electricity in coordination with other MMWEC municipalities. At the time of this writing, the IMLD has baseload power contracts with two nuclear plants, intermediate load MMWEC power plants (natural gas), New York Power Authority hydroelectric plants (Niagara Falls), and Quebec hydropower. Clean energy from hydropower accounts for about roughly 5% of the portfolio.

IMLD is also pursuing wind energy projects that could add several megawatts (MW) of capacity in 2011. One wind turbine planned for Town Farm Road is expected to be completed in the Spring of 2011. An RFP for a second wind turbine in Ipswich was recently issued. IMLD is also a co-op member of the Berkshire Wind Project, a ten-turbine installation located in Hancock, MA.

[11] "Finding the 'Weapons' of Persuasion to Save Energy", Saqib Rahim, www.eenews.net, June 21, 2010.

Figure 3.1 Three of the wind turbines from the Berkshire Wind Project, a ten-turbine installation located in Hancock, MA.

Recommendations:

- Add renewable energy to the power source portfolio.
- Publicize successes in order to raise awareness of the need for and useful application of clean energy.

Add Local Wind Power

Its natural landscape and prevailing winds make Ipswich a good candidate for wind energy. A single 1.5 MW turbine could power about 3% of residential customers, or three hundred homes. Given the amount of remote, open space that has been preserved along the coastline and on hilltops, there are several suitable locations for turbines in Ipswich.

IMLD has been a strong champion for bringing wind power to Ipswich for a number of years, and voters have demonstrated their support of its efforts at the ballot box. The persistence of IMLD and the support of Ipswich citizens should begin to pay off in 2011 with the completion of the municipal wind turbine on Town Farm Road.

While turbines require an initial investment for purchase and install, they generate electricity at essentially a constant cost for the life of the turbine and offer a hedge against rising fossil fuel prices. Additionally, local generation avoids the cost of long distance transmission. (Transmission from remote sources adds approximately 15% to the cost of delivered power.

Recommendations:

- Assess the feasibility of installing additional municipal wind turbines in Town.
- Assess the efficacy of implementing local incentive programs for residential and private, commercial wind energy generation.

Add Solar Power

IMLD has taken a leadership role in the Town's initial solar energy initiatives. In 2010, a solar demonstration project was installed on Town Hall. This solar array helps raise awareness of the potential of solar power in Ipswich – a live link to the IMLD website (www.ipswichutilities.org) records the electricity generated to date and the pounds of carbon emissions that have been offset by this clean electricity.

Figure 3.2 Some of the 160 solar PV panels making up the 33.6 kW capacity system installed on the roof of Town Hall in 2010.

Since 2009, IMLD has joined with MuniSolar, a program of HELPS, to offer property owners rebates of up to $10,000 per applicant to install solar PV panels. As of this writing, several homeowners have completed installations and received the rebates. Enhanced publicity of the program, including press releases, tours of the Town Hall roof installation, and additional demonstration projects around town, would likely lead to even greater enrollment. The increased adoption of solar hot water systems would be aided by inclusion in this program or a similar incentive program.

In order for solar power to have a significant effect on Ipswich GHG emissions, more residents and businesses will need to adopt and invest in the technology. With enough interested parties, IMLD could

eventually consider distributed generation, or the generation of energy from many small sources within Town that are net metered into the local grid. In order to get access to additional roof space for PV, IMLD should assess all municipal buildings for PV installation suitability. IMLD could also consider a lease-type program whereby building owners would host IMLD-owned PV panels on their roofs in exchange for a monthly fee or a discounted electricity rate.

Recommendations:

- Consider developing a lease-type program where building owners would host IMLD-owned PV panels on their roofs in exchange for a monthly fee or a discounted electricity rate.
- Expand the solar program to include solar hot water installations.
- Assess all municipal buildings for suitability for solar PV installation.

Facts and Figures: Distributed Generation

In 2010, Colorado enacted a law requiring that by 2020, 3% of the power generated in the State utilize some type of distributed generation.

Explore Landfill Gas to Power Renewable Energy Sources

Landfills emit both carbon dioxide and methane as garbage decomposes. Ironically, these dangerous greenhouse gases can be extracted and converted to clean, safe, renewable energy. As part of its serious commitment to dramatically change the power portfolio and reduce emissions, in 2009 IMLD attempted to negotiate a contract with a renewable energy landfill gas project in Rhode Island that would have supplied 35% of Ipswich's electricity needs (35 MW), but the deal ultimately fell through for reasons beyond the Department's control. Although in this case the effort did not succeed, a similar opportunity could in the future significantly change the Town's carbon footprint and propel Ipswich toward its 2020 emission target. The IMLD is urged to continue its practice of seriously evaluating new opportunities in light of the potential for so significantly reducing GHG emissions in Ipswich.

Recommendation:

- Continue to explore and pursue viable landfill gas to power contracts.

Offer a Green Power Purchase Program

The Commission recommends that IMLD consider offering a green power purchase program, through which customers seeking to reduce their carbon footprint voluntarily pay a slightly higher rate for electricity produced from renewable sources. Depending on customer participation, this would increase the ratio of clean electricity consumed in Ipswich. The program would also provide a useful option for customers seeking to use less fossil fuel.

Green power purchase programs have enjoyed mixed success nationally. The programs that have attracted the highest rates of subscribers tend to be in areas where renewable energy sources are local and visible to customers, such as nearby wind farms or solar fields. If such installations are eventually built in or near Ipswich, the close proximity of the generation source to customers' homes might be the

basis of a successful green power purchase program. Ipswich customers may take sufficient pride in locally-generated power that they are willing to pay a higher price for its acquisition.

Recommendations:

- Consider offering a green power purchase program, linked to local generation facilities.

Success Story:

The GreenChoice program in Austin, TX is the nation's most successful, voluntary, utility-sponsored green purchase program. As of January 2011, subscriptions amounted to almost 800 million kilowatt-hours (kWh). Customers who enroll in the program at this time volunteer to pay 5.7 cents per kWh, compared to regular fuel charge of 3.105 cents. This means that customers consuming 1,000 kWh per month pay $25.95 more per month for subscribing to GreenChoice. As a hedge against fluctuating fossil fuel prices, the GreenChoice rates remain fixed for up to 5 years.[12] Most of Austin Energy's green power comes from large wind farms that are visible from major roadways. The program's success is closely linked to the customers' high level of familiarity with the wind farms and the utility's promotion of GreenChoice as a means of making a lasting contribution to the quality of life in the Austin area (see http://www.austinenergy.com/Energy%20Efficiency/Programs/Green%20Choice/index.htm).

3.2.3. Invest in Efficiency

Audit Internal Operation

IMLD has been active in examining and evaluating its facilities and processes for ways to improve and improve energy conservation and efficiency and increase the use of renewable energy. It has conducted energy audits of its facilities and has invested in retrofitting and upgrading the light fixtures and other electronic equipment. It has also evaluated the solar potential of its properties, but was found to be unsuitable.

IMLD has also shown a commitment to reducing emissions from its vehicle fleet, and its recent vehicle purchases have been hybrid electric trucks. IMLD should consider a full review of its fleet vehicles to minimize vehicle emissions as much as possible. It could also review the way its fleet is used, such as by implementing anti-idling policies.

Retrofit and Upgrade Streetlights

IMLD upgraded and retrofitted street lights on Green Street to improve efficiency. Specifically, 70-watt low pressure sodium bulbs were replaced with 40-watt induction fluorescent bulbs. The new bulbs were 42% more efficient that the ones that were replaced, and will last 3 times as long. IMLD should incorporate similar retrofits and upgrades of the street lights throughout town as part of its long-term maintenance planning.

[12] www.austinenergy.com

Install Smart Meters

As mentioned previously, IMLD has plans to install smart meters and smart grid infrastructure so that customers will have the information and incentives they need to help shave peak demand, shift energy use to off-peak times, and reduce emissions. These infrastructure investments are critical to the future efficiency of the Town's electric grid and to meeting Ipswich's 2020 emissions target and should remain a high priority for the Department.

Prepare for Plug-In Hybrid and Electric Vehicles

In anticipation of plug-in hybrid and fully-electric vehicles, the Commission recommends installation of centrally-located charging stations. Public charging stations in various locations in downtown Ipswich could be part of a larger network of stations available to both residents and commuters, and could be an added benefit to local businesses who may gain exposure to new customers whose car batteries are charging.

Recommendations:

- Continue to improve the efficiency of internal operations at IMLD.
- Develop a long-term plan to incrementally retrofit and upgrade streetlights throughout Town.
- Install smart meters and smart grid infrastructure.
- Install centrally located charging stations for plug-in hybrid vehicles.

3.2.4. Help Finance Renewable Energy and Efficiency

Continue the Public Benefit Fund

IMLD dedicates a percentage of consumer energy bills to financing energy efficiency projects in the service area, such as home energy audits, solar rebates, CFL giveaways, and more. This funding pool is essential in order to raise awareness about smart energy use, encourage conservation and efficiency, and emissions. In 2010, any unspent funds will roll into the next year's budget. This program is important to creating a sustainable energy future for Ipswich, and the available funds should be expended effectively each fiscal year.

Offer Solar Incentive Programs

Continue to offer the solar rebate program for homeowners. To encourage broader adoption of solar technologies, the Commission recommends that IMLD consider developing a leasing program for solar hot water heaters and swimming pool heaters. Under such a program, rather than asking homeowners to make a large upfront investment in solar equipment, by renting the equipment homeowners would pay for installation and a monthly rental fee. Participants of such a program would pay an installation fee and a monthly rental fee.

Partner with Financial Institutions

The availability to Ipswich homeowners and businesses of low-interest loans for energy efficiency and renewable energy projects would help to make such projects more accessible. With that goal in mind, the Commission suggests the IMLD consider partnering with local banks to offer special low-interest loans for those purposes. For projects in which the IMLD will offer a substantial rebate (such as solar installations), IMLD could work with the applicant and the bank in order to have the rebate be used as a down payment, or as collateral for the loan. An alternative would be to work with MMWEC to develop a low-interest loan program for municipal electric customers in MMWEC member communities. A successful program to consider in developing a program for Ipswich is Austin Energy (TX)'s loan incentive program, which helps its customers finance projects such as weatherize their homes by adding attic insulation, weather stripping, HVAC duct repairs, and Low E glass installations (www.austinenergy.com).

Recommendations:

- Effectively expend all resources available public benefit fund every year.
- Continue the existing solar incentive program and explore ways to encourage customer participation through equipment leasing programs.
- Partner with financial institutions and/or MMWEC to secure low-interest financing for customers who qualify for IMLD's renewable energy incentive programs.
- Consider replicating some of the loan incentives offered by Austin Energy in TX (www.austinenergy.com), which helps its customers weatherize their homes by adding attic insulation, weather stripping, HVAC duct repairs, and Low E glass installations.

3.3. School Department

In recent years, the Ipswich Public School Department (School Department) have undergone some substantial upgrades which have both modernized the facilities and have made them more energy efficient. Examples include various lighting and motion sensor upgrades throughout the district; new high efficiency boilers, HVAC upgrades, roof insulation, and doors at the Winthrop School; new windows, doors, and roof at the Doyon School; and an energy management system (EMS), insulation, and improved hot water system at the Middle and High Schools. The School Department has also been a proactive supporter of wind energy in Ipswich, by contributing essential financing for the construction of a municipal wind turbine on Town Farm Road. In return for its investment, the School Department will receive a portion of the energy generated by the turbine, which will serve to lower its utility bills.

These are all significant achievements, and together they demonstrate the School Department's willingness and capability to take on energy challenges. However, the School Department is in a position to achieve much more, if energy issues are given greater priority by all members of the school community; school leaders, facilities personnel, curriculum designers, extra-curricular advisors, parents, students and the School Committee. Climate change will continue to present fundamental challenges to throughout the lifetime of today's students, and therefore it is essential for Ipswich schoolchildren to fully understand the problem and to be part of the solution.

3.3.1. Create a Culture and Curriculum that Promote Smart Energy Use

In its daily role as host to hundreds of schoolchildren, the School Department will play a key role in the Town's Climate Action Plan. There is a tremendous opportunity to integrate awareness and concrete action steps for sustainable practices and energy conservation into the fabric of school life at every grade level. In turn, the children will bring home what they have learned and practiced in school home, which will help to build an energy saving culture in households across Ipswich.

The renewable energy installations in Ipswich (wind turbine, Town Hall solar panels) offer unique learning laboratories that could be used for field trips, science projects, and other educational lessons. For example, students could collect data from these power generation sources that will help them learn the fundamentals of renewable energy systems and to understand the influence of weather on renewable energy production. There are also many opportunities for classrooms to draw on community expertise (local professionals and green businesses), by inviting knowledgeable professionals to share their wisdom and hands-on experience. With appropriate guidance, students could participate in building small-scale, renewable energy generators and devices powered by renewable energy.

Recommendations

- Teach every grade about energy conservation, efficiency, and renewables.
- Provide tools and systems that allow students to apply and practice what they have learned (recycling bins, compost disposal, bike racks, etc.).
- Encourage classroom-based and extra-curricular competitions and special events that focus on energy conservation, efficiency and renewable energy.
- Use local renewable energy installations as learning laboratories and field trip destinations.
- Seek educational partnerships with local energy professionals and green businesses.

Success Story:

Students in an Engineering & Design course at Peabody High School built a solar hot water system, including three solar panels and the required plumbing fixtures, and mounted on a trailer to serve as a display and demonstration of the technology. High school seniors transported the unit to local elementary schools, where they made presentations about its construction, operation and useful applications. The project was primarily funded by the Museum of Science. Using another grant, the class also was successful in building a solar car, which they demonstrated on the school's track.

3.3.2. Pursue Technical Opportunities for Efficiency Improvements

The Commission recommends that the School Department work in concert with the Town's Facilities Department to set and achieve common energy-related goals. The first step will be to develop and implement a comprehensive energy plan. The plan should address strategies such as standard temperature set points, HVAC operation schedules and lighting control schemes. It should also include an educational component to promote energy awareness and beneficial changes in energy habits.

Energy use benchmarking should also be a regular practice. For example, *Portfolio Manager* is an energy benchmarking and tracking tool on www.energystar.gov that is widely used to benchmark fuel consumption in public buildings. No energy strategy is complete without requisite measurement of their impact.

Another way to give structure to the School Department's energy strategy is to pursue the Energy Star rating for Ipswich school buildings. This designation is awarded by the Federal Environmental Protection Agency to school buildings that demonstrate, through a certification process, documented energy efficiency in the performance operation of the school. The Energy Star program validates hard work and signals genuine energy efficiency achievements.

Recommendations:

- Develop and implement an Energy Plan for the School Department as part of and consistent with a comprehensive plan for all Town departments.
- Promote energy conservation and efficiency, and benchmark School facilities' energy use.
- Pursue the Energy Star designation for school buildings.

3.3.3. Invest in Renewable Energy

The School Department has been proactive in supporting renewable energy in Ipswich through its partnership with IMLD on the wind turbine project. In return for its role in financing part of the project, the schools will receive about 37% of the turbine's output, which will serve to lower its utility bills. This successful example could be followed by other renewable energy investments in renewable energy. For example, the large roof areas of school buildings may make them good candidates for solar PV installations. The Commission recommends that the School Department evaluate school buildings for the feasibility of installing solar PV arrays.

Recommendations:

- Consider additional renewable energy investments.
- Evaluate school buildings for the feasibility of installing solar PV arrays.

3.3.4. Transportation & Bussing

A significant portion of GHG emissions are generated from transportation. The Commission recommends that the School Department seek ways to streamline transportation of students to and from school, and to facilitate alternative modes of travel. This goal is particularly challenging in the vicinity of the Doyon School and the Mile Lane Playing fields, which cannot be safely accessed by walking or bicycling on Linebrook Road as it does not have a sidewalk or paved shoulder.

One way for the School Department to reduce its transportation-related emissions is to require all bus drivers to adhere to the Massachusetts Anti-Idling Law. In addition, the School Department should consider requiring the vendor chosen for the next bussing contract to use low-emission busses.

The School Department should also consider the overall carbon impact of bussing decisions beyond the emissions of the busses themselves. For example, eliminating bussing within 2 miles of a school may lower costs and reduce emissions from the buses themselves, but it increases private vehicular traffic to the schools (and the associated congestion and carbon emissions),and the wear and tear on the parking lots as more parents drive their children to school. Issues related to emissions from private vehicular traffic at the schools can also be addressed through educational initiatives that promote anti-idling and carpooling.

Recommendations:

- Contract for clean busses.
- Consider the town-wide carbon impacts of bussing decisions, beyond the emissions of the busses themselves.
- Encourage walking or bicycling to school and ensure safe routes of travel.
- Encourage carpooling, such as by setting up a carpool board for user communications.
- Educate drivers, including bus drivers, on anti-idling laws and use signage to discourage idling.

4. Residential Sector Plan

In 2005, residential energy use, for such things as heating and cooling homes, powering appliances with electricity, driving motor vehicles, and solid waste incineration accounted for 62% of Ipswich's GHG emissions (Ipswich Energy Use and GHG Inventory 2009). Home heating was the largest source of residential emissions, with 43% from heating oil and another 16% from natural gas. Electricity usage, at 28%, was the second-largest source of residential emissions.

Only about 10% of residential emissions were attributed to transportation-in the GHG inventory, which is low compared to the national average of 33%.[13] This is because of the way transportation-related emissions were calculated in the 2009 Inventory – it included only emissions from vehicles driven by Ipswich residents and employees traveling within the Town itself. However, many residents work and travel outside of Ipswich – commuting long distances by car, commuter rail, bus or airplane. Actual emissions from residential transportation are in fact much greater than the levels reflected in the GHG inventory.

Because Ipswich's more than 13,000 residents are together responsible for such a large percentage of the Town's overall emissions, the cooperation and participation of thousands of local people will be needed in order for the Town to meet its 2020 emissions target. Everyone can contribute to this effort by conserving energy, and by using it more efficiently using the strategies described in this section of the Plan. Energy is expensive, and is expected to become more so in the future, and Ipswich residents who help to reduce the Town's overall emissions by using less energy themselves will also save considerable sums of money.

Heating and cooling account for 45% of all energy consumed in Massachusetts homes.[14] This challenge is compounded by the fact that the many of the homes in Ipswich are older, which typically have less insulation compared to newer homes. The Department of Energy (DOE) reports that 80% of houses built before 1980 are inadequately air sealed and insulated. Since national building codes did not begin to include energy standards until 1993, houses built before that time generally represent the most cost-effective opportunities for insulation and air sealing upgrades. Here is an analogy for owners of older homes who are wondering where to start on home improvement projects: think of a house as being like an old boat. If the boat leaks water, it makes sense to fix the holes before investing in the latest electronics or engine upgrades. The same logic applies to houses leaking heat. In most cases, fixing the leaks should take priority over investing in new appliances, heating equipment, or renewable energy systems.

Residential electricity consumption is another significant contributor to GHG emissions. Residential electricity consumption is influenced by the efficiency of appliances and lighting, and by homeowner

[13] http://tonto.eia.doe.gov/energy_in_brief/greenhouse_gas.cfm.

[14] Energy Savings Tips Pamphlet. MA Energy Consumers Alliance.

behavior. Home electricity demand is one of the easiest areas homeowners can address in putting their houses on an "energy diet." The bar graphs on the monthly electrical bills make it easy to see the impact of reducing consumption. Utility customers who use less power can have the satisfaction of both saving money and making a positive environmental impact.

Together, the combined actions of every individual in Town can provide for much of the 3 percent per year reduction in emissions Ipswich needs in order to meet its 2020 GHG emissions target. Individually and collectively, Ipswich residents can become smarter consumers of energy. The following pages outline what residents can do to conserve energy (which requires changing habits and will save money at the same time), use it more efficiently (which usually involves investing in upgrades to buildings and equipment), and explore new renewable energy technologies.

Every household should start by taking a thorough assessment of its current energy usage, including inside the home, personal transportation, and other choices such as purchases of food and disposable products. For the home, an important first step is to gather fuel and electric bills from the past year or two in order to quantify annual energy use. The second step is to have a certified professional conduct a home energy audit to assess where energy demand can be reduced through home improvements. Free energy audits are available from HELPS (the Home Energy Loss Prevention Service, sponsored by the Ipswich Municipal Light Department) and from private energy professionals, which are not free, but can provide a more comprehensive evaluation.

After assessing household energy consumption, the next step is to develop a plan. Much like financial or business planning, homeowners should develop short term, medium term, and long term goals that will reduce energy demand and consumption. Short term actions could include behavior modifications, such as turning out lights in unoccupied rooms, turning down the heat at night and when the house is unoccupied, replacing incandescent light bulbs with compact florescent bulbs, drying clothes on a laundry line instead of in the clothes dryer, and carpooling, walking, or biking to work. Medium term actions could include improving house insulation and air sealing, upgrading refrigerators and washing machines to more efficient models, and replacing the oldest leakiest windows. Long term actions could include upgrading to more efficient heating and cooling systems, installing a renewable energy source, and purchasing more fuel-efficient vehicles.

Another way to view a home energy plan is by the three main strategies for reducing emissions: energy conservation, energy efficiency, and renewable energy. Turning out lights in unoccupied rooms, turning down the heat at night and when the house is unoccupied, and drying clothes on a laundry line instead of in the clothes dryer are energy conservation strategies. Implementing conservation measures is generally cost free (except for perhaps the cost of a clothes line) and, because there is no upfront investment, payback in energy conservation is immediate. Although there is often some degree of personal sacrifice (such as the extra time spent putting laundry on an outside clothes line or wearing a sweater in response to turning down the heat), energy conservation is something that anyone can do regardless of your financial situation.

Energy efficiency strategies do not involve sacrifices of time or convenience, but they do require an upfront financial investment to purchase products that operate more efficiently. Replacing incandescent light bulbs with compact florescent (CFL) bulbs or light emitting diode (LED) lights, replacing inadequate house insulation with a material with a higher R-value and air sealing, upgrading an old refrigerator or clothes washer to more efficient models, and replacing the oldest, leakiest windows with modern, double-pane, low-e windows are all energy efficiency strategies. The payback time on energy efficiency investments can range from a few days or weeks to several years. Homeowners should examine the costs and payback times for various energy efficiency options before making large investments, such as replacing windows or upgrading walls and attic insulation. A certified home energy auditor should be able to recommend appropriate energy efficiency measures and provide estimated pay-back times based upon the results of a thorough examination of a home.

Finally, for homeowners interested in reducing their carbon footprint to the maximum degree possible, installation of renewable energy systems, such as solar photovoltaic and solar hot water systems, wind energy generators, and geothermal heat pump systems, may be a viable option. Renewable energy systems are able to generate electricity or heat without accompanying GHG emissions. However, even though costs continue to fall and efficiency of the technologies continues to increase, and in spite of substantial incentives offered by local, state, and federal governments, the high up-front costs and long pay-back times can be an obstacle to many homeowners.

Figure 4.1 illustrates the relationship between the costs of implementing energy conservation, energy efficiency, and renewable energy measures and the reductions in GHG emissions. The actual costs of implementing any of these measures and the subsequent GHG reduction benefits accrued vary considerably (hence the relative scales for each axis). However, the figure demonstrates that energy conservation strategies are nearly always more cost effective to implement than either energy efficiency or renewable energy strategies. While renewable energy may provide the greatest benefits of reducing GHG emissions, implementation costs can be substantial and payback time much longer than energy efficiency measures. Due to the high up-front costs, the energy produced from renewable energy is often more expensive than traditional, fossil-fuel derived energy. For this reason, homeowners will find that reducing their home energy demands provide a better return on investment, and should therefore be prioritized over installing renewable energy systems, and in fact may generate sufficient savings that the homeowner can afford a renewable energy installation later on. In developing a home energy plan, homeowners may find it advantageous to implement energy conservation, energy efficiency, and renewable energy measures in step-wise fashion.

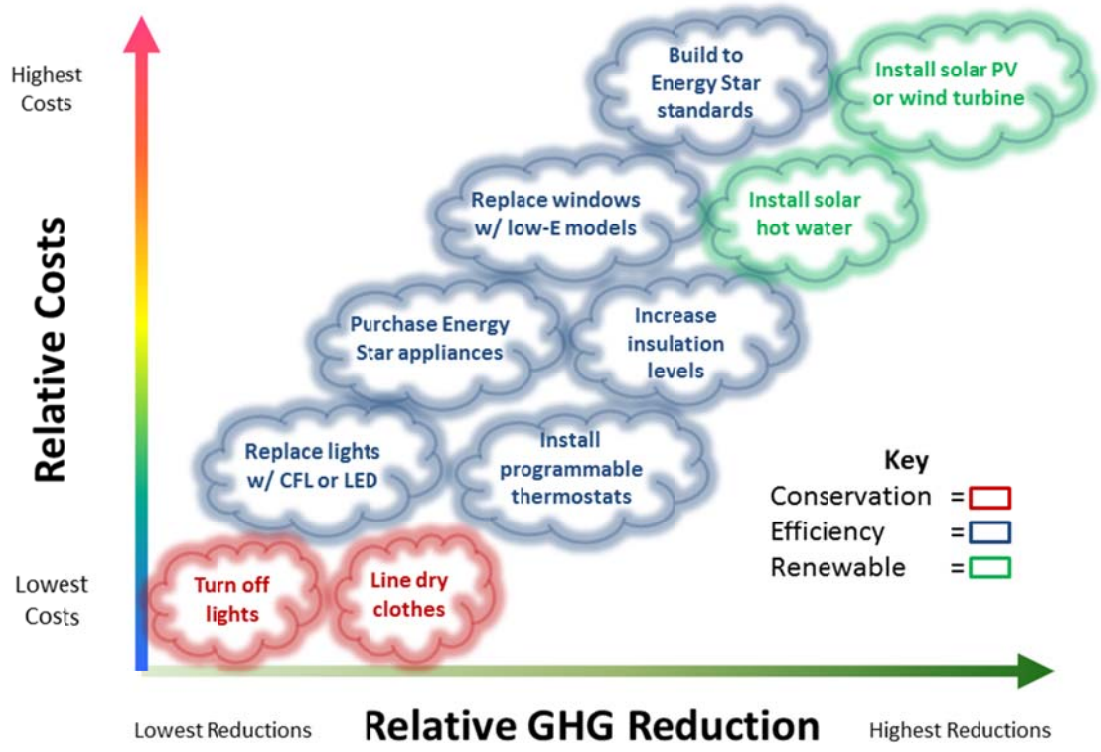

Figure 4.1 The Relationships between Cost and Carbon Impact of Selected Energy Conservation, Efficiency and Renewable Strategies
Note: the scale on this graph is relative and the placement of each measure is based on general calculations.

Call to Action

The top priorities for Ipswich residents are to:

- Conduct a home energy audit and assess your current energy use.
- If your home audit reveals inadequate sealing and insulation, take action to improve the building envelope.
- Reduce your transportation related emissions by driving less; use public transportation, walk, bike, or carpool. When possible, replace older vehicles with more fuel efficient models.
- Develop short term, medium term, and long term action plans to reduce your energy use.
- Conserve energy, use energy efficiently, and support renewable energy.

4.1. Conserve Energy

Conserving energy means to reduce your energy consumption. It may involve sacrifices, like turning down the heat in the winter, behavior changes, like turning the lights off in unoccupied rooms), or adaptations, like drying clothes on a line rather than in the dryer. Most conservation strategies can be implemented with no upfront expense and result in financial savings.

Conserving energy is like putting a house on an energy diet. It requires changing habits and using energy mindfully, and success requires consistent practice and commitment. To realize the full potential conservation strategies to save energy, every household member needs to participate. See below for energy conservation strategies that can start saving energy right away.

4.1.1. Use Less Electricity, Natural Gas and Oil at Home

Heating and cooling

Maintaining constant heating and cooling levels in a room or a house when no one is in it, or everyone is sleeping, wastes a significant amount of energy; energy that can be saved if heating and cooling is scheduled for the times they are needed most, , like when residents are home and awake. Heating and cooling levels can be adjusted manually, but programmable thermostats are more effective at controlling temperature during different times of the day and week. Energy Star-certified programmable thermostats are eligible for rebates (50% of cost) from the IMLD. Using these thermostats can save about $180 a year on heating and cooling costs.[15] Using multiple heating and cooling zones that allow independent and separate control of different areas and floors of a home can conserve even more home heating and cooling energy.

Lighting

Turning off the lights in unoccupied rooms is an easy way to save energy, but getting in the habit requires practice, and the more members of a household that remember to do this, the more energy can be saved. Motion-activated light switches can be installed that automatically turn lights on and off based on room occupancy. For reading or other stationary activities, task lighting is a good way to conserve energy. Illuminate the work area with a single light, instead of using many lights to brighten an entire room.

Kitchen

The Energy Information Administration estimates up to 30% of the energy used at home is consumed in the kitchen[16], in particular by dishwashers, refrigerators and ovens. Using existing appliances wisely can result in considerable savings. For example, an average electric oven uses about 700 kWh of electricity

[15] www.energystar.gov

[16] http://www.eia.doe.gov/emeu/reps/enduse/er01_us.html

per year.[17] However, more efficient alternatives are available. Microwave ovens use less electricity because the food is heated more directly than conventional ovens, which heat food indirectly by heating the air space in the oven. Convection ovens use less energy than conventional ovens by using fans to circulate hot air around food as it cooks; as a result, convection ovens cook faster and at lower temperatures than conventional ovens. Convection ovens can also be loaded more fully than conventional ovens due to the increased air circulation. The U.S. Department of Energy estimates convection ovens are 23% more efficient than conventional ovens.[18]

To use stoves efficiently, keep burners and stove tops clean; cover pots and kettles when cooking; match the size of the pan to the burner; and use toasters and microwaves to heat small meals. Make sure the gaskets on ovens seal appropriately, otherwise heat is wasted, raises the temperature of the kitchen, and can increase the demand on a home's air conditioner. Some people save energy by turning off the stove and oven before the food is finished cooking, and allow it to finish cooking in the residual heat.

Because refrigerators and freezers are some of the largest electricity consumers in a home, adding a second refrigerator in the basement or garage adds a major energy drain. Often such units are older, and such units can cost more than $100 a year to run, according to the U.S. Department of Energy. Keep refrigerator temperatures between 35°F and 38°F, and keep the freezer at 0°F. Locate refrigerators and freezers away from heat sources such as ovens, dishwashers, and direct sunlight. Allow air circulation behind the unit by leaving a few inches between the wall and the back of the unit. Keep condenser coils clean on older models (coil cleaning brushes can be purchased at most hardware stores). Keep the refrigerator door closed as much as possible, and only open it when a specific item is needed. Make sure the rubber gasket lining makes a tight seal when the refrigerator is closed. One way to test the seal is to close the refrigerator door on a piece of paper— if the paper slips out, it is time to replace the gasket. Frost buildup of more than a quarter of an inch can interfere with a freezer's efficient operation; manual freezers should be periodically defrosted to avoid such buildup.

Use the dishwasher, rather than hand washing dishes. The US Environmental Protection Agency states that washing dishes by hand costs about $40 per year more in utility costs than washing them in a fully loaded dishwasher[19]. Avoid pre-rinsing dishes – just scrape food off dishes. Energy Star qualified dishwashers and current detergents are designed to do the cleaning for you. If dirty dishes sit overnight, use the dishwasher rinse feature (it uses a fraction of the water compared to hand rinsing). Dishwashers use almost the same amount of energy and water regardless of the number of dishes inside, so run full loads whenever possible. **S**elect the no-heat drying option and the most efficient settings (avoid power dry); it dries dishes well and uses less energy. When possible, let the dishes air dry.

[17] http://www.energysavers.gov/pdfs/energy_savers.pdf

[18] *Technical Support Document: Energy Efficiency Standards for Consumer Products,* U.S. DOE, 1993.

[19] http://www.energystar.gov/index.cfm?c=dishwash.pr_handwash_dishwash

Another useful conservation strategy in the kitchen is to keep the faucet lever in the cold position so the hot water heater is not turned on unnecessarily. Foot pedal faucet controllers allow hands-free dish washing and is reported to reduce water use (and energy to heat the water) in the kitchen by as much as 30%.[20]

Laundry

Clothes dryers are energy "hogs". The biggest way save energy in the laundry room is to air dry clothes on a laundry line when weather allows or on an indoor drying rack. This is how washed clothes are dried throughout the world, and many people love the fresh smell of clothes and sheets dried outdoors.

Energy (and cost) can also be saved by washing clothes in cold water, instead of hot or warm water. Cold water detergents are available that are just as effective as detergents used with hot water. This method offers the additional advantage of preserving colors. Run full loads in the washer and dryer for greatest efficiency.

Make sure the lint filter is cleaned after each load, and periodically check that the exhaust duct and the outside vent are clear of lint and other debris. If the outside vent is equipped with a spring door, make sure it closely tightly to prevent outside air from leaking in. Flexible hoses should be replaced with smooth pipes to prevent lint buildup, which compromises efficiency.

Bathroom

Depending upon the shower head's flow rate, taking showers instead of baths saves both water and energy used to heat the water. A low-flow shower head restricts the flow rate to about 1-2 gallons per minute (gpm), compared to about 5 gpm for one made before the 1990s. Limit showers to five minutes whenever possible. Keep the sink faucet in the cold position, so the hot water heater won't be triggered unnecessarily, and turn the water off while brushing teeth. Foot pedal faucet controllers (discussed in the Kitchen section above) save water and energy, and can be installed in new or existing bathrooms.

Home Electronics

Many home electronic devices use "standby" power, which creates "phantom load", where power is consumed even when the device is turned off, if it remains plugged in. Computers should be turned off or put in "sleep" mode when not being used. TV's, stereos, DVRs, cable boxes, etc. can be plugged into a surge protector/power strip which can be shut off when devices are not in use in order to eliminate "phantom loads." Some new "smart" surge protectors have features that automatically shut off power to devices when the main device is powered-down; others have motion detectors that automatically shut down devices when the room is unoccupied. Most new computer monitors do not require screen savers, so there is no longer any reason to run graphic-intense visual displays on unused monitors.

[20] http://www.metaefficient.com/bathroom-products/efficient-foot-pedal-faucet-controllers.html

4.1.2. Recycle and Compost

Recycling waste materials results in a lower carbon impact compared to producing new materials or incinerating solid waste. In addition, diverting materials from the waste stream through recycling saves the town approximately $45 per ton in disposal costs. Every time residents recycle, they reduce Town emissions and waste hauling expenses.

Reducing the amount of materials that need to be recycled or sent to the landfill is the most cost effective means to lower carbon emissions. This can be accomplished by wisely choosing products that contain minimal packaging or packaging that can be recycled, such as cardboard and paper. Buying non-perishable products such as rice, pasta, paper towels, and toilet paper in bulk quantities is another way to reduce packaging.

A large proportion of household solid waste is generated in the kitchen, where the high water content of discarded food increases the weight of trash hauling. It follows that home composting directly results in reduced trash transportation and disposal energy, and reduced hauling cost. Home composting usually involves easily degraded food products, such as vegetable, egg shell, and bread scraps, and is placed in outside compost bins in a homeowner's yard. The compostable food products are converted to rich soil that can be used in gardens and flower beds. Another type of composting that is becoming increasingly popular is curbside composting, which often can include all food products, not just vegetable material. For example, a new pilot composting program, funded through a local grant, at the Ipswich High School and Middle School diverts food scraps from the cafeteria to a local farm that uses the compost on site. Preliminary estimates indicate about 2,400 pounds of food scraps per month are diverted from the waste stream.

Recommendations:

- Recycle plastics, aluminum, glass, paper, and cardboard according to the instructions from the Town DPW.
- Purchasing products that have minimal packaging and buy in bulk quantities, whenever possible.
- Compost vegetable, egg shells, and bread scraps using an outdoor compost bin.

4.1.3. Transportation

Transportation is an area where a change of priorities and habits can lead to a dramatic reduction in a family's GHG emissions. Nationwide, automobile use represents about 51% of the typical household's emissions.[21]

Public transportation (commuter rail and seasonal bus service) is available in Ipswich and can be an effective way to reduce transportation costs and GHG emissions, particularly for those who regularly commute to workplaces along the MBTA train route. Public transportation offers other benefits, such as lowered vehicle maintenance expenses, potential reductions in automobile insurance, less stress during

[21] http://www.fueleconomy.gov/feg/climate.shtml

commuting, and more time to read a book or catch up on email (commuter rail has free Wi-Fi on some of its trains). In addition, many employers offer cash incentives to encourage their employees to use public transportation for commuting to work.

Carpooling is another way to reduce GHG emissions and lessen expenses associated with vehicle maintenance. Online services such as carpoolworld.com and commute.com can assist in connecting with others interested in joining a carpool group. In addition, as with public transportation, some employers offer incentives to employees who carpool to work. Special "high-occupancy vehicle" lanes are available on some highways during rush hour, which can shorten commuting time.

There are a number of ways to lower emissions while driving. Avoid idling of a vehicle while picking up kids or doing errands. Not only does idling waste fuel and cause unnecessarily emissions, with few exceptions it is illegal in Massachusetts to let a vehicle idle more than five minutes. Minimize vehicle warm-up times, since vehicles can be driven in less than one minute of starting without any deleterious effects). Combine multiple errands into one trip rather than making repeated trips. Accelerating and braking gradually saves fuel and reduces vehicle wear-and-tear. To improve gas mileage, make sure that vehicles are serviced regularly and the tires are inflated to the recommended pressure.

Recommendations:

- Reduce vehicle trips – combine errands, carpool, bike or walk, use public transportation where possible. Find information on alternatives to driving at www.commute.com.
- Maximize vehicle fuel efficiency – maintain the car, ensure your tires are properly inflated, and keep the rate of speed moderate (for more information visit www.eot.state.ma.us/gastips).
- Consider fuel efficiency as a major priority when buying a new car especially if many unavoidable miles are driven every year that cannot be reduced in other ways (See also Section 4.2.9: Vehicles).

4.2. Invest in Efficiency Upgrades

Energy efficiency refers to the amount of energy a product or system uses compared to others to do the same thing. More efficient models use less energy to do the same or a better job than less efficient models. For example, the Energy Star designation is awarded to more efficient appliances, electronic devices, and heating and cooling equipment that operate using less power. A building's efficiency refers to the energy required to heat and cool it. Modern construction techniques and materials are available that help save energy in buildings. For example, many homes have heating and cooling equipment and appliances that are more than twenty years old, which are typically inefficient compared with models available today. Federal, state, and IMLD rebates can help to lower the upfront costs of replacing old and inefficient heating and cooling systems. In addition, choosing a model based on efficiency results in energy cost savings for the lifetime of the product, which can often offset a higher purchase price within a few years.

4.2.1. Home Energy Audits

Home energy audits can identify sources of energy loss and potential areas for energy savings. Free residential energy audits are available through IMLD and its subcontractor, the Home Energy Loss Prevention Service (HELPS). Energy audits are important tools for homeowners who are interested in reducing their energy bills and reducing the carbon footprint of their homes. With an audit, Energy audits can give homeowners gain a clear picture of their household energy use and building energy losses and can identify and help them to make informed decisions about energy improvements and upgrades. One of the most helpful aspects is use of an infrared camera to determine where insulation may be missing or dislodged.

For a much more detailed and comprehensive energy audit, independent auditors can be hired for between $350-$1,200 (depending on the size and complexity of the house). These professionals offer blower door tests to identify the weak points in the building envelope and assess overall building air leakage. They also assess efficiency of combustion equipment, such as heating and cooling systems, appliances, windows and doors, etc. After completion of a comprehensive energy audit, a home is assigned an overall rating of energy use, which indicates how the home compares with other homes and where improvements can be made.

Recommendations:

- Call 1-888-333-7525 to schedule a free home energy audit from HELPS.
- Hire an independent professional for a more comprehensive home energy audit.

4.2.2. Insulation and Air Sealing

One of the most cost-effective energy strategies a homeowner can do is to improve the insulation and air sealing in their homes. The Department of Energy (DOE) reports that only 20% of homes built before 1980 are adequately sealed and insulated.[22] One way to detect a problem of inadequate insulation and air sealing is to observe whether ice dams and icicles form at the roof's edge a few days after a snow storm– ice dams are formed from interior heat melting the snow on the roof, which then freezes at the colder roof edge. Both air sealing and insulation are low-cost high-yield investments and work best together, because air sealing improves the performance of insulation the same way that putting on a wind breaker over a sweater makes a person warmer in cold weather.

Homeowners should insulate exterior walls, basement ceilings, and attics in order to create a complete thermal barrier around their heated living space. They should also seal around the areas where electric wires, water and gas pipes cross a thermal barrier, such as penetrations through the outer wall of the home. Drafty windows should be sealed with removable rope caulking in winter and/or insulated blinds. Attic hatches should have insulated covers with gaskets to prevent heat escaping from the top floor into the home's attic. Many companies now offer comprehensive air sealing and insulation upgrade services. Older homes tend to have exposed attics and basements where insulation can easily be added. Blown-in

[22] U.S. Department of Energy

(cellulose or fiberglass) or sprayed-in (various formulations of expanding foam) insulation allows significantly less air leakage than fiberglass batt insulation because it seals much better against framing, pipes and electrical penetrations.

The DOE estimates that with proper insulation and air sealing, residents can save up to 30% on home heating and cooling costs. As the average New Englander spends $2983 per year to heat a home this represents a significant savings. Homeowners can recoup their investments in 2 years or less in houses with no insulation, and in 3 to 7 years for insulation upgrades. An added benefit for homeowners is that well-insulated and air sealed homes are more comfortable year round, as they protect against both temperature extremes. [23]

Households that are eligible for fuel assistance are also eligible for home weatherization through the Weatherization Assistance Program. This service typically includes insulation and air sealing of the attic, sidewalls, and basement ceiling. More information is available from the Weatherization Assistance Program at www.mass.gov.

Recommendations:

- Insulate homes to provide a barrier around the heated living areas on all sides.
  - ✓ Add insulation in attics up to R-50 insulation level for New England climate
  - ✓ Install rigid foam insulation to inside of basement walls
  - ✓ Install fiberglass insulation on underside of 1st floor in basement
  - ✓ Install rigid foam insulation dome over pull-down attic stairs
- Seal holes and drafty areas to prevent airflow between indoors and outdoors.
  - ✓ Install caulking between baseboards and outside walls, and around windows and door trim
  - ✓ Spray expanding foam insulation (available in small cans) around wires and pipes in attics and basements
  - ✓ Install foam gaskets behind electrical outlets and switches on outside walls

[23] National Energy Assistance Directors Association/Boston Globe article from March 24 titled "$100 million sought in emergency aid for heating".

Figure 4.2 An example of blown-in, closed-cell foam insulation installed in the attic of a home.

4.2.3. Windows and Doors

Many older homes in Ipswich have single-pane glazed windows and uninsulated exterior doors, both of which are major sources of heat loss. Installing new insulated doors with modern weather stripping can provide significant energy savings. Another option is to install a high-quality, tight-fitting storm door on the exterior of wood doors. In homes that have windows with side cavities containing window weights on pulleys, the cavities may cause more heat loss than the windows themselves. Installing new windows and insulating the cavities around them can reduce home energy costs by up to 20%. New, insulated "Low-E" (low emissivity) windows offer three times the insulating properties of single-pane glazed windows. They reflect heat instead of light to keep living spaces warmer in winter and cooler in summer. Although installing new windows and doors can generate significant energy savings and add to a home's value, this can be an expensive upgrade.

A more affordable option is to install insulated interior window coverings. These are a much less expensive, yet highly effective alternative to replacing windows. Insulated blinds can be purchased for around $100-$150 for an average size window and will triple the insulating properties of an uninsulated window. Insulated drapes are also an effective means of adding insulation, although these are less effective at air sealing than insulated blinds.

Recommendations:

- Check whether existing windows and doors are energy efficient.

- Install insulated fiberglass doors or storm doors on the exterior of wood doors.
- Insulate and weather-strip windows if needed, especially in window weight cavities.
- Replace single pane windows with insulated Low-E glass windows.
- Install insulated blinds or drapes over windows.
- Visit www.energystar.gov to research possible rebates and tax credits.

4.2.4. HVAC Upgrades

Improving the efficiency of heating, ventilation, and air conditioning ("HVAC") equipment is a crucial long-term priority for reducing home energy demands. Homeowners should get their heating equipment tested for its rated efficiency. Equipment which tests at 75% efficient or lower should be replaced (most furnace over 20 years old are in this category). Federal rebates for efficient heating and cooling equipment upgrades are available through 2016. Go to www.energystar.gov for information on rebates and tax credits.

Replacing a boiler or furnace requires a significant monetary investment by homeowners and carries a typical payback from energy savings of 6 to 8 years. The age and efficiency of the current system will be major factors in deciding on whether and when to make such an investment. At a minimum, boilers or furnaces that fail should be replaced by more efficient systems. Energy efficient options are available for most types of boilers and furnaces (gas and propane boilers are available with efficiency ratings of up to 96%, oil boilers and furnaces with ratings up to 90% efficient). Choose the most energy efficient model in your price range. Although 95% efficient gas furnaces are among the more expensive options, most experts agree that this is an optimal system in locations where natural gas is available.

A home's overall heating efficiency is determined both by the heating equipment and the efficiency of the heat distribution infrastructure of the house, which is generally much less expensive to upgrade. According to the Energy Star website, homeowners can improve the heating efficiency of their homes by as much as 20% by air sealing and insulating heating pipes and ducts[24], especially in unfinished basements. The vast majority of houses with ducted heated and cooling have inadequately air sealed and insulated, which offers a great opportunity for a major efficiency upgrade at a low-to-moderate cost.

Improving home cooling system efficiency can also create significant energy savings. Energy Star-rated air conditioners are available for both centralized systems (which have a minimum Seasonal Energy Efficiency Ratio or "SEER" of 14.5) and room units (which have a minimum Energy Efficiency Ratio or "EER" of 10.7 for units smaller than 6,000 Btu). Using Energy Star-rated cooling equipment can save as much as 20% on cooling costs.[25]

[24] http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing

[25] http://www.energystar.gov/index.cfm?c=heat_cool.pr_checklist_consumers

In addition to a wide-range of energy efficient heating systems available, homeowners can further reduce their home heating demands by buying new heating equipment, or retrofitting existing systems, with options such as outdoor temperature setback control device. These devices save energy by measuring the temperature outside the house and adjusting the boiler temperature appropriately. Because the heat loss of a home (and the corresponding energy demands placed on a heating system) is related to the outdoor temperature, an outdoor temperature setback control device allows a boiler to operate "smarter" and consume less energy.[26]

Recommendations:

- Determine the rated efficiency of heating and air conditioning units and replace equipment that is less than 75% efficient.
- Choose new Energy Star-qualified heating systems and air conditioners.
- Buy the most efficient system in your price range.
- In neighborhoods where natural gas lines have been installed, investigate whether switching from oil to natural gas makes sense. Switching incentives are sometimes available from utilities and dealers.
- Insulate and air seal heating ducts (best done by a professional).
- Install foam pipe insulation around heating and hot water pipes
- Visit www.energystar.gov for information on rebates and tax credits.

4.2.5. Water Heaters

Energy Star estimates that households in the Northeast spend on average $400-$600 per year heating water. Different water heater technologies and models have a wide range of efficiencies and operating costs associated with them, and as a result, the choice of a water heater can have a significant impact on energy usage and emissions. There are four main types of residential water heaters:

1. **Electric water heaters** have the shortest life expectancy and the highest operating costs. The water in the tank is heated by electric coils and kept at a constant temperature. Electric water heaters typically last 10 years before they need to be replaced.
2. **Gas water heaters** are more efficient than electric ones and have double the life expectancy. The annual operating costs of gas water heaters are typically about half as much as those for electric water heaters. Gas water heaters require venting of combustion exhausts.
3. **Indirect-fired water heaters** are storage tanks that work in conjunction with oil or gas fired boilers. These heaters have no burner, operating instead as a zone utilizing the heating capacity (and efficiency) of the boiler. Because these tanks have no burner, the life expectancy is usually 30 years or more.
4. **Gas tankless water heaters** are the most efficient type of water heater and have the lowest operating costs. These water heaters operate "on demand" – water is heated very rapidly when the hot water tap is turned on. When hot water is no longer needed, the equipment stops

[26] www.tekmarcontrols.com/tn4/reset.html and www.homeowners.taco-hvac.com/products

running. Unlike the three alternatives previously mentioned, this type of system eliminates the need for a water tank to be heated to a set temperature at all times. Gas tankless heaters require a source of natural gas and a flue or power vent for venting.

5. Electric tankless water heaters are available, but are not a cost-effective or efficient option under most circumstances. The exception is small tankless water heaters installed very near the point of end use, such as water heaters that raise the water temperature for a dishwasher, or for remote, infrequently-used sinks.

See http://www.consumerenergycenter.org/home/appliances/waterheaters.html for more information on different types of hot water heaters.

It is best to plan ahead and understand the options for and requirements of replacing your current hot water heater before it fails. Knowing that replacing a tank heater with a tankless system requires an exhaust vent to the outside, for example, will make it easier and more convenient to switch technologies at the time of replacement, rather than urgently replacing the failed unit with another tank heater. Keep in mind that with the federal energy tax credit, payback time for an efficient water heater upgrade can be as low as 1-2 years.[27]

For most hot water heating systems, a set point temperature above 120°F is unnecessary, and has been shown to waste energy and increase hot water costs.[28] Exceptions can include dish washers without booster heaters, which may need hot water set point temperatures between 130°F and 140°F for optimal cleaning.

Recommendations:

- Research the variety of systems that are available, in order to understand a sense of what will work best to meet your needs, and if switching technologies, what additional work may be required, before the existing equipment fails.
- Factor energy efficiency and return on investment into the decision process.
- Set the water heater set point temperature no greater than 120°F. Higher set point temperatures have been shown to waste money.
- See http://www.consumerenergycenter.org/home/appliances/waterheaters.html for more information on different types of hot water heaters.
-

Success Story:

The owner of an Ipswich house with an old, oil-fired hot water boiler converted to natural gas and installed a 96% efficient condensing boiler. As a result of these changes, the annual heating and hot water costs were reduced from $2,944 to $1,263. The homeowner also received a $1,000 rebate from the

[27] http://www.energystar.gov/ia/partners/manuf_res/downloads/WH_PartnerResourceGuide_2009.pdf

[28] http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13090

gas company for making the conversion. The combination of energy cost savings and the rebate means a short expected payback period on the new equipment.

4.2.6. Lighting

Electric lighting accounts for about 15% of household electricity use.[29] Replacing traditional incandescent bulbs with more efficient options is one of the easiest and least expensive ways to reduce energy consumption and lower utility bills. CFLs are widely available and use 75% less energy than traditional incandescent bulbs[30] (Note that CFL bulbs contain trace amounts of mercury and should be disposed of in special cartons located at the IMLD, Town Hall, and at many home improvement retail stores). The new LED lights are even more efficient and longer-lasting than CFLs. To find out more about efficient lighting, please refer to Section 5.2 in the commercial/industrial section of this report.

Avoid installing recessed lights in insulated ceilings, which can create a void or weak spot in the insulation and compromise the thermal barrier of the building envelope. Heat from the conditioned living space can escape through recessed lights (much like heat rises through a chimney).

Recommendations:

- Replace incandescent light bulbs with CFLs or LEDs.
- Dispose of used CFLs in proper recycling drop-off locations (e.g., Town Hall, IMLD, retailers). These bulbs contain mercury and should not be thrown into the trash.
- Avoid installing recessed lights in insulated ceilings.

4.2.7. Appliances and Energy Star Rebates

The two household appliances that use the most energy are refrigerators and clothes washers. Since it is expensive to run these appliances, homeowners should invest in efficient equipment that utilizes advanced technology. Energy Star-rated appliances perform as well or better than standard models. According to the Energy Star website, replacing a refrigerator from the 1980s with a new, efficient model will save about $100 per year on usage costs. Making a similar upgrade to a 10-year old clothes washer will save about $137 per year on utility bills. Energy Star-qualified clothes washers use about 37% less energy and use at least 50 percent less water than regular models. In addition, many have greater capacity, which translates to fewer loads of laundry.[31] To check the efficiency of appliance models check www.energystar.gov or www.appliances.energy.ca.gov.

[29] www.energysavers.gov

[30] http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12050

[31] www.energystar.gov

Although a new refrigerator or freezer is an added expense, the newest Energy Star-qualified units cost half as much to run as pre-1993 units.[32] Consider buying a refrigerator with a top-mounted freezer, which uses 10 to 25% less energy than bottom-mounted or side-by-side models. Automatic ice-makers and through-the-door dispensers increase energy use by 14 to 20%.[33] The larger the unit, the more energy it consumes, so purchase an appropriately –sized refrigerator. If you purchase a stand-alone freezer, chest freezers are generally more energy efficient than upright freezers.

When installing or replacing a dishwasher, purchase an Energy Star-qualified unit and choose the right size dishwasher for the home. Compact-capacity models hold up to eight place settings and six serving pieces; standard-capacity models hold even more. If you operate a compact model frequently, you may use more energy over time than you would with a standard model. Choose a dishwasher with several wash cycle options, as energy-saving wash cycles use less water for a shorter period of time.

Clothes washers that are more than 10 years old should be replaced with a new Energy Star-qualified washer. Energy Star-qualified clothes washers use about 37% less energy and use over 50% less water than regular washers and can save $135 each year on utility bills.[34] Many qualified clothes washers also have a greater capacity than conventional models, meaning fewer loads of laundry.

Clothes dryers are also a major culprit when it comes to energy use. Unfortunately, there are no Energy Star-rated models on in U.S. stores, because more efficient technologies are not available. This is also the reason why the Federal Trade Commission does not require Energy Guide labels for clothes dryers.[35] At this time, clothes lines and air drying are the only efficient options available.

Although a damp basement makes it tempting to run a dehumidifier, avoid using a dehumidifier whenever possible, because they consume a great deal of electricity. In homes with excess basement humidity, insulating basement walls and sealing basement floors can eliminate humidity and condensation without resorting to a dehumidifier.

IMLD offers rebates to Ipswich residents for purchasing Energy Star-rated appliances, thermostats, and air conditioners. Rebates range from $20 to $475, and often are enough to offset the higher price of Energy Star appliances over less efficient models. Since Energy Star appliances have relatively short payback periods in the first place, the IMLD rebates are basically free cash for residents. To find out more information about the IMLD Energy Star rebate program for residents, visit www.IpswichUtilities.org or visit the IMLD office at 272 High Street. The process is as simple as filling out a form and attaching a receipt. Federal and/or state rebates or other incentives for purchasing Energy

[32] http://www.energysavers.gov/pdfs/guide_to_kitchen_appliances.pdf

[33] http://www.energysavers.gov/pdfs/guide_to_kitchen_appliances.pdf

[34] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW

[35] http://www.energystar.gov

Star appliances may be available as well. To learn about federal or state incentive programs, visit www.energystar.gov.

Recommendations:

- Replace inefficient appliances with highly-efficient Energy Star-qualified models. To check the efficiency of appliance models check www.energystar.gov or www.appliances.energy.ca.gov.
- Take advantage of the IMLD Energy Star rebates when purchasing an Energy Star appliance (www.ipswichutilities.org).
- Investigate the availability of federal or state rebates or tax incentives are available (www.energystar.gov).
- Air-dry rather than machine-dry laundry whenever possible.
- Avoid using dehumidifiers. These use lots of electricity to operate. In homes with excess basement humidity, insulating basement walls and sealing basement floors can eliminate humidity and condensation without the use of a dehumidifier.
- Avoid the operation of a 2nd refrigerator, especially if it is an older, inefficient model.

Success Story

One local family has dramatically improved their home's energy performance. Their house was built in 1955. At the time of purchase in 1988, the house was an uninsulated, one-story ranch house with single glazed windows, contained the original furnace and water heater, and all incandescent lighting Since then, the house has undergone a gut renovation and a second floor addition to convert it to a Cape style. The project included many energy upgrades, including insulation throughout the house(R-13 fiberglass for 1st floor walls; R-21 for 2nd floor 2 x 6 walls; R-38 for 2nd floor flat ceiling; R-30 for 2nd floor sloped ceilings; 1" extruded Styrofoam insulation (R-5) for inside foundation; air sealing and insulation (to R-26) for1st floor perimeter; insulated concrete slab floor, R-19 2 X 6 walls and double-layer fiberglass (R-49) ceiling for breezeway; foam gaskets on electrical outlets and switches);new Low-E, argon-filled glass windows; new heat systems (85% efficient oil boiler, new 80% efficient woodstove installed for breezeway heat source; new wood pellet fireplace insert in dining room fireplace, now used as the main heating source; outside combustion air supply for two wood burning stoves); new Energy Star-qualified appliances; and CFL,LED, and fluorescent lights in 50 of 57 light sockets.

Following these renovations, an energy audit was conducted in 2010, which measured 0.28 air changes per hour (less than 0.35 air changes is considered a "tight" house), and a Certified Home Energy Rating System (HERS) score of 64, which indicates that this house uses 36% less energy than a house built to the 2006 International Energy Code. This rating (lower is better) also surpasses the qualifying score of 85 for Energy Star compliance and the qualifying score of 70 for the Stretch Energy Code for houses under 3000 square feet. Annual oil costs for heating and hot water have averaged only $777 for the past 2 years.

4.2.8. Efficient Vehicle Choices

If it is time to replace a vehicle, compare the gas mileage ratings of the types or models being considered (e.g., www.fueleconomy.gov). Better gas mileage means spending less on gasoline. These savings can add up quickly. For example, assuming 15,000 annual driving miles and $3.52 gasoline,

driving a car that gets 30 miles per gallon (mpg) instead of one that gets 20 mpg saves $880 per year, or $4,400 over five years (www.fueleconomy.gov).

Consider purchasing a hybrid vehicle, or even a new plug-in hybrid or electric vehicle. The number and type of hybrid vehicles available from manufacturers will continue to increase, and many are affordable today. Although tax incentives for most standard hybrid vehicles have expired, buyers of new plug-in hybrid and fully electric vehicles are eligible for up to $7,500 in tax credits (consult www.IRS.gov for details). In addition, some employers offer incentives to employees who commute to work with hybrid vehicles.

4.3. Residential Renewable Energy

Many Ipswich residents will decide to go beyond energy conservation and efficiency to reduce their carbon emissions footprints even further, and will look to renewable energy systems for their homes or properties. However, it is important to address energy waste through conservation and efficiency strategies before deciding to invest in a renewable energy system, so that the new system can have the maximum impact. Energy conservation and efficiency efforts should be the first priority because they generate much greater energy savings per dollar invested[36] compared to residential renewable installations. For example, replacing a 100-watt incandescent light with a 25-watt, equivalent compact fluorescent saves 75 watts, or about $0.16/watt in return for the $4 investment in the CFL. Solar photovoltaic (PV) systems require a large initial investment (e.g., $35,000 for a 4 kilowatt system) making the cost per watt much higher (i.e., $7.50/watt, or about $3.25/watt after considering the incentives and rebates available to Ipswich residents). Consequently, the return on investment for a solar PV system (after incentives) may be 20 years, compared to an 18-day payback for a 25-watt CFL. Therefore, homeowners should consider renewable energy only after they have reduced their home energy demands as much as possible through energy conservation and efficiency measures.

For those who are ready to proceed with renewable energy at their homes and properties, these systems are now both practically and economically feasible, due to a combination of advances in technology and performance, decreases in manufacturing and installation costs, and various federal, state or local incentives. Aiming for net-zero living (no emissions impact) is increasingly achievable.

There are a variety of renewable energy systems designed to be installed in residential homes and properties. Not every technology may be suited to every home, property or situation, however, so homeowners should fully evaluate the feasibility of installing the different types of renewable energy systems on their own property. The following sections describe some of the renewable technologies available for home use. It is important to note that the economics of renewable energy are dynamic; factors such as costs and payback periods change over time as energy prices fluctuate; as the efficiencies of renewable technologies improve, renewable energy system prices come down; and the presence and

[36] U.S. Department of Energy

extent of local, state and federal incentives; all will remain key drivers in determining whether and which renewable systems are affordable in the future.

4.3.1. Solar Energy

Solar installations require substantial access to the sun either on south facing roofs or on ground installations. Both installations only work where the panels are not shaded by surrounding trees or hills. Current federal tax credits for solar systems are available through 2016, and IMLD rebates of up to $10,000 are available for photovoltaic (PV) installations through 2011. As of 2010, Federal Renewable Energy Tax Credits for renewable energy home improvements are calculated at 30% of the purchase price with no upper limit for the purchase.

Solar Hot Water

Most solar hot water systems utilize a water glycol (antifreeze) solution which circulates between the solar collectors and a heat exchanger (2nd water heater tank) in the basement. The heated glycol solution is circulated in a coil through the solar hot water storage tank, and the two liquids never mix while the domestic water is heated.

Solar hot water systems can cost between $5,000-$8000 dollars and reduce domestic hot water costs by 50%-80%. In the Northeast, payback through energy savings is expected in ten years or less. Solar hot water installations have among the lowest costs and fastest paybacks of any renewable installation, and are impacted less by partial shading than solar PV systems.

Success Story:

An Ipswich family installed a Schuco 3-panel "Slim V" solar hot water system, including an 80 gallon tank with a circulating pump, in February 2008. The net purchase cost of the system was $6,500 ($9,500 purchase price less $2,000 Federal rebate and $1,000 State rebate).Payback is expected in 9-10 years. The system provides about 75% of annual hot water needs (90% spring through fall, 55% winter).

Solar Photovoltaic

Solar Photovoltaic (PV) systems combine PV panels on the roof with an inverter, which converts DC power from the system to AC electricity that can be used in the home. Solar PV systems cost between $7.50 and $10 per watt of installed solar power before subsidies. A typical solar PV system may cost between $25,000 and $35,000, although rebates and tax credits can reduce the upfront costs by one-third or more. Typical payback time can be 10 years or less after all incentives.

The Ipswich Net Metering policy allows homeowners who produce unused electrical power from their renewable energy systems to feed that electricity into the town's electrical distribution system. Homeowners receive credits for this electricity on their electricity bill. Installations with a rated capacity of up to 10 kW are eligible to participate in this program.

Ipswich IMLD customers are eligible for significant solar PV rebates through HELPS PV, which provides one-time incentive payments of up to $10,000 per account for the installation of a PV system connected

to the electrical system in their homes. HELPS PV will provide a rebate of up to $3.00 per installed watt of PV, depending upon the equipment used in your installation. If the panels or inverters are manufactured in Massachusetts the customer will receive an additional $0.50 per installed watt.

Success Story:

Taking advantage of Federal, State and the IMLD HELPS PV program, an Ipswich household installed a 3.15 kW PV system with 18 SunTech 175 panels in May 2010. The system is projected to produce 3,764 kWH annually, which will offset approximately 35% of the homeowner's electricity use. The family anticipates being able to shorten the payback time of their system even more by selling renewable energy credits (RECS) via the Massachusetts Solar Credit Clearinghouse Auction in 2011.

Figure 4.3: An 18-panel, 3 kw solar array installed on the roof of a residential home in Ipswich in 2010. The IMLD HELPS PV program and state and federal incentives helped defray some of the costs of the system for the homeowner.

4.3.2. Wind Turbines

Residential wind turbines are smaller (1-10 kW) versions of commercially-sized turbines, and currently cost $15,000 to $50,000. As with solar installations, Federal tax credits are currently available through 2016 for wind energy installations. Renewable Energy Tax Credits for renewable energy home improvements are calculated at 30% of the purchase price with no upper limit for the purchase as of 2010.

4.3.3. Wood and Wood Pellets

Wood is a traditional renewable heat source in New England. Both woodstoves and pellet burning stoves can be considered to be carbon neutral because the carbon emitted by burning wood is

comparable to the carbon that would be absorbed as the plants grow. The latest generation of wood stoves operate considerably more efficiently (rated efficiency 80-88%) and cleanly (emissions of 2.5-3.4 grams per hour)[37] than the woodstoves and fireplaces of the past, and can be used as the primary heat source in smaller and/or well-insulated homes. In rural areas where cordwood is relatively inexpensive, wood stoves can be an economical way to heat a home.

Wood pellets have become more widely accepted as a heat source, in part because they can be used in multiple ways. Boilers, furnaces, heating stoves, and fireplace inserts that burn wood pellets are available. Pellet stoves typically have rated efficiencies of 80-95%, but wood pellets have heat output 4-5 times greater than the same amount of cordwood, and produce extremely low carbon emissions and ash.[38]

4.3.4. Geothermal Power

Geothermal systems can contribute to household space heating and cooling, and hot water. Geothermal heat pump systems move heat from deep in the ground, which has a fairly consistent temperature of around 55°F year-round, to a building (or from a building to the ground) through a series of flexible pipe "loops" containing a refrigerant. The refrigerant is pumped through a closed loop in a way that creates two distinct temperature zones— a cold zone and a hot zone. In the winter, heat from the relatively warmer ground goes through the heat exchanger into the building. In the summer, hot air from the building is pulled through the heat exchanger into the relatively cooler ground. Geothermal heat pump systems are so efficient that they have been shown to reduce energy consumption—and corresponding emissions—up to 44% compared to air-source heat pumps and up to 72% compared to electric resistance heating with standard air-conditioning equipment.[39] In the Ipswich area, geothermal systems typically cost $40,000+, and federal tax credits cover up to 30% of the purchase price through 2016. For more detailed descriptions of geothermal heating and cooling systems, visit: www.northeastgeo.com or www1.eere.energy.gov/geothermal/.

Renewable Energy Recommendations:

- Assess solar orientation and access to determine whether a house or property is suitably sited for collecting solar energy.
- Remember that solar hot water offers the fastest payback of solar installations and is generally the lowest cost renewable energy system to install.
- Consider installing an efficient pellet fireplace insert or stove for clean, cheap renewable energy.
- Replace older woodstoves with newer more efficient models or with pellet stoves.
- Investigate whether solar PV or geothermal is a viable option for your site.

[37] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12570

[38] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12570

[39] http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12660

- Research State and Federal tax credits for renewables (http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F) and the Ipswich Solar Rebate Program (http://www.munihelps.org/Ipswich_Solar_PV_Rebate_Program.html).

4.3.5. Green Power Purchase Programs

Although it is not yet available in Ipswich, a Green Power Purchase program may someday be an option for Ipswich utility customers. Under such a program, for example, residents may be able to purchase electricity exclusively from Town wind turbines and solar installations in the future, at a slightly higher rate than the standard rate for electricity. Such a program would be voluntary, opt-in program, but sufficient numbers of subscribers would be needed in order to keep the program going. Green power purchase programs offer a reasonable alternative for people who can't install their own renewable energy sources.

4.4. Community Awareness and Engagement

4.4.1. Political Activity

It is important to keep up to date with energy-related legislation, and to support legislation that has a positive impact on reducing GHG emissions. Proposals aimed at conserving energy and protecting the climate (such as the Stretch Energy Code) will be considered by various Town boards and Town Meetings and will periodically need the support of Ipswich voters and citizens. Similarly, elected officials at the State and Federal level should hear from community members in support of heightened efforts to reduce GHG emissions. Ipswich residents can also get involved by working with groups such as this Commission, the Ipswich Recycling Committee, Ipswich Citizens Advocating Renewable Energy (ICARE), and various other local and nonprofit organizations that devoted to climate and environmental issues.

4.4.2. Community Engagement

Ipswich is fortunate to have many public and private organizations (farms, schools, green businesses, nonprofits, and local clubs) that set important examples of more sustainable living. Many of these organizations sponsor events, discussions, and film showings for the public. Notice when and where these events occur, and invite a neighbor to attend. Help raise awareness of the educational opportunities that happen close to home.

Also begin to notice when schools, businesses or other organizations fall short in using energy-saving practices. Consider talking with them about how they might be able to improve their carbon footprint for everyone's benefit. Let these organizations know that conservation and efficiency practices are valued in Ipswich, and organizations that follow them may draw more customers or constituents as a result.

5. Commercial/Industrial Sector Plan

The Ipswich 2009 Energy Use and Greenhouse Gas (GHG) Inventory estimated that the Town's commercial/industrial (C/I) sector contributed approximately 34% of Ipswich's total GHG emissions in 2005, and projected an increase to 39% of total emissions in 2020. The major sources of C/I sector GHG emissions in 2005 were electricity (49%) and natural gas (34%) consumption, with the balance from heating oil, gasoline/diesel fuel, and solid waste.[40]

By pursuing energy efficiency, conservation and renewable energy strategies, businesses can simultaneously reduce their GHG emissions and improve their competitiveness. Beyond the direct, bottom-line benefit of reducing energy costs, adoption of GHG-reducing practices and investment in more efficient technologies are becoming increasingly important to businesses' public images and reputations. A growing number of consumers and businesses are increasingly interested in doing business with companies that follow environmentally-sustainable standards and practices. Additionally, in many cases, government incentives are available that can improve the return on investment, shorten payback times, and help make the business case for investments in GHG-reducing technologies and practices.

Businesses with Different Energy Profiles Need Different Strategies to Reduce Energy Use

Ipswich plays host to a wide range of economic activities, and has approximately 670 businesses of various types registered with the Town Assessor's Office.[41] Businesses all have unique characteristics underlying their own specific needs for and uses of energy, but although the energy profiles may be quite different for individual businesses in a given category (restaurants, gas stations, manufacturers, etc.), each category has a general set of attributes and needs that influence its energy profile, and can be used to help identify the energy conservation, efficiency and/or renewable technology investments with the most potential for a given business. These attributes should be kept in mind as particular businesses attempt to take advantage of various GHG reduction strategies, and as energy audits are conducted among town businesses. For example, agricultural and recreational businesses are typically accompanied by large tracts of open space that may include potentially viable sites for renewable energy installations, while restaurants and caterers require a significant amount of heating, refrigeration, and dishwashing and should therefore focus on having efficient equipment.

Two companies, New England Biolabs and EBSCO Publishing, dominate Ipswich's C/I sector in terms of building size, employee headcount, electricity useage, and revenues. Both companies have emerged as leaders in local GHG reduction efforts. Several of the initiatives undertaken by these two companies are featured as Success Stories throughout this report. However, most Ipswich businesses operate on a

[40] Ipswich Energy Use and Greenhouse Gas Inventory, 2009.

[41] Ipswich Assessors Office Database, 2010.

smaller scale; most gross less than $1M/year, and occupy less than 8,000 sq. ft. of building space and 0.5 acres of land (excluding farms and recreational businesses).

Incentive Programs for Businesses to Invest in Energy Efficiency and Renewable Energy

Up until recently, there have been few incentive programs for businesses at the local level. Beginning in 2010, the IMLD and MMWEC instituted various incentive programs, including the *Commercial/Industrial Retrofit* and *New Construction and Major Renovation* pilot programs, to encourage its business customers to invest in energy efficiency and renewable energy. Through the *Commercial/Industrial Retrofit Pilot Program*, IMLD will pay 100% of the cost of energy audits. Businesses that implement energy audit recommendations can apply for rebates of up to 50% of implementation costs up to $5,000 or $10,000, depending on the size of the business, for projects such as renewable energy installations, lighting upgrades, and upgrades to variable frequency drive motors.[42] The *New Construction and Major Renovation Pilot Program* provides technical services and financial incentives to further the installation of highly efficient equipment for time-dependent projects, such as new construction and replacement of equipment that fails or is near the end of its useful life.

These new programs are meant to encourage businesses to implement energy efficiency, conservation and renewable energy strategies that will lower their energy usage and operational costs. Ipswich businesspeople with ideas for how to increase participation in these valuable programs are encouraged to contact IMLD directly.

Ipswich businesses may be eligible to participate in statewide incentive programs as well. The Massachusetts Clean Energy Center (MassCEC) provides funds for growth and venture capital investment in clean energy, and sponsors Catalyst Program Awards to businesses that successfully implement clean energy programs.[43] Other incentives for businesses include renewable energy property and personal tax exemptions, alternative energy and conservation patent exemptions, solar and wind excise tax deductions, and microloan programs.[44]

Finally, Federal incentives for businesses are available, including corporate tax deductions and tax credits for energy efficient buildings and renewable energy systems (e.g., energy investment tax credits, new home energy-efficient tax credits for home builders, renewable electricity production tax credit), federal grant programs, and federal loan programs (e.g., Clean Renewable Energy Bonds, Qualified Energy Conservation Bonds, US Department of Energy Loan Guarantee Program, USDA Rural Energy for America Program [REAP] Loan Guarantees).[45]

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[42] MA Municipal Whole Electric Company website: www.mmwec.org

[43] Massachusetts Clean Energy Center website: www.masscec.com/.

[44] Database of State Initiatives for Renewables and Efficiency (DSIRE) has up-to-date listings of available resources, http://www.dsireusa.org/incentives/index.cfm?state=MA.

[45] For more information on federal incentives for energy efficiency and renewable energy, visit: http://www.energy.gov/utilities_tax_incentives.htm.

Aligning Business and Landlord Energy Investment Incentives

For many energy efficiency and renewable energy investments, the combined benefits of energy savings and incentive programs together produce a return on investment that is high enough to justify implementation. This is a relatively straightforward equation for businesses that own the buildings or properties in which they operate; owners pay for the investment and in turn receive the combined benefits of the energy savings and incentives.

In contrast, businesses that lease space, and the building owners who lease that space to tenants, may not achieve the same high returns for many types of energy investments, especially HVAC equipment and building envelope energy efficiency upgrades. In most commercial leases, tenants pay a prorated share of building operating costs, while the building's owner pays for capital improvements. As a result, a business tenant typically has neither the incentive nor the authority to invest in HVAC equipment or building envelope upgrades, since the building owner owns and maintains these systems. Conversely, building owners have little incentive to invest in HVAC or building envelope energy efficiency improvements, since although they may be eligible for incentives, the tenants rather than the owner of the building would receive the energy savings benefits. This creates a major obstacle to widespread adoption of energy efficiency investments in commercial buildings.

Real estate developers, property managers, businesses, and federal, state and municipal governments have begun to try to address this issue. For example, sustainability clauses have been added to leases that divide the savings generated by efficiency investments between the tenant and building owner, allowing building owners to recover their energy efficiency investments, or use the savings to make additional equipment or building envelope upgrades. The Obama Administration's proposed Better Building Initiative would increase existing tax incentives for building owners to make their properties more energy efficient.[46] The State of California is implementing a publicly-available energy efficiency rating system for commercial buildings.[47] New York City's Greener, Greater Buildings Plan attempts to encourage adoption of sustainability clauses in commercial leases through changes to energy efficiency requirements for new and newly-renovated commercial buildings.[48]

In Ipswich, the combined efforts and dialogue of businesses, landlords, government and citizens will be needed to resolve these incentive issues and ensure the widespread adoption of energy efficiency upgrades to the Town's commercial buildings that will be needed in order for the Town to reach its 2020 GHG emissions target.

[46] http://www.whitehouse.gov/the-press-office/2011/02/03/president-obama-s-plan-win-future-making-american-businesses-more-energy

[47] http://www.energy.ca.gov/greenbuilding/documents/background/02_GREEN_BUILDING_ACTION_PLAN.PDF

[48] http://www.nyc.gov/html/planyc2030/html/plan/buildings_plan.shtml

Call to Action

The top priorities identified for Ipswich businesses include:

- Contact IMLD to schedule a free energy audit and assess current and projected future energy needs and use.
- Include IMLD rebates and state and Federal incentives when calculating the return on investment, payback time of energy efficiency and renewable energy investments under consideration.
- Contact IMLD if you have for suggestions on how to improve or increase participation in its new rebate programs.
- Use the results of the energy audit, assessment of current and projected future energy use, and return on investment of potential energy investments to develop short-, medium- and long-term energy plans. Depending on your business, this plan may include a combination of ways to reduce HVAC losses, improve lighting efficiency, improve energy efficiency, adopt conservation practices, install renewable energy systems, and increase community involvement and advocacy.
- Work with other businesses, landlords, government offices and citizens to evaluate how the costs and benefits of HVAC equipment and building envelope upgrades can be shared among both owners and tenants.

5.1. Reduce HVAC Losses

Heating and cooling demands for commercial and industrial buildings are the second-largest source of GHG emissions for Ipswich businesses after electricity.[49] A significant proportion of the energy consumed by building HVAC systems is simply lost, through inefficient system operation, inadequate insulation, etc. Most businesses, especially offices and manufacturing operations, can realize significant savings by applying various HVAC loss reduction strategies to lower their energy costs and reduce GHG emissions.

5.1.1. Building Codes

At the time of this writing, there are voluntary building codes that encourage energy efficiency, of which the US Green Buildings Council's Leadership in Energy and Environmental Design (LEED) certification is probably the most accepted and prestigious (www.usgbc.org). Local businesses (and property owners) should investigate these code guidelines for their potential to reduce energy consumption in their buildings. Many local architect and design groups employ LEED AP personnel to support local businesses in these endeavors.

Recommendation:

- Follow LEED or other energy efficiency building codes in C/I building construction and renovation to improve energy efficiency and reduce GHG emissions.

[49] Ipswich Energy Use and Greenhouse Gas Inventory, 2009

5.1.2. Insulation

Properly insulating a building is the lowest cost, most effective way to reduce HVAC losses. The best time to incorporate good insulation and create an efficient thermal and air barrier is during new construction or major renovation projects. However, many effective measures can be implemented at any time in an existing building, such as air sealing and weather-stripping, replacing and sealing windows, and the use of thermal window coverings and insulating media on interior surfaces.

Significant amounts of heating and cooling are lost whenever outside doors are opened. Businesses that experience a relatively high amount of foot traffic or vehicle loading/unloading can minimize such losses by, for example, installing double "air-lock" doors for entryways, air barrier curtain flaps for large openings, or loading dock wind flaps and canopies that allow for movement of goods and vehicles while providing some level of closure between the building and the truck. Businesses such as automotive and boat repair shops can use closed garages with forced ventilation and engine exhaust collector systems to help maintain climate control while providing a safe work environment.

Installing drop ceilings to reduce the volume of heated/air conditioned space can be an effective installation method in offices and in manufacturing areas that do not generate large amounts of dust or water vapor. Dropped acoustical ceilings have the added benefit of reducing noise levels.

On open, flat or minimally sloped roof areas with sufficiently strong underlying structural support, a sod or "green" roof can provide a low-maintenance, superior method of insulation and offers better overall thermal stability year-round. Green roofs also reduce rain water runoff and filter the remaining water.

Using lightweight, low-heat absorption roof materials (e.g., crushed white marble or bright metal) to cover or replace traditional roofing materials can help prevent cooling losses in the summer months.

Recommendations:

- Add thermal insulation wherever possible to reduce HVAC losses.
- Cover or replace traditional roofing material, such as asphalt, with lightweight, low-heat absorption roof materials like bright metal, or consider adding a 'Green' Roof for added insulation and improved runoff.

Success Story: Whipple Riverview Place, Ipswich, MA

With a $110,000, US EPA Targeted Watersheds Grant administered by the MA Dept. of Conservation, the Whipple Riverview Place elderly housing complex installed a green roof in 2006. The green roof consists of drought-resistant, low-maintenance plants growing in several inches of special growth media, and forms an attractive roofscape of solid ground cover. The green roof absorbs and filters rainwater, especially important due to the building's proximity to the Ipswich River; doubles the life expectancy of the underlying rubber roof membrane by blocking UV radiation; and its additional thermal mass significantly reduces building heating and cooling costs (upper-floor air conditioning costs have been reduced by 25%).

Figure 5.1 The green roof installed in 2006 on the Whipple Riverview Place elderly housing complex, consisting of drought resistant, low-maintenance plants that absorbs and filters rainwater, is especially important due to its proximity to the Ipswich River.

5.1.3. Control Systems

Since most businesses are not open or staffed all the time, there is a tremendous opportunity to reduce GHG emissions and save energy simply by adjusting the thermostat when the business is closed. Programmable thermostats for small businesses and offices, and more sophisticated automated HVAC systems or complete building automation systems (BAS), are effective ways to control energy consumption for heating and cooling. Even the most basic programmable thermostats allow the specification of temperature targets and ranges over the course of a day or week so that temperature set points match periods of use. A BAS is a sophisticated system with a number of features that allow tighter control of temperatures and further efficiency gains; it can be set for control targets throughout the year with adjustments for holidays and shutdowns, and can simultaneously control multiple temperature loops/zones, which helps to localize heating and cooling to areas that are in use. A BAS can be used to integrate free cooling with air conditioning and vent louver openings or other "on-demand" localized adjustments. A single BAS can control HVAC, lighting, and other electronics. The level of sophistication and control needed to effectively control temperature depends on factors such as the size of the building, number of rooms, and differentiation of work environments.

In conjunction with temperature controls, variable frequency drive (VFD) motors can also be used in blowers and pumps to very accurately control temperature and prevent over/under-shooting target temperatures. Use of these control loop feedback motors also reduces electrical consumption. Although the initial cost of these motors exceeds the cost of traditional technologies, VFDs can deliver

greater efficiency improvements and fuel consumption savings that in turn yield reasonable returns on investment.

Controlled HVAC systems can also allow exchange heating and cooling, such as in heat recovery ventilator (HRV) and energy recovery ventilator (ERV) systems. In warmer months when buildings are typically cooled, the system draws outside air into the building when the temperature outside is lower than the temperature inside. In cooler months when buildings are typically heated, the system draws outdoor air inside when the outside temperature is higher than the inside temperature. This circulated ambient air requires far less energy than directly heating or cooling the air inside a building, and helps to avoid "sick building" syndrome by frequently exchanging inside and outside air. An HRV system transfers temperature, while an ERV system usually transfers temperature and moisture.

An important factor in determining the effectiveness of any HVAC control system is to ensure that temperature sensors are located in isolated walls and corners rather than high draft areas such as doorways, anywhere near vents or radiators, or areas that receive direct sunlight.

Recommendations:

- Use programmable thermostats.
- Consider installing a building automation system.
- Assess HVAC efficiency technologies, such as VFD motors, HRV and ERV systems.

5.1.4. Set Points and Temperature Ranges

Businesses can substantially reduce GHG emissions and reduce energy costs simply by adjusting their HVAC system temperature set points. Every 1°F reduction in heating temperature set point translates into 4% in energy savings, while every 1°F increase in cooling temperature results in a 5% energy savings.[50] Conserving energy in this way encourages employees to "dress for the weather" and results in a significant reduction in energy consumption and GHG production while maintaining a comfortable work environment. Where VFDs are not an option and standard on-off drives must be used, broader ranges of control can allow time for air circulation and help reduce switching and thermal overshoots, which can generate considerable energy savings.

Businesses can further reduce the heating and cooling demands of their building by installing outdoor temperature setback controls. These devices adjust the heating/cooling system to account for the temperature differential between outdoor and indoor temperatures. Because building heat loss or gain (and the corresponding energy demands placed on an HVAC system) is related to the differential between the outdoor temperature and the preferred indoor temperature, outdoor temperature setback

[50] Energy Star Programmable Thermostat Calculator: http://energystar.supportportal.com/ics/support/default.asp?deptID=23018&task=knowledge&questionID=15561

controls allows an HVAC system to operate more efficiently and consume less energy.[51] An example of an outdoor temperature setback control can be found at: www.tekmarcontrols.com/tn4/reset.html.

Recommendations:

- Adjust thermostat set points down for heating and up for cooling to conserve energy.
- Consider HVAC efficiency technologies, such as outdoor temperature setback controls.

Success Story: New England Biolabs, Ipswich, MA

New England Biolabs reduced their daytime office temperatures to 62-65°F with a drop to 55°F at night in winter, and increased to 75-78°F daytime and 85°F nighttime in summer, achieving approximately 20% savings in energy use compared to single-point temperature settings of 65°F in winter and 75°F in summer.

5.1.5. Forced Air and Radiant Systems

In theory, forced-air convection systems heat and cool buildings more efficiently than many radiant systems, but this potential efficiency often is not realized because of improper setup and/or maintenance of the system. For example, vents that are improperly opened or closed may allow unnecessary flows or inhibit necessary ones. Simple adjustable louvers can provide localized control, and can help to close off flows to areas not in use. The efficiency of forced air systems also depends greatly on the cleanliness of ducts and filters, which not only allow sufficient pressure differential for blowers to operate efficiently, but also help prevent the incidence of mold and dust allergies and reduce the potential for fire hazards. Radiant systems must also be kept clean in order to maintain system efficiency; dusty or dirty radiating media can become heat absorbing rather than emitting. Both forced hot air and radiant systems also have pumps and blowers that can reduce system efficiency when rotors are un-lubricated and become sticky.

Recommendations:

- Have forced air and radiant heat systems inspected to ensure that they are properly set up for maximum efficiency.
- Schedule regular maintenance for forced air and radiant energy systems.

5.1.6. "On-Demand" Systems

"On-Demand" systems for heating, cooling, and hot water can improve workplace energy efficiency when work spaces or plumbing fixtures are used only sporadically. For example, personal space heaters and fans are more efficient than centralized HVAC systems in work areas where occupancy is infrequent. Similarly, localized "tankless" water heaters are more efficient than traditional hot water heaters where demand for hot water is relatively low and sporadic, for example, in employee restrooms, kitchens and cafeteria areas or manufacturing wash stations.

[51] For more information, visit: http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH9_HVAC

Recommendations:

- Consider "on demand" heating and cooling systems for infrequently used work spaces, and "tankless" water heaters where demand for hot water is relatively low and sporadic.

5.2. Energy Efficient Lighting

5.2.1. Upgrade Inefficient Lighting

According to the Department of Energy's Energy Information Agency, lighting accounts for 38% of the total electrical load for commercial buildings. However, the large amount of electricity used by businesses for lighting and the drastic gains in efficiency that can be achieved by replacing inefficient lighting sources with efficient ones create opportunities for businesses to significantly reduce GHG emissions and electricity bills.

Table 5.1 illustrates the variability in the efficiency of different lighting sources; the most efficient (light emitting diodes [LED], fluorescent, metal halide) lights are 500 percent or more efficient than the least efficient light sources (incandescent, halogen incandescent, halogen reflector).

Light Type	Lumens/ Watt[52]	Primary Application	Notes
Incandescent, Type A	10-17	Retail, offices, restaurants, churches	Bulbs to be phased out in U.S. between 2012-2014
Tungsten halogen incandescent, 240 V	22	Retail, restaurants, churches	Generates heat; not for applications near flammable material
High intensity discharge (HID) high-pressure sodium	50-140	Retail, exterior, security, high-bay uses	Slow start up
HID, mercury vapor	25-60	Retail, exterior, security	Produces cool blue/green light
HID, metal halide	60-115	Street lighting, gas stations, Industrial, high-bay uses	Provides bright white, point light
Compact fluorescent light (CFL)	50-70	Offices, retail, restaurants	Contains small amounts of mercury; produces minimal heat
T12 fluorescent w/ magnetic ballast	60[53]	Offices, retail, industrial	Contains small amounts of mercury; produces minimal heat
T8 fluorescent w/ electronic ballast	100	Offices, retail, industrial	Contains small amounts of mercury; produces minimal heat
T5 fluorescent w/ electronic ballast	90	Offices, retail, industrial	Contains small amounts of mercury; produces minimal heat
Light emitting diode (LED)	50-100	All uses	High efficiency; produces minimal heat

Table 5.1: Relative Efficiencies of Different Light Sources

[52] Lumens/Watt or Lumens Per Watt (LPW) is an efficacy rating given to light bulbs to determine how much light they produce for each watt of energy they use.

[53] http://www.home-energy-metering.com/home-lighting.html

Source (except where noted): Lighting Efficiencies. Energy eco-efficiency opportunities in Queensland Foundries: Benefits of correct lighting. Queensland Government, Australia. http://www.ecoefficiency.com.au/Portals/56/factsheets/foundry/00976%20F6%20Lighting.pdf

These lighting sources are not all interchangeable, as some may be intended for different purposes and applications. For any given application, however, choosing more efficient alternatives can have a major impact on electricity usage. The following provides a discussion of the primary types of lighting technologies and their comparable efficiencies.

Incandescent

Traditional tungsten-filament incandescent light bulbs are among the least efficient lighting sources, at only 15 lumens per Watt (a measure of how much light is produced by a given amount of power). Incandescent lights are also the easiest and least expensive to upgrade to more efficient lighting. Incandescent bulbs can usually be replaced with much more efficient and long-lasting compact fluorescent (CFL) bulbs without any additional investment in light fixtures or equipment. Incandescent lights are typically used in restaurants, churches and commercial buildings. Almost without exception, it is cost effective to replace incandescent bulbs with CFL bulbs or LED lights (see below). In any event the Energy Independence Act of 2007 will effectively phase out standard incandescent lights by 2014. This Act will require most general-purpose lighting to be at least 30% more efficient than standard incandescent lights, starting in 2012 for 100 W bulbs and ending in 2014 for 40 W bulbs.

Halogen Incandescent

Halogen light bulbs use incandescent technology, but the bulbs contain halogen gases that enable the filaments to operate at higher temperatures, and give the bulbs a longer life and higher efficiency. Halogen incandescent bulbs have traditionally been used by retail businesses in reflector lamp forms (such as PAR38 or PAR30) but are also becoming available in standard incandescent-like bulbs for general purpose use. Although halogen incandescent bulbs are more efficient than standard incandescent bulbs, the user can save more energy by upgrading to an infrared coated halogen bulb, a compact fluorescent, a high intensity discharge reflector bulb, or an LED (in order of increasing cost and efficiency). Each of these technologies has different performance characteristics, which gives the user many alternatives among which to choose the most efficient product for a specific application.

Compact Fluorescent

Compact fluorescent lamps, or CFLs, are small-diameter fluorescent tubes either bent or spiraled into a shape that allows them to function as high-efficiency light sources that can generally be used in traditional incandescent light sockets. CFLs have undergone a significant increase in quality and an equally dramatic decrease in cost in recent years that has driven an equally great increase in adoption. CFLs have great potential for use in commercial/industrial applications such as retail, hospitality and commercial offices. A disadvantage of CFLs is that they contain a small amount (about 4 mg) of mercury

inside the bulbs that, if broken, can be toxic if ingested or inhaled. All CFL bulbs should be properly disposed of at designated recycling facilities, including the IMLD building and some retailers.

Fluorescent

Fluorescent lamps are typically in the form of long (4 feet or more) tubes containing a small amount of mercury and an ultraviolet-to-light converting substance along the tube wall called a phosphor. They have been used universally in commercial office space, retail and industrial applications. Generally, these lamps are highly efficient but they come in forms with varying efficiencies, and operate on two different types of ballasts, which also affect efficiency. In general, smaller tube diameters equate to better bulb efficiency. In addition, electronic ballasts provide substantial energy savings compared with magnetic ballasts.

Metal Halide High-Intensity Discharge

Metal halide, high-intensity discharge (HID) lamps are composed of a quartz arc tube filled with a metal halide gas and an outer glass jacket. They have screw-in bases but require operation on either magnetic or electronic ballasts. As with fluorescent, the electronic ballasts are much more efficient than magnetic ballasts. Metal Halide HID lamps are used at gas stations, some high bay retailers and street lighting. Some metal halide lamps are now being upgraded with LED light sources that use less energy while delivering the same amount and intensity of light.

Light Emitting Diodes

Light emitting diodes are solid-state lighting devices that use materials similar to those used in electronics. Initially they were used as solid-color devices to replace red traffic lights or exit signs. LED technology has made great advances in recent years, and LEDs are now efficient enough to be considered in many commercial and industrial applications, but are still very expensive relative to traditional light sources. This is expected to change, however, over the next 15 years, as the efficiency of LEDs continues to improve and the LED costs decrease. The Department of Energy's efficiency and cost forecasts for LEDs and other lighting sources are shown in Figure 5.2. and Figure 5.3. As these figures illustrate, DOE anticipates LED efficiencies will double by 2025, while LEDs become fully competitive with traditional light sources for most commercial applications. By the end of this decade, LED light sources are likely to be common in retail spaces, street lighting, office buildings, hospitals, and gas stations.

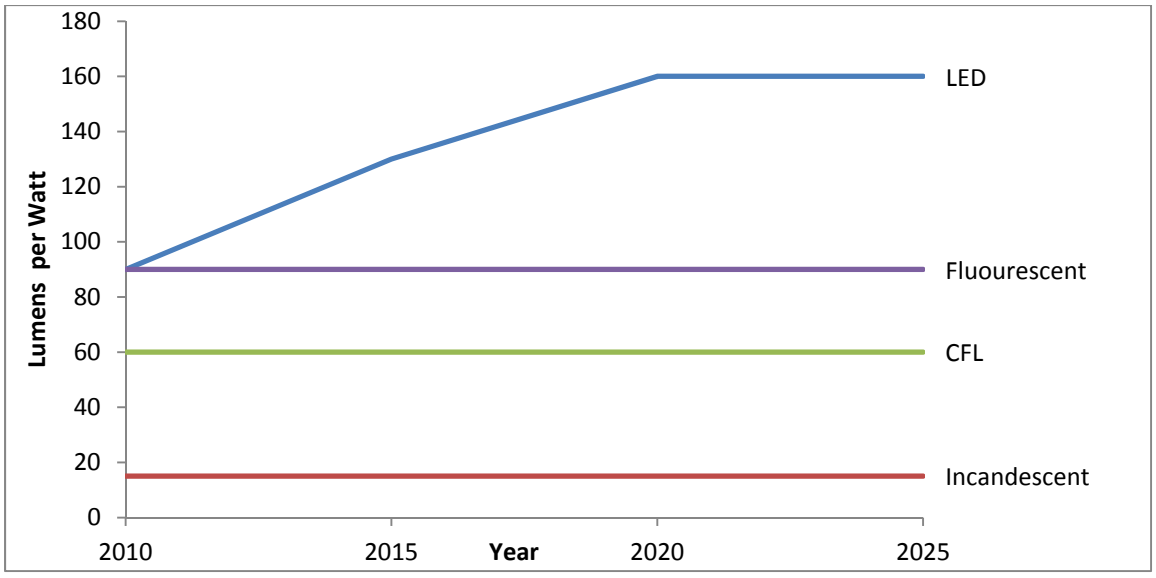

Figure 5.2 Projected Efficiency Changes (lumens per Watt) for Lighting Sources through 2025.
Source: U.S. Department of Energy[54]

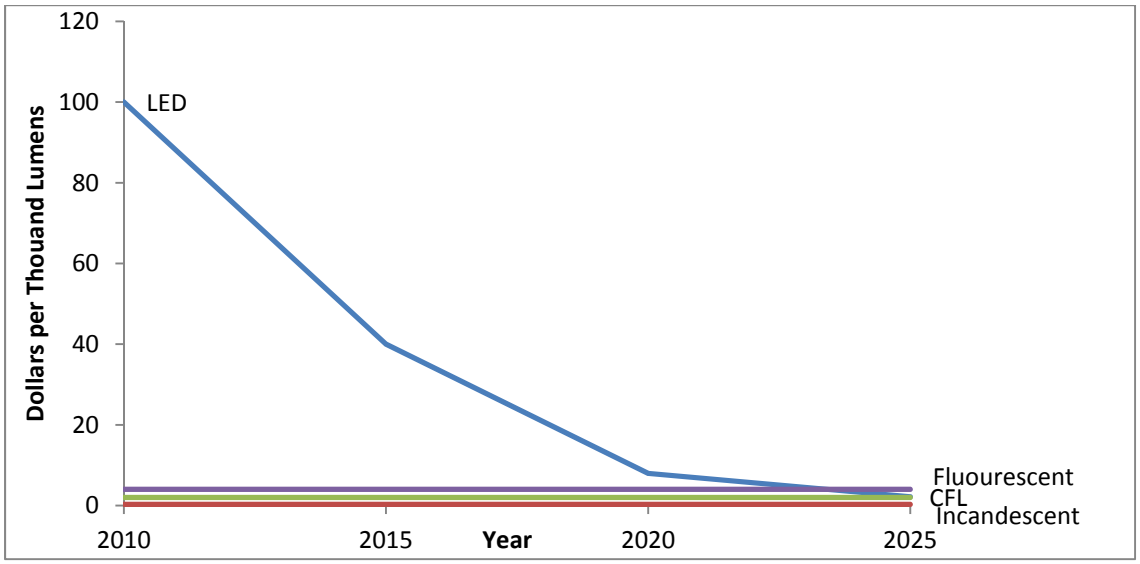

Figure 5.3: Projected Efficiency Changes (Dollars per 1000 lumens) for Lighting Sources through 2025.
Source: U.S. Department of Energy[55]

[54] Multi-Year Program Plan for FY09 - FY15, section 4 Technology, Research and Development Plan, US Department of Energy, January 2009.

[55] Multi-Year Program Plan for FY09 - FY15, section 4 Technology, Research and Development Plan, US Department of Energy, January 2009. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2009_sec4.pdf.

5.2.1. Occupancy and Daylight Sensors

Lighting controls are available that combine light or motion sensors with dimming ballasts, switches and software to detect when lights are not needed and can turn them off, or dim them so that no more light is generated than is necessary for the application. Lighting controls work for a wide variety of applications, but are an underutilized opportunity that could generate significant electricity savings for Ipswich businesses.

5.2.2. Incentives for Lighting Upgrades

The many opportunities to save energy through lighting upgrades all require varying degrees of upfront capital investment. To undertake this kind of investment, businesses have to be confident they will realize sufficient returns in the form of energy savings. Ipswich businesses can improve the return on investment and shorten payback times for lighting upgrade investments by taking advantage of the IMLD/MMWEC lighting incentives as well as any applicable state and Federal incentives. Many lighting upgrade projects make economic sense when these incentives are factored into ROI and payback analysis.

The Energy Policy Act of 2005[56] provides incentives for bi-level or dimming system-controlled lighting upgrades through 2013, in the form of tax deductions for efficiency improvements relative to American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 efficiency standards.[57] The amount of the deduction depends upon the extent of improvement relative to ASHRAE 90.1, as shown in Table 5.2. For example, the ASHRAE 90.1 commercial building lighting standard is 1.3 W/sq ft. An upgrade that that results in an efficiency of 1.8 W/sq. ft. (40% improvement) or more is eligible for the $0.60 sq. ft. deduction, for an effective cost offset of about $20/fixture. This deduction combined with state and/or utility incentive programs, provides ROIs and payback times that make lighting efficiency upgrade projects worthwhile economically.

Percent reduction of the lighting power density below ASRAE 90.1 -2001	25%	30%	35%	≥ 40%
Eligible tax deduction per sq. ft	$0.30	$0.40	$0.50	$0.60

Table 5.2: Federal Tax Deduction of Lighting Upgrades for Businesses Authorized through 2013
Source: http://www.lightingtaxdeduction.org/tax_deduction.html

Other Federal initiatives that may encourage investment in more efficient lighting over the next decade include programs to support Smart Grid[58] installations, and programs to increase the efficiency and

[56] Energy Policy Act of 2005 Commercial Building Tax Deductions. http://www.efficientbuildings.org/

[57] American Society of Heating, Refrigeration and Air-Conditioning Engineers. http://www.ashrae.org/education/page/1834

[58] Smart Grid refers to an electricity network that utilizes digital technology, such that two-way communication can occur between the supplier and the consumer. Smart grids make it possible for consumers to dynamically respond to changes in the price of electricity or the grid condition.

lower the cost of LED lighting. Smart Grid technologies may offer particularly attractive opportunities in large commercial facilities such as EBSCO and New England BioLabs.

Finally, local banks like the First National Bank of Ipswich and the Ipswich Cooperative Bank have a long history of financing local projects. These and other banks with a local presence should be encouraged to offer business loans to finance lighting upgrades, which would help encourage businesses to invest in energy savings.

Recommendations:

- Consider upgrading lighting and/or installing lighting controls to save energy. For most applications, here are efficient lighting alternatives that do not result in any loss of functionality or performance.
- Include IMLD/MMWEC, Federal and state incentives in evaluating ROI and payback times for potential lighting upgrades.

Success Story: New England Biolabs

The New England Biolabs' new research and production facility is LEED (Leadership in Energy and Environmental Design) certified , a distinction given based on a suite of environmentally focused standards that include site sustainability, water efficiency, energy conservation and atmospheric protection, choice of building materials and resources, indoor environmental quality, innovation and building design. The state of the art buildings incorporate many design and energy efficiency upgrades that reduce the facility's GHG emissions. For example, the building is designed with glass walls maximizing the use of ambient lighting. All fluorescent and LED lights use light level sensing dimmers to adjust for available sunlight. Control systems program lights by date and time, and are on motion sensors during off-hours. Outdoor pole lights are 480 volt, 150W metal halide bulbs and are also programmed.

5.3. Energy Efficiency and Conservation in Business Practices, Processes and Equipment

Every business has unique practices, processes, and equipment that use energy and create GHG emissions. Energy costs are part of the business's operating costs, so reducing energy costs has a direct, positive impact on a business's bottom-line. Many of the recommendations in this Plan are relatively inexpensive to implement, such as conservation measures. Others require a larger investment and more planning, but should be done when practical, such as when replacing equipment.

5.3.1. Office Electronics

Office electronics represent some of the simplest, least expensive, and most effective ways to lower electricity bills and reduce emissions. Simply training employees to turn devices off when they are not in use can eliminate a significant amount of unnecessary electricity consumption. Efficient, Energy Star-qualified versions of most office equipment are readily available. Most include "sleep" mode; after a period of inactivity, the device will power down into a low-energy mode that allows for quicker re-start

than a complete shut-off. Most also have timers for full shut-down (simple mechanical outlet timers can be used to achieve the same effect). In addition, newer LCD and LED visual displays use significantly less power than traditional CRT or plasma displays. Office network software is available that enables computers to be automatically shut down after business hours. Finally, for computer networks, a "virtual server" setup can be used that dynamically uses available memory on computers in active use to provide server functions to the network, saving the energy that would be consumed by a fulltime dedicated server.

Recommendations:

- Purchase Energy Star-qualified products when replacing or buying new office electronics.
- Take advantage of low-energy modes and shut-down timers.
- Turn off unused devices.

5.3.2. Break Rooms

Businesses can often conserve energy and improve efficiency in kitchens and break rooms. Many newer vending machines and non-perishable, controlled environment food/drink dispensers and water bubblers have temperature control settings that allow the machines to power down when not in prime use time and save on energy for refrigeration/warming. The most efficient models are Energy Star-certified. For older models, the same types of conservation gains can be achieved using simple electric outlet timers. This is a good energy saving strategy for bars and restaurants as well.

Recommendations:

- When buying or replacing food and drink dispenser equipment, purchase Energy Star-qualified products. For older models, use electric outlet timers to conserve energy outside of prime usage times.

5.3.3. Shipping

Businesses such as retailers, manufacturers, distributors, and agricultural businesses tend to produce a large amount of waste material from packaging. There are a number of ways companies can reduce packaging waste. Businesses that primarily ship locally can radically reduce waste and GHG emissions by using re-useable and recyclable packaging. Another option to consider is whether packing materials can be returned to their source, especially if the additional routing would be minimal. Consolidating shipping, such as through improved logistical planning, reduced frequency, or cooperative shipping from co-located businesses with a shared customer base, would help to maximize load and minimize distance traveled, which will reduce costs as well as emissions.

Engine idling for delivery vehicles should be minimized. In climate-controlled vehicles, optimal insulation can help reduce the need for idling. For diesel engines in colder weather, use of battery-powered engine warmers will allow for easy startup and reduce the need for idling. At the same time, these strategies will help reduce emissions and ensure compliance with Massachusetts' anti-idling laws.

Recommendations:

- Look for ways to reduce, reuse and recycle packaging materials.
- Investigate whether shipping can be consolidated.
- Shippers should implement and enforce no-idling rules and minimize engine idling.

5.3.4. Construction Waste

Purchasing and transporting materials and disposing of construction wastes are costly processes and cause significant GHG emissions. Construction firms can reduce their carbon footprints while at the same time lowering their materials and disposal costs. Firms with multiple on-going projects can look for ways to consolidate shipping and waste disposal. For example, modular components could be pre-fabricated at a single site, and distributed to individual worksites. This would improve transportation efficiency and reduce transportation costs, as raw materials would be delivered to a single site. At the same time, waste from pre-fabricating components would also be aggregated in a single place, which would make it easier and more economical to chip or pelletize waste wood, or collect it for further processing and re-use as mulch or fuel rather than discarding it, and lower the cost and improve the efficiency of the remaining waste.

Landscapers and golf-course groundskeepers can also reduce waste and shipping by mulching/chipping grass, brush and tree limbs on-site and reusing them elsewhere on the property.

Recommendations:

- Consolidate, reuse or recycle construction and landscaping waste to reduce GHG emissions.

5.3.5. Food Processing and Refrigeration

Food preparation businesses, 6% of Ipswich's C/I base, consume large amounts of energy for cooking or refrigeration, use large amounts of water, and generate a great deal of waste heat energy. Larger businesses may be able to benefit from co-generation techniques, in which excess heat from ovens and ranges is used to keep food warm as it awaits serving, or to pre-warm water for use in dishwashing, restrooms, or radiant heating systems.

The energy required for refrigeration and cold storage can be significantly reduced by insulating refrigerators from heat sources, and by minimizing the amount of cold storage needed and the need to open and close refrigerators. Just-in-time delivery of perishables may be one way to minimize refrigeration demand, and provides other benefits as well, including fresher products and lower proportion of discarded perished products. Using multiple smaller refrigerators are also more efficient than a single large refrigerator, as goods can be staged for immediate use and for longer term storage to reduce the frequency of opening and closing refrigerator doors.

Refrigeration systems are important components of many businesses. The refrigerant used, the type of refrigeration system, and whether or not it has been properly maintained can have a significant impact on GHG emissions. Depending on factors such as the age and condition of existing systems, the

refrigerant currently used, and refrigeration needs, businesses may have a number of options to reduce refrigeration-related GHG emissions and energy costs at the same time.

The refrigerant used in a system can have a particularly large impact. Even within a single chemical group, some refrigerants have exponentially higher or lower ozone depletion or GHG potential than others of the same type. A number of different refrigerants have been used over the years, with a general trend toward less toxicity and environmental impact. The manufacture of chlorofluorocarbons (CFCs), which were used in the oldest refrigeration systems, has been banned for years by the U.S. Environmental Protection Agency and by international agreement (i.e., Montreal Protocol) because of CFCs' severe ozone-depleting and GHG emissions effects. CFCs were replaced by hydrochlorofluorocarbons (HCFCs) such as R-22, which have much less of an ozone depleting effect, but still produce high rates of GHGs, and most are in the process of being completely phased out under the Montreal Protocol. One HCFC, R-123, can still be used in new systems, and is still the best overall standard refrigerant in terms of environmental impact and thermal performance. HCFCs were replaced by HFCs (R-134a and R-410a), which have negligible ozone-depleting effects, but have significantly lower thermal efficiencies, and produce high levels of GHGs, and are becoming increasingly regulated under the Kyoto Protocol.

The environmental impact of refrigerants results from their escape into the atmosphere from spills during charging, or through system leaks. As long as a refrigeration system remains intact, sealed and leak-free, there is no immediate environmental danger. Refrigerants must be stored in sealed, air-tight containers, and by law must be recovered and reclaimed by licensed service providers. For these reasons, if an older system is not leaking, environmentally it is better to leave the system alone until it breaks down or begins to leak. The refrigerants in leaking systems should be replaced with R-123 or its designated HFC replacement compound. At the time of this writing, efficient replacement refrigerant that scores very well both in ozone depletion potential and in global warming potential is unfortunately not available.

Many newer systems use "natural" refrigerants that have a much smaller environmental impact, including some hydrocarbons (HCs) (propane, butane, isobutene, ethane, isopentane), NH_3 (ammonia), and CO_2. These refrigerants require significantly greater safety measures for handling and sealing, but with the exception of CO_2, they are more thermally efficient than HFCs in newer systems specifically designed to handle them. HCs can only be used undiluted in very small refrigeration systems such as home or restaurant refrigerators due to their high flammability, but are compatible with HFCs for direct replacement. Ammonia is used for many industrial process cooling applications where corrosion concerns can be controlled, but it is flammable and a biohazard and must be handled accordingly. CO_2 is not highly efficient, but it lacks the explosive and toxicity issues of other "natural" coolants and is being designed into new automotive air conditioning systems and building air conditioning systems.

Non-refrigerating heat exchange systems that use vegetable or silicone oil-based coolants, water or air are a viable option where cooling requirements are minimal (temperature reduction less than 35°F, and absolute temperatures above 45°F). These systems are appropriate for applications such as process

cooling or building air conditioning and automotive engine cooling in combination with forced air convection, especially when water cooling towers or geothermal heat sinks can be installed.

Finally, proper maintenance and upkeep of any refrigeration system minimizes GHG emissions. For example, refrigeration systems should be properly insulated; joints and seals in refrigerant plumbing should be intact; and heat exchangers should be regularly cleaned, to allow free convection over the maximum surface area.

Recommendations:

- Larger operations should consider co-generation techniques that use heat "waste" to keep food warm or preheat water for dishwashing.
- Insulate refrigeration systems from heat sources.
- Minimize the amount of cold storage needed.
- Minimize the need to open and close refrigerators, especially in the case of large refrigerators.
- When re-charging refrigerants, use an HC compound if possible, or the appropriate compatible HFC, or R-123 where the others are not options.
- Leave older equipment in place if it works and is not leaking.
- Replace leaking older equipment and plumbing with Energy Star-rated equipment or with systems utilizing "natural" refrigerants.
- Use non-refrigerating heat-exchange systems where cooling requirements are minimal..
- Always store refrigerants in closed, air-tight containers and dispose of waste through licensed service providers.
- Ensure good insulation of all closed/contained refrigeration systems.
- Ensure integrity of all joints and seals in refrigerant plumbing.
- Ensure cleanliness of all heat exchangers for free convection over maximum surface area.

5.4. Renewable Energy

Renewable energy in its many forms, including solar photovoltaic, solar thermal, wind power and geothermal, has the potential to significantly reduce energy costs for Ipswich businesses. A business that invests in a renewable energy installation effectively installs its own clean energy-producing, mini-power plant that can avoid or significantly reduce its monthly electric bills. The importance of renewables for reducing GHGs is evident in Figure 5.4 – renewable energy sources are typically the lowest lifecycle producers of GHG of all current electrical generation technologies.

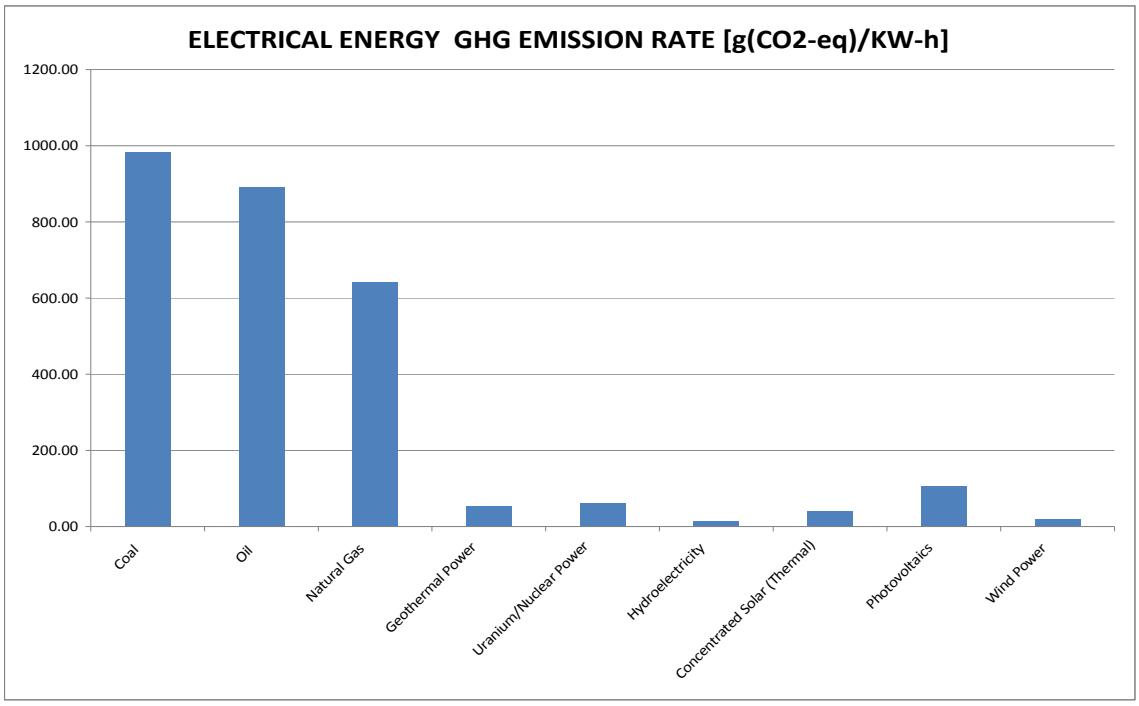

Figure 5.4: Equivalent CO_2 Emissions per KWh from Fossil Fuels and Alternative Energy Sources
Sources: Bilek et al. (2008)[59], Fridleifsson et al. (2008)[60], Dowlatabadi et al. (2007)[61]

Longterm cost comparisons for renewable energy versus traditional fuels are difficult to gauge due to constantly changing incentives and carbon costs. A study by Lazard Ltd. in 2009[62] found the levelized cost over the system lifecycle of renewable electrical energy sources to be competitive or slightly higher than traditional electricity generation. However, the study did not take into account carbon costs or the fact that fossil fuel costs are expected to rise over time, while renewable energy costs are expected to continue to decrease with increased availability, improved manufacturing technologies and improved efficiencies. Federal and state rebates, as well as reduced tax rates are available to businesses that implement renewable energy sources on site. These incentive programs cover energy sources including photovoltaic and wind power for electrical, and solar thermal for heating.

Grid buyback of independent photovoltaic- and wind-generated electricity is currently the most practical method for local businesses to realize the potential cost savings of renewable electrical energy systems.

[59] Bilek M, Hardy C, Lenzen M, Dey C. 2008. Life-cycle energy balance and greenhouse gas emissions of nuclear energy: A review. Energy Conversion & Management 49 (8): 2178–2199

[60] Fridleifsson I, Bertani R, Huenges E, Lund J, Ragnarsson A, Rybach L. 2008. O. Hohmeyer & T. Trittin, ed. The possible role and contribution of geothermal energy to the mitigation of climate change. pp. 59–80.

[61] Dowlatabadi H 2007. Strategic GHG reduction through the use of ground source heat pump technology. Environmental Research Letters.

[62] http://blog.cleanenergy.org/files/2009/04/lazard2009_levelizedcostofenergy.pdf

Leasing options are also readily available for such installations, in which the capital investment is minimized, the lessor receives the rebates and credits, and the lessee gains the benefit of grid buyback. However, businesses, unlike residential owners, can depreciate the cost of the renewable energy system (minus the tax credit) over 5 years, which might make it more cost effective for a business to purchase rather than lease.

Electrical production of heat energy is far less efficient than direct thermal production (i.e.,combustion or heat transfer). When investing in renewable energy technology, it is important to evaluate the predominant application of energy, and to consider mixed renewable sources and cogeneration to optimize efficiency. For instance, rather than using photovoltaics to generate electricity to heat a business, consideration should be given to using solar thermal or geothermal; to generate heat for operations of a stove, oven, or clothes drier, natural gas would generally be more suitable.

5.4.1. Biofuels

Biofuels potentially have a number of GHG- and non-GHG-related benefits and advantages over petroleum-based fuels. It generally takes less energy to manufacture Biodiesel made from recycled cooking oil than the energy required to produce petroleum-based fuels. Biodiesel burns cleaner as well, and has the added benefit that it uses waste oil that otherwise would need to be disposed. Biodiesel is 18% more dense than petroleum diesel, and as a result delivers 7% better fuel economy. Biodiesel's molecular structure provides better lubricity than petroleum fuel which reduces wear and tear on engine components. According to a report by the U.S. Departments of Energy and Agriculture, the energy yield of biodiesel is 280% greater than that of petroleum diesel.[63] At this time, however, most biodiesel from recycled cooking oil is made by individuals or small groups in garages or backyards, in part because waste oils are mainly collected locally on a small-scale basis. Until and unless production can be scaled up into large manufacturing facilities, availability will be the limiting factor on implementation of biodiesel.

Methane/methanol and ethanol are a natural byproduct of agricultural activities and can also be leveraged as cleaner-burning fuels than petroleum-based products. Ipswich's agricultural operations are on a much smaller scale than those in the Midwestern states, making on-site development of fermenters on individual properties infeasible. Consolidation of waste among multiple farms could make volume production of these fuels a possibility.

Finally, to the extent biofuels are locally produced and consumed, they save significantly on GHG emissions related to transporting petroleum to refineries and refined products to markets.

[63] Sheehan, J., V. Camobreco, J. Duffield, M. Graboski, and H. Shapouri, Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus, Final Report, National Renewable Energy Laboratory, NREL/SR-580-24089 UC Category 1503, May, 1998.

Success Story: Russell Orchards, Ipswich, MA

Russell Orchards, a local farm, orchard and retail store, sets an example for the potential of biodiesel in Ipswich by recovering the donut-frying oil from its retail operation and collecting used cooking oil from other restaurants in town for use in its farm equipment.

5.4.2. Solar Photovoltaic and Solar Thermal Energy

Photovoltaics, also called solar cells, use materials, usually silicon or other semiconductors, that convert sunlight into electricity. Photovoltaic energy has typically required the largest investment among renewable energy sources due to the sophisticated manufacturing processes, high material costs and supporting electronics used to make these systems. However, recent advances in thin film technology have significantly reduced costs, while efficiencies are continually improving. As of this writing, standard crystalline or polycrystalline photovoltaic systems cost less than $5/watt (including installation costs). Because they are chemically inert, crystalline and polycrystalline panels are warrantied to retain 80% efficiency for 20 years, but are subject to fracture from impact.

In sizing photovoltaic systems, the solar insolation value (the average daily amount of maximum solar radiation received at a particular latitude and climate) plays a key role, as does southerly exposure and sunlight obstruction. Many commercial and industrial buildings have large, flat, unobstructed roofs, which would allow optimal panel placement. Standard polycrystalline panels typically produce 10 watts/ft^2, while thin-film and amorphous panels require about twice the area for the same energy production. For example, a 5 kW system will require 500 ft^2 of standard panels, and will have an average production of 19 kW-h/day in Ipswich. Businesses that might particularly benefit from photovoltaic power include shopping centers, churches and clubs, office complexes and manufacturering facilities.

Sunlight can also be used to heat water circulated on rooftop or ground-mounted panels. If a heat exchange system is already in place, solar thermal systems require a relatively small additional investment. The relatively small roof or ground area required to mount solar hot water panels broadens the range of businesses that can make use of this technology. Siting solar installations properly is important (i.e., south-facing orientation, obstructions that might block sunlight need to be taken into consideration) and due to the weight of the panels, the strength of underlying support structures is more important than is the case with photovoltaic. Churches, restaurants and food processors, and recreational/fitness/spa facilities are most likely to benefit the most from solar thermal installations.

5.4.3. Wind Power

Wind energy can turn turbine blades and generate electricity. Businesses or properties located where there is an annual average windspeed of 9 mph or higher should be good candidates for one or more wind turbines.[64] The ROI and payback time of a given wind turbine installation depends on a number of factors, including the wind conditions at the location, the expected lifespan of the turbine, the cost of

[64] http://www1.eere.energy.gov/windandhydro/small_wind_system_faqs.html

equipment and installation, and the availability of government incentives or rebates. Most turbines will average about 35% of their rated capacity in production over the year because of the variability of wind speeds, and are warrantied for about 10 years; regular maintenance can significantly extend the life (and consequently, improve the ROI) of a turbine. Many newer turbines use new technologies that achieve efficiences of close to 50% and promise longer life spans.

There are a number of locations in Ipswich with the right conditions to support wind turbines, including areas near the shore, such as along Town Farm Road, Argilla Road and Jeffrey's Neck Road out to Great Neck and Little Neck, or even in Ipswich Bay. Other good placement locations are where air is channelled between hills as along parts of Pine Swamp Rd and Rt 1A, or on unobstructed rises such as Boone Park, Prospect Hill, Castle Hill, and Turner Hill. Because of noise and debris concerns as well as size constraints, large free-standing turbines of >100 kW size should be located at least 500 ft from neighboring buildings. According to the US Department of Energy, a general rule of thumb is to install a small wind turbine on a tower with the bottom of the rotor blades at least 30 feet above any obstacle that is within 300 feet of the tower.[65] For this reason, as well as concerns with vibration and structural problems with a building, the DOE recommends against installing small wind turbines on rooftops. In addition, rooftop mounting can expose the turbine to excessive turbulence that can shorten its life.

Agricultural and recreational businesses and industrial parks are the primary candidates for large-scale wind power, both for grid tie-in as well as for direct powering of irrigation systems and remote outbuildings. Wind power is generally less expensive than solar PV energy.

Success Story:

The Cuvilly Arts & Earth Center in Ipswich installed a 10 kW wind turbine on the school's property in 2006. The turbine, along with a solar photovoltaic array, provides much of the electricity needs of the school and provides an excellent example of sustainable living for the students.

[65] http://www1.eere.energy.gov/windandhydro/small_wind_system_faqs.html

Figure 5.5 The Cuvilly Arts and Earth Center's 10 kW Wind Turbine on a Crisp Winter Day.

5.4.4. Geothermal Energy

Geothermal heat pumps (GHPs) (also known as geo-exchange, ground-source, or water-source heat pumps) have been in use since the late 1940s. These systems use the constant temperature of the earth as the exchange medium instead of the outside air temperature. While New England experiences seasonal temperature extremes—high heat in the summer to sub-zero cold in the winter—a few feet below the earth's surface the ground remains at a relatively constant temperature (i.e., around 55°F). The GHP takes advantage of this by exchanging heat with the earth through a ground heat exchanger. Geothermal and water-source heat pumps are able to heat, cool, and, if so equipped, supply the building with hot water.

Geothermal systems can be effective for water pre-heating, radiant heating and cooling systems, and where excavateable land is in close proximity to the building being heated/cooled. Livestock barns, greenhouses, golf course clubhouses, and general offices with sufficient property may be good candidates for geothermal systems. The installed cost of a geothermal system can be several times that of an air-source system of the same heating and cooling capacity, but the additional costs are returned

in energy savings in 5–10 years. System life is estimated at 25 years for the inside components and 50+ years for the ground loop (US DOE). Investment tax credits are available to businesses, including an investment tax credit of 10% of the installed cost available through 2016. More information on GHPs can be found at:
http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640).

Recommendations:

- Where practical, substitute petroleum-based fuels with biofuels made from recycled cooking oil and produce biofuels locally.
- Investigate site's potential for solar electricity, solar thermal, wind and geothermal energy.
- For technologies that are viable at the site, include the IMLD/MMWEC commercial/industrial pilot program and applicable federal and state incentive programs in the calculation of ROI and payback time.
- Ipswich businesses with limited rooftop space may consider ground-mounted panels or placing solar thermal panels directly below photovoltaic panels.

5.5. Agriculture and Animal Husbandry

Ipswich is fortunate to have a number of farms that supply locally-grown, sustainable agriculture to its residents. Having access to locally-grown produce provides a number of benefits to the Ipswich community, including a fresher and healthier product and reduced GHG emissions associated with shipping and handling. However, agriculture is an energy-intensive industry and is responsible for various gas emissions, such as methane and nitrous oxide, identified as strong greenhouse gases. For example, in 2009 the agriculture sector was responsible approximately 6.3 percent of total U.S. GHG emissions.[66] Methane emissions from enteric fermentation and manure management represent about 20% and 7% of total U.S. methane emissions from anthropogenic activities, respectively, primarily attributed to beef and dairy cattle.[67] Agricultural soil management activities such as fertilizer application and other cropping practices were the largest source of U.S. nitrous oxide emissions, accounting for 69%.[68]

However, because plants absorb CO_2 for photosynthesis agricultural lands can also serve as GHG sinks. The management of cropped, grazed, and forestland has helped offset GHG emissions by promoting the biological uptake of CO_2 through the incorporation of carbon into biomass, wood products, and soils.

[66] Inventory of US Greenhouse Gas Emissions and Sinks: 1990 – 2009. April 15, 2011. U.S. Environmental Protection Agency. EPA 430-R-11-005. Washington, DC 20460.
http://www.epa.gov/climatechange/emissions/usinventoryreport.html

[67] Ibid.

[68] Ibid.

For example, in 2005 forests in the U.S. offset total domestic GHG emissions by approximately 11%.[69] Agricultural sinks for GHGs include forests (72%), harvested wood (13%), urban trees (11%), and agricultural soils (4%).[70]

According to the Ipswich Assessor's data, there were 82 properties associated with agriculture in Ipswich in 2010. Large commercial farms, like Appleton Farms, Russell Orchards, and Marini's Farms, make up the largest land area for the agriculture sector in Ipswich. However, the largest number of individual properties associated with agriculture include animal husbandry, such as horse stables.

The Energy Use and Greenhouse Gas Inventory Report completed in 2009 did not include the agriculture sector for Ipswich and, consequently, the CEUCP has not evaluated GHG emissions reduction actions that are available for these operations in this Plan.[71] Nonetheless, a number of farms in Ipswich have taken the lead in assessing their GHG emissions and have taken steps to reduce their carbon footprints. For example, the Trustees of Reservations-owned Appleton Farms completed a GHG emission inventory in 2010 and identified measures to reduce the farm's GHG emissions. Some of these measures include increased use of alternative energy vehicles (electric, post-consumer biodiesel, hybrid), conducted many energy efficiency projects and deep energy retrofits, constructed a LEED Platinum-certified building (a net-zero energy building), and completed a model sustainability plan for TTOR properties. In addition, Russell Orchards converts used fry oil into biodiesel for the tractors used on the farm. These are just a few practices that agriculture businesses can employ to reduce their GHG emissions. Additional GHG emission reduction measures will be identified in subsequent revisions of this Plan, and after GHG emissions have been quantified from the agriculture sector.

5.6. Community Education and Outreach

Ipswich business organizations and their member businesses, such as the Chamber of Commerce and the Rotary Club, have a long history of exemplifying and promoting community responsibility among local businesses. These organizations play important leadership, communication and coordination roles in the Ipswich business community, and the membership itself consists of influential local business leaders. Together, these organizations and individual members can help speed the adoption of energy-saving practices by the entire Ipswich business community, by publicly recognizing the importance of reducing the energy consumption and GHG emissions of Ipswich businesses, by endorsing the Plan, and by actively pursuing the Plan's emissions reduction goals and recommendations. They can also play an

[69] U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990-2005. Global Change Program Office, Office of the Chief Economist, U.S. Department of Agriculture. Technical Bulletin No. 1921. 161 pp. August, 2008. http://www.usda.gov/oce/global_change/AFGGInventory1990_2005.htm.

[70] Ibid.

[71] The 2010 GHG inventory, which will be completed later this year or next, will include GHG emissions from the agriculture sector.

important coordination and communication role within the business community, for example, by distributing a 'recommended practices' list or brochure to local businesses such as real estate agents, contractors, bankers, restaurant owners, electricians, and carpenters, that provides tips on minimizing GHG emissions in their own business areas and for their clients.

A local business organization, such as the Chamber of Commerce, could host a website that lists best practices for saving energy for local businesses, as well as featuring "success stories" that demonstrates a business's progress in reducing GHGs that can be shared with other local businesses. Local businesses should also consider advising the Town to adopt a town stretch code for improving energy efficiency and conservation in commercial and industrial buildings, as it has done already for residential construction.

Recommendations:

- Take an organized advocacy role to reduce GHG emissions through organizations like the Ipswich Chamber of Commerce and Rotary.
- The Chamber of Commerce and/or Rotary could develop and distribute tips for local professionals on ways to effect energy savings and GHG reduction. A 'best practices' list could be developed online and made available to local businesses.

6. Conclusion

Ipswich has taken some significant steps forward in the last few years, and has made some progress in reducing GHG emissions. However, these successes represent only tentative first steps toward reaching the 2020 GHG emissions target of 90% of 1990 levels, Despite our Town's progress to date, there is a crucial and immediate need for all of us – government, residents, and business owners -- to do more. We are in a critical moment, where the global response (or lack thereof) to climate change will have profound, long-term effects on life on Earth. Now is the time for Ipswich to act. Now, while the world's ever-increasing appetite for energy fills the headlines with one energy-related environmental disaster after another. Now, as climate scientists across the globe warn us, temperatures and sea levels, in some cases, have been rising faster than their models have predicted. Now, when advances in green energy technologies put a sustainable future in our grasp. Political gridlock, short-term thinking, and complacency seem to make a long-term national energy strategy all but out of reach. Nonetheless, communities like Ipswich, whose future quality of life is so closely intertwined with securing a sustainable energy future, must step up and lead the way by taking local action against this global problem. Local action against the global problem of climate change by sufficiently large numbers of local communities begins to look like global action. Grassroots momentum may be what is required to help prod national governments into action on a coherent long-term national energy strategy after all.

Ipswich can and must demonstrate leadership and commitment on this issue, and we will, if everyone commits to and focuses on achieving the 2020 emissions target of 90% of 1990 over the next decade. This will represent a dramatic change in Ipswich's energy habits. As a single monumental effort and without a plan, it might truly be a daunting task, but we can get most of the way there through a series of many incremental steps, and this Plan tells us what we need to succeed. We can reach the 2020 goal through a series of mostly small incremental steps taken by individuals and groups in Town, which together will reduce GHG emissions by the 3% per year needed to achieve the 2020 emissions target.

As laid out in the Plan, municipal government has at least three pivotal roles in implementation of the Plan: leadership in building and demonstrating an energy-saving culture Town-wide; education and outreach in ensuring that town employees and volunteers, residents and businesses all know what to do, how to do it, and what resources are available to help them afford it; and facilitation, in making sure Town bylaws, statutes, regulations and funding sources are in place to actively encourage rather than hinder energy-saving behaviors and investments.

Leadership and action by every municipal government department, employee and volunteer will be critical to the Plan. However, municipal government is directly responsible for less than 4% of total emissions in Ipswich, and cannot on its own meet the reduction target for the entire Town. It must be joined in the effort to reduce emissions by active buy-in, planning and support by residents and businesses. To ensure widespread and effective adoption of the Plan's energy conservation, efficiency and renewable energy strategies, the municipal government must be joined in its education and outreach efforts by business organizations and non-governmental advocacy groups. For municipal government, residents, and businesses, putting the Plan into action will involve implementing strategies

that fall along the spectrum between “low-hanging fruit” and strategies that require fundamental changes in the way we think about energy use. If we can all work together, the Town will meet its 2020 emission target, and Ipswich will become a shining example of a cleaner, more sustainable community, and an even better place to live and work than it is today.

7. Appendix

Appendix 1

- CEUCP History and Membership
- Resolution by the Ipswich Board of Selectmen, November 2006
- Decision by the Ipswich Board of Selectmen, April 2010

CEUCP History and Membership

The Commission on Energy Use and Climate Protection was established by the Ipswich Board of Selectmen in October 2006. The Commission includes a broad range of representatives of town government, local businesses, and citizens.

The following individuals are (or were) members of the Commission during the preparation of this report:

- Robert Markel, Town Manager
- Web Bingham, Corporate Real Estate Advisor
- Brian Ditchek, Ph.D., Materials Scientist, VP Business Development
- David Feldman, Real Estate Valuation, Lawyer
- Charlie Flowers
- Tim Henry, Director of Public Utilities
- Mike Johnson, Marine Biologist
- Ingrid F. Miles, Realtor and former Selectman
- Heidi Paek, Writer
- Anne Reynolds, Environmental, Health & Safety Professional
- Ken Savoie, Architect
- Marc Simon, General Contractor
- Sarah Simon, Environmental Compliance Manager

Other individuals who contributed information for the preparation of this report are: Steve Clifford, (Director of Facilities for the Tri-Town Public Schools, CEUCP Volunteer), James Donovan (Energy Consultant, CEUCP Volunteer), Steve Manley (CEUCP Volunteer), and Chris Reif (Mechanical and Materials Engineering Consultant, CEUCP Volunteer).

Resolution by the Ipswich Board of Selectmen, November 6, 2006

The Ipswich Board of Selectmen voted to approve the following resolution on November 6, 2006, thereby officially joining cities throughout the world in a program of the International Council for Local Environmental Initiatives (ICLEI) known as Cities for Climate Protection (CCP):

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

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

WHEREAS, the U.S. Conference of Mayors endorsed the 2005 U.S. Mayors' Climate Protection Agreement initiated by Seattle Mayor Nickels and signed by 238 mayors in the United States as of June 2006; and

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

WHEREAS, in 2001, at the request of the Administration, the National Academy of Sciences (NAS) reviewed and declared global warming a real problem caused in part by the actions of humankind; and,

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

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

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

WHEREAS, the Cities for Climate Protection Campaign sponsored by ICLEI – Local Governments for Sustainability has invited Ipswich to join ICLEI and become a partner in the Cities for Climate Protection Campaign;

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

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

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

BE IT FINALLY RESOLVED that Ipswich, Massachusetts requests assistance from ICLEI's Cities for Climate Protection Campaign as it progresses through the milestones.

Decision by the Ipswich Board of Selectmen, April 20, 2010

The following memo was presented to the Board of Selectmen on April 20, 2010. Following a presentation by the CEUCP, the Board unanimously approved the carbon reduction recommendation.

TO: Board of Selectmen
FROM: The Commission on Energy Use and Climate Protection (CEUCP)
DATE: April 20, 2010
RE: Recommendation re: Carbon Emissions Reduction Target

Background
Ipswich is a member of the Cities for Climate Protection (CCP), a division of the International Council for Local Environmental Initiatives (ICLEI). The CCP outlines a five-milestone process:

Cities for Climate Protection Process	*Completion date*
Milestone 1 – Conduct a carbon emissions inventory	Dec. 2009
Milestone 2 – Adopt an emissions reduction target for the forecast year	Apr. 2010
Milestone 3 – Develop a local Climate Action Plan	In process
Milestone 4 – Implement policies and measures	
Milestone 5 – Monitor and verify results	

Recommendation
On Milestone 2, the CEUCP unanimously recommends that Ipswich adopt the Massachusetts carbon emissions reduction target, which calls for reducing emissions to 10% below 1990 levels by 2020.

Rationale
- Setting a carbon reduction goal of 10% below 1990 levels by 2020 is equivalent to decreasing emissions by just over 3% per year, a figure that has been widely adopted by governments, communities, businesses, and private citizens.
- Three initiatives currently underway at the Ipswich Municipal Light Department (Ipswich wind; Berkshire wind; Rhode Island landfill gas to power) will correspond to 55% of goal attainment.
- Other current projects in Town will have a quantifiable, beneficial impact. These include strict limits on garbage disposal, solar installations, streetlight retrofits, hybrid vehicle purchases, home weatherization and energy audits, public awareness campaigns, and possibly new building codes.
- Legislation at the federal and state level will also limit emissions and require efficiency. For example, there will be revised energy standards for household appliances, residential and commercial lighting, automobiles, the power source portfolio in general, and manufacturing processes to name a few. New legislation, regulations, and energy standards such as these will help Ipswich achieve its carbon reduction goal.
- As part of the Climate Action Plan (Milestone 3), the CEUCP will recommend additional measures that can be undertaken to attain the goal before 2020.

Appendix 2

Key Findings of the Ipswich Greenhouse Gas Inventory, December 2010

In the base year of the inventory report (2000), total Ipswich **GHG (CO_2) emissions** equaled 86,600 metric tons (mt) (Table 2-1).[72] This represents the approximate "**carbon footprint"** of Ipswich in 2000 and is the primary benchmark by which future emission reduction goals will be measured. Over time, GHG emissions generated in Ipswich have been increasing, reaching roughly 109,700 mt in 2005.

While the relative proportion of energy sources has shifted somewhat (e.g., less home heating fuel is used during mild winters, such as happened in 2000), energy use and emissions have been steadily rising overall (Table 2-1, Figure 2-1). The Commission considered several historic data points between 1990 and 2005, and has summarized the results of key time periods below. The source analysis of Ipswich's GHG emissions indicates:

- Total emissions are increasing and will continue to do so in the absence of reduction measures.
- Electricity use is the greatest single source of emissions, and its relative importance is projected to increase in the future.
- Heating fuels (heating oil and natural gas) are also major contributors of GHGs.
- Emissions from the use of heating fuel use in homes and businesses are generally increasing, but annual emissions are variable and dependent upon average winter temperatures.

	1990	**1995**	**2000**	**2005**	***2010***	***2015***	***2020***
Electricity	30,200	31,300	32,800	40,100	*48,300*	*52,700*	*57,500*
Heating Oil	28,400	26,500	24,000	32,600	*28,600*	*28,600*	*27,900*
Natural Gas	16,800	18,100	16,700	23,700	*26,700*	*28,500*	*29,000*
Gasoline/Diesel	12,800	11,700	10,600	10,500	*10,400*	*10,300*	*10,300*
Solid Waste	3,400	2,500	2,500	2,800	*2,800*	*2,900*	*3,100*
Total	**91,600**	**90,100**	**86,600**	**109,700**	***116,800***	***123,000***	***127,800***

Table 2-1 Estimated and projected GHG emissions (mt CO_2) by source

Note: Differences in annual totals reported for source and sector emissions are due to rounding errors

[72] 1 metric ton = 2,205 pounds

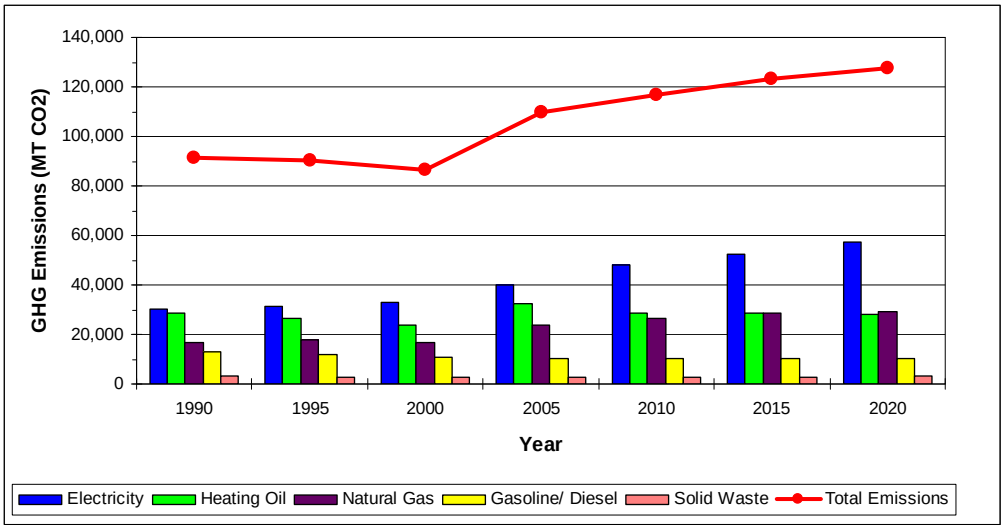

Figure 2-1 Estimated and projected GHG emissions (mt CO_2) by source

The CEUCP also analyzed the carbon footprint of each Town sector (i.e., residential, industrial/commercial, and municipal) (Table 2-2 and Figure 2-2). The sector analysis of Ipswich's GHG emissions indicates:

- The residential sector is the greatest contributor of GHG emissions.
- The industrial/commercial sector shows the fastest growth in terms of the emissions rate.
- Emissions from the residential and industrial/commercial sectors are growing at rates that far exceed the rate of population growth, new job creation, and built space (Table 2-3).

	1990	**1995**	**2000**	**2005**	***2010***	***2015***	***2020***
Residential	59,900	58,500	55,300	69,000	69,800	72,500	74,200
Indust./Comm.	29,000	28,900	28,400	37,600	43,500	46,800	49,400
Municipal	2,800	2,700	2,800	3,100	3,600	3,800	4,000
Total	**91,700**	**90,100**	**86,500**	**109,700**	***116,900***	***123,100***	***127,600***

Table 2-2 Estimated and projected GHG emissions (mt CO_2) by sector