Town of Deerfield

Master Plan

Energy Chapter

Deerfield, New Hampshire

2013

Prepared by the Southern New Hampshire Planning Commission
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This Draft Report has been prepared by SNHPC with assistance by town staff and the Deerfield Planning Board, and is intended to be presented to and adopted by the Deerfield Planning Board as a chapter in the Town's Master Plan

Executive Summary

The purpose of this chapter is to promote energy efficiency and conservation in the Town of Deerfield with the expectation that through the implementation of the goals in this chapter, Deerfield can increase energy efficiency, reduce operating costs and cut carbon emissions. This chapter sets out an energy strategy for the Town, building on the goals initially identified in the 2009 Master Plan.

"The Town of Deerfield recognizes that energy efficiency is the cleanest, cheapest, most readily available resource to meet energy needs and will act on the need to reduce energy use in buildings and transportation; and to maintain land uses that absorb greenhouse gases…"

Guided by the values and vision discussed in this chapter, the Deerfield Planning Board will strive to provide leadership supporting the following goals:

1. Establish municipal leadership and coordinate an integrated education, outreach, and workforce training program;
2. Reduce energy use and increase renewable and low carbon dioxide emitting sources of energy
    - For municipal buildings: Net Zero by 2030
    - For transport: Maximize mobility of people, goods, and information while minimizing Vehicle Miles Traveled (VMT)
    - For Deerfield: aspire to become a net zero community;
3. Encourage new construction or renovation that encourages energy independence;
4. Reduce municipal energy costs;
5. Encourage energy efficient land use patterns;
6. Reduce vehicle miles traveled (VMT) through an integrated multi-modal transportation system;
7. Protect natural resources (land, water, wildlife) and maximize land uses that absorb greenhouse gases and provide local sources of food and fiber;
8. Plan for existing and potential climate change impacts and extreme weather events (adaptation); and
9. Support regional and national actions to reduce Greenhouse Gases.

The Deerfield Energy Chapter provides an analysis of energy and fuel resources, needs, scarcities, costs, and problems affecting the municipality and a statement of policy on the conservation of energy. In addition, recommendations and an action plan are outlined for implementation of those recommendations. This chapter for the first time sets out an energy strategy for the Town, building on the goals initially identified in the 2009 Master Plan.

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1. Introduction

1.1. Purpose

There are many interrelated elements to consider when addressing energy issues. NH RSA 674:2, III(n) (Master Plan; Purpose and Description) describes the energy section as addressing: an analysis of energy and fuel resources, needs, scarcities, costs, and problems affecting the municipality and a statement of policy on the conservation of energy.

The purpose of this chapter is to promote energy efficiency and conservation in the Town of Deerfield, with the expectation that through implementation of the goals in this chapter, Deerfield can increase energy efficiency, reduce operating costs and cut carbon emissions. This chapter sets out an energy strategy for the Town, building on the goals initially identified in the 2009 Master Plan.

1.2 Energy Opportunity

Energy planning has become a key issue to communities, as energy costs continue to increase and concern grows over the environmental and health costs of major forms of energy production. The United States and New Hampshire primarily use dirty and increasingly expensive fossil fuels of coal and oil for most energy needs – electricity, space heating, and transportation. Reducing our dependence on such energy supplies for our needs serves many purposes, including:

- Reducing operating costs for buildings and vehicles;
- Providing buildings that can operate longer without inputs (i.e. energy sources);
- Increasing building comfort and user productivity;
- Keeping more money in the local and regional economy by using more local sources of energy, services, and food supply;
- Giving people more options for multi-modal mobility (walking, bicycling, private vehicles, public vehicles, etc.); and
- Diversifying energy supplies to include more local supplies such as wood and renewables for more energy security.

Despite the apparent controversy in parts of the U.S. over climate change, evidence demonstrates that extreme weather events have increased in frequency, and energy prices have increased at a rate above that of other goods and services. The country has entered a new energy era, and Deerfield residents have the potential to benefit from that change in many ways.

1.3 Deerfield Energy Chapter Scope, Vision and Goals

Scope
For the purposes of this chapter, the scope will focus on those elements of energy demand and supply most influenced by Deerfield residents and local government policies and actions:

- Buildings/Grounds;
- Transportation; and
- Land Use.

Vision
From the 2009 Deerfield Master Plan: "The Town of Deerfield recognizes that energy efficiency is the cleanest, cheapest, most readily available resource to meet energy needs and will act on the need to reduce energy use in buildings and transportation; and to maintain land uses that absorb greenhouse gases. This will be accomplished through initiatives such as the '2030 Challenge', 'Energy Star and US Green Building Council Leadership in Energy and Environmental Design (LEED)' and '350/300'."[1] Goals, objectives and strategies related to energy from the 2009 Deerfield Master Plan can be found in Appendix F.

Goals
Guided by the values and vision discussed in this chapter, the Deerfield Planning Board will strive to provide leadership supporting the following goals:

1. Establish municipal leadership and develop an integrated education, outreach, and workforce training program;
2. Reduce energy use and increase renewable and low carbon dioxide emitting sources of energy
    - For municipal buildings: Net Zero[2] by 2030
    - For transport: Maximize mobility of people, goods, and information while minimizing Vehicle Miles Traveled (VMT)
    - For Deerfield: aspire to become a net zero community;
3. Encourage new construction or renovation that encourages energy independence;
4. Reduce municipal energy costs;
5. Encourage energy efficient land use patterns;
6. Reduce vehicle miles traveled (VMT) through an integrated multi-modal transportation system;
7. Protect natural resources (land, water, wildlife) and maximize land uses that absorb greenhouse gases and provide local sources of food and fiber;
8. Plan for existing and potential climate change impacts and extreme weather events (adaptation); and
9. Support regional and national actions to reduce greenhouse gases.

[1] 2009 Deerfield Master Plan
[2] Definition found in Appendix B

Existing Conditions in Deerfield

2.1 Extreme Weather

According to the Intergovernmental Panel on Climate Change (IPCC) the type, frequency and intensity of extreme weather events are expected to change as earth's climate changes, and these changes could occur even with relatively small mean climate changes. Changes in some types of extreme events have already been observed, for example, increases in the frequency and intensity of heat waves and heavy precipitation events. These changes have been observed in Deerfield and New Hampshire in the past 5-6 years with extreme weather events happening almost every year and with power outages from these extreme weather events ranging from 125,000 – 322,000 statewide outages, many of concerning duration:

Event	Year	Month	Description
1	2006	May	Mother's Day (Flood #1)
2	2007	Apr	Patriot's Day (Flood #2)
3	2008	Jul	Tornado (50 mile touchdown, starting in Deerfield; 1 fatality)
4	2008	Fall	Flood #3
5	2008	Dec	Ice Storm (PSNH new record @ 322,000 outages)
6	2010	Feb	Wind storm (PSNH 2nd most outages @ 269,000)
7	2010	Mar	Flood #4
8	2011	Aug	Tropical Storm Irene (PSNH 125,000+ highest non-winter outage)
9	2011	Oct	Halloween Snow Storm (PSNH 3rd most outages @ 237,000; biggest Northeast Utilities peak outage on record @ 1,248,000)
10	2011-12	Dec-Jan	Second warmest winter on record
11	2012	Mar	Warmest on record, 9 degrees F higher than average

The events listed above compare to the 1990s when there were only four major storms resulting in 55,000 – 93,000 power outages.[3] The intensity and frequency of these events exemplifies the need for increased hazard mitigation planning and adaptation to new conditions. It also shows the connection between the ways we consume energy as a whole and how that affects us individually. Community preparedness should be a top priority for communities and individuals as we plan for the future, because it is apparent that these events are now the new normal.

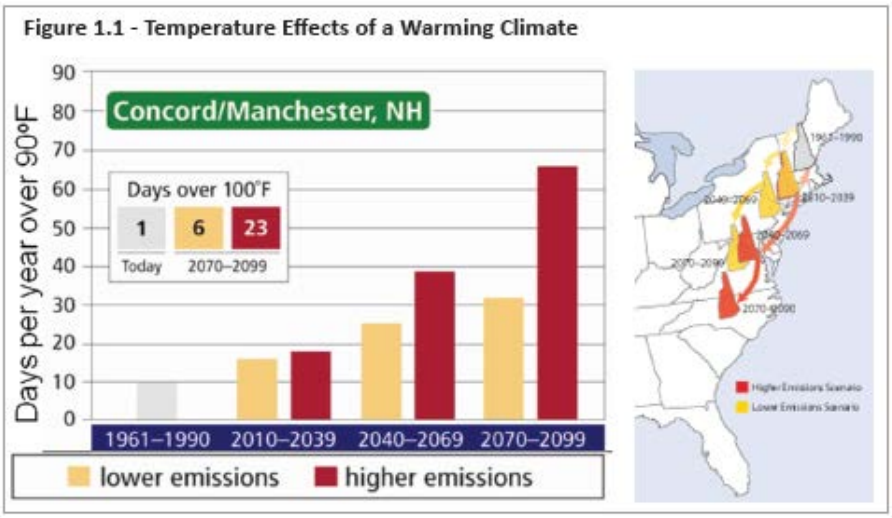
[3] PSNH

2.2 Energy Conservation, Adaptation and Hazard Mitigation

"Energy conservation" is the efficient use of energy or the reduction of energy use by implementing energy efficient practices, policies, technologies, construction, development or any other action aimed at reducing energy use.

An extensive analysis of peer-reviewed scientific literature by IPCC has clearly shown that if global greenhouse gas emissions continue to grow at current rates, there will be significant and far-reaching changes in our future climate that will profoundly affect our health, economy, security, and quality of life.[4]

On a regional scale, the 2007 Northeast Climate Impacts Assessment (NECIA) concludes that if greenhouse gas emissions continue to increase at current rates, by late in this century New Hampshire's climate will more closely resemble that of North Carolina (Figure 1.1).[5]



Such a change in New Hampshire's climate presents numerous potential economic impacts including reduced viability of New Hampshire ski areas, change in forest species and extinctions and increased frequency and severity of extreme weather events and related property damage and human health impacts. To reduce these negative impacts of climate change, a transition to efficient and renewable sources of energy will be necessary to bring greenhouse gas levels in our atmosphere down to safer levels.

[4] Gittell, R. and Magnuson, M. (2007). Economic Impact of a New Hampshire Renewable Portfolio Standard. UNH Economic Analysis, 74 pp. http://des.nh.gov/organization/divisions/air/tsb/tps/climate/documents/unh_rps_report.pdf.

[5] Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions. Northeast Climate Impacts Assessment Synthesis Team. July 2007. Available at: http://www.climatechoices.org/assets/documents/climatechoices/confronting-climate-change-in-the-u-s-northeast.pdf

2.3 Energy Inventories/Audits for Deerfield's Municipal Buildings

Deerfield participated in the Energy Technical Assistance and Planning (ETAP) Program during 2010-2012 administered by the New Hampshire Office of Energy and Planning. The town received an initial high level energy assessment of five municipal buildings as part of this program to address the town's interests and needs with respect to energy efficiency improvements and capital upgrades. Those buildings are: the Town Hall, Central Fire Station, George B. White Building, Library, and Highway Shed.

Table 1, from Appendix C: Peregrine Energy Group. *Energy Efficiency Opportunities for Town Buildings Deerfield, NH*, April 4, 2011, shows the annual utility use and energy density of these five buildings based on data collected from 2008-2010. The highest energy use per square foot of the municipal buildings assessed is the George B. White Building, followed by the Highway Shed. These two buildings have the most opportunity for energy reduction and savings in town.

Table 1 –Annual Utility Use and Energy Cost Intensity

Facility	Square Feet	Electric Cost ($)	Oil Cost ($)	Propane Cost ($)	Waste Oil Cost ($)	Total Cost ($)	st ($) per uare Foot
George B. Wright	13,774	25,091	11,792	-	-	36,883	2.68
Central Fire Station	6,442	3,205	-	4,360	-	7,566	1.17
Town Hall	6,820	3,251	3,861	-	-	7,112	1.04
Library	2,120	2,031	825	-	-	2,856	1.35
Highway Shed	2,800	2,001	731	1,285	-	4,018	1.43
Total	31,956	$35,580	$17,209	$5,646	$0	$58,434	$1.83

The George B. White Building has a number of opportunities for energy reduction and savings outlined below in Table 2. Further details on these recommendations and the others mentioned below can be found in Appendix C.

Table 2 – Summary of Energy Reduction Opportunities for the George B. White Building

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Review heating controls	low cost				296	$590	<1
2	Upgrade windows	$4,000				177	$354	10+
3	Air seal and targeted insulation	$14,000				414	$1,750	7-8
	Estimated Program	***$18,000***	***$0***		***-***	***887***	***$2,693***	***6.7***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$36,883 /yr***
Percent Reduction: ***7%***

Table 3 – Summary of Energy Related Opportunities for the Highway Shed

"Following are two recommendations for the Highway Shed. In addition to these recommendations, the Highway Agent has several in-house projects that he can work with the Selectmen and the Town's Energy Committee to develop, including a replacement entry door, replacement windows, and other energy-related upgrades that Dept. of Public Works staff can install as schedules permit."

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Upgrade garage doors	N/A					$0	10+
2	Review ventilation options	N/A					$0	
3							$0	
	Estimated Program	***$0***	***$0***		**-**	**-**	***$0***	***#DIV/0!***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$4,018 /yr***
Percent Reduction: ***0%***

Table 4 – Summary of Energy Reduction Program Potential Results

Facility	Approximate Installed Cost ($)	Utility Incentive Available[1]	Potential Utility Savings			Annual Cost Avoidance ($)	Simple Payback Yr
			Other Benefits	Electric kWh/yr	LP or Oil Gal/yr		
George B. Wright	18,000	-	-	-	887	2,693	6-7
Central Fire Station	4,000	-	A	-	177	354	10+
Town Hall	7,000	-	A	-	355	708	10+
Library	5,000	-	A,B,C	-	177	354	10+
Highway Shed	-	-	-	-	-	-	
Total	$34,000		A,B,C	-	1,596	$4,108	8-9

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$58,434 /yr***
Percent Reduction: ***7%***

As of April 2012 a number of the recommendations in the ETAP report have been completed, including:

<u>Library</u>

- Troubleshoot Furnace (furnace air circulation fan corrected)
- Air Seal and Insulation

<u>George B. White Building</u>

- Programmable Thermostats installed
- Window replacement (in progress)
- Air Sealing and Insulation (planned for 2012)

Town Hall

- Programmable Thermostats installed

A number of the remaining recommendations in the buildings assessed in the ETAP report are similar, and a feasibility analysis for aggregating projects should be conducted in order to reduce project costs across multiple buildings if possible.

The primary goal for the ETAP building assessments was to identify cost-effective energy efficiency and renewable energy investments that Deerfield may want to consider as part of its long-term energy management plan. The report includes Peregrine Energy Group's recommendations for energy cost reductions that Deerfield may want to pursue, and a summary of building energy use and cost information that was available at the time of the assessments.

The assessments did not include all municipal buildings and facilities in the Town of Deerfield, nor did it include streetlights or a fleet audit. Further audits that include all of these municipal energy-users are recommended to develop a long-term energy management plan for the Town.

2.4 Current Deerfield Initiatives, Ordinances and Projects

- **Deerfield participated in the Energy Technical Assistance and Planning for New Hampshire Communities (ETAP) program,** a two-year program that provided energy efficiency technical assistance at no charge to municipalities and counties in NH. ETAP's goal was to advance energy efficiency in all New Hampshire municipalities and provide the tools communities need to monitor energy performance. ETAP was funded by the American Recovery and Reinvestment Act (ARRA) of 2009, and administered through New Hampshire's Office of Energy and Planning.

- **Energy Chapter Workshops**
  As part of the technical assistance offered through the ETAP program, Southern New Hampshire Planning Commission guided the development of this Energy Chapter for the Town's Master Plan. Regular public workshops were conducted to receive input from the town for the chapter.

- **Municipal Building Energy Efficiency Upgrades**
  Several of Deerfield's municipal buildings have recently had energy efficiency upgrades or are currently undergoing upgrades, including the Philbrick-James Library, the George B. White Building / Town Offices and the Town Hall.

- **Recycling**
  Deerfield operates a voluntary recycling program and swap shop for reuse of used goods at the Deerfield Transfer Station. Recycling, reusing and reducing are all practices which

help to reduce the amount of waste we throw away and conserve natural resources, landfill space and energy.

- **Plans and Ordinances**
    - 2009 Deerfield Master Plan – vision and goals related to energy are included in the most recent Deerfield Master Plan found in Appendix F
    - Open Space Development – Section 325 of the Deerfield Zoning Ordinance has the following objectives:
        - Preserve the natural beauty of existing rural roads, topography, agricultural and wooded areas and to provide usable open space and recreation facilities in close proximity to dwelling units; encourage the use of buffers, wildlife habitats and corridors and greenways in order to achieve the above;
        - Encourage a less sprawling form of development which makes more efficient use of land, requires shorter networks of streets and utilities, and fosters less consumption of rural and/or agricultural land;
        - Provide an efficient procedure which can ensure appropriate, high-quality design and site planning and a high level of environmental amenities;
        - Avoid development of portions of sites which have poor soil conditions, high water tables, are subject to flooding, or have excessively steep slopes;
    - Commercial Flexible Overlay
    - Pleasant Lake Watershed Overlay

3. Energy-Related Problems Affecting Deerfield

One of the purposes of this chapter is to address problems related to energy conservation and planning. Over the past several years, municipalities have made important progress in the areas of energy efficiency and sustainability. However, as we enter the second decade of the 21st Century, there are still many challenges to overcome. There are many people who are skeptical of the climate science, and unconvinced about the economic potential of a new energy future. As we discover the true costs of the use of fossil fuels as our main source of energy, we are learning that we cannot remain resilient if we follow this same path. Further education is needed to emphasize the increased comfort, safety, health, cost effectiveness, and flexibility that new practices will provide. The purpose of this chapter is not to argue those issues, but rather to find common ground to accomplish the goals identified based on the vision in 2009 Master Plan and values cited above, within the scope defined. Problems that affect Deerfield and its ability to accomplish energy-related goals may include:

1.) **Fuel Prices:** The price of oil has increased by more than 400 percent since 1998, and in New Hampshire, the cost of home heating oil rose 23 percent between January 2010 and January 2011, and another 11 percent between January 2011 and January 2012[6].

[6] New Hampshire Heating Oil Dealers and Price Guide. < http://www.heatingoilnh.com/lowest-prices.htm > Retrieved 2012-05-14

2.) **Patterns of Development:** In recent decades, development in the United States has been characterized by the tendency of communities to fracture into residential and commercial zones, accessible to each other only by automobile.

3.) **Public Transit:** Like many other New Hampshire towns, Deerfield lacks access to public transit lines such as rail or bus.

4.) **Funding:** Although cost-effective in the long run, many energy efficiency projects require significant up-front costs that businesses and individuals cannot afford.

5.) **Complexity, Interest and Education:** Many energy efficiency and sustainability programs in New Hampshire are complex and difficult for the general public to understand. For instance, one recent survey showed that more than 40 percent of NH residents had little to no idea about where to go for sustainable energy loans, rebates, or grants.[7] Also, lack of residential interest and education can present a challenge when trying to make positive changes in a community toward energy efficiency and sustainability.

6.) **Split Incentives:** In the case of rented buildings, owners pay the costs of initiating energy efficiency programs, but tenants receive the savings from implementing them (or the costs from not implementing them). This leads to a disincentive for landlords to invest in energy efficient projects or renovations.

7.) **Adaptation and Hazard Mitigation:** Town's vulnerability to floods and other natural events can lead to power outages.

4. New Opportunities for Deerfield

It is widely acknowledged that current patterns of growth, development, and consumption cannot be maintained indefinitely. As the costs of energy increase, many municipalities are turning to new, more creative methods of energy use. These new methods can be direct, such as implementing plans for alternative or renewable energy, or indirect, such as increasing citizen awareness about the importance of resource conservation.

4.1. Buildings and Grounds

Building codes should allow for energy efficient design and use. Programs like the U.S. Department of Energy's Building Energy Codes Program (BECP) and certifications such as Leadership in Energy & Environmental Design (LEED) offer guidelines and metrics that can be used to increase a building's energy performance and result in greater energy efficiency and ultimately cost savings.

Current building codes represent the minimum legal energy efficiency for structures. These standards focus on the building envelope and mechanical systems and disregard

[7] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. A:3.

natural and renewable means of reducing a building's environmental impacts. By applying passive solar design in conjunction with building codes, energy utility bills can be decreased by 30 percent. Add to that "well insulated and tightly constructed building shells" and the savings can reach 75 percent.[8]

RSA 155-A:2, VI allows municipalities to adopt more stringent building codes than the state codes. Examples include the Energy Efficient Development Model Ordinance in the Innovative Land Use Planning Techniques Handbook[9] as well as the Massachusetts Stretch Code.[10] In lieu of ordinances requiring energy-efficient building design, Deerfield may consider ordinances that incentivize such design.

4.1.1 Resources for reducing demand

Almost all existing buildings have the potential to **reduce energy use by up to 60%** with relatively **simple and low cost practices**. These include: energy audits, passive solar/daylighting, air sealing, insulation, shades/drapes, upgrades to efficient appliances and controls, etc. Site design opportunities include using sun, shade, topography, and integrated landscaping practices to help reduce energy use. The Architecture 2030 Challenge (defined in Appendix B and outlined in Appendix E) outlines practical steps that all sectors can take to start implementing these demand reduction techniques.

Architecture 2030 asks that all firms, organizations and individuals choosing to adopt the 2030 Challenge commit to design all of their projects to meet the targets outlined by the initiative. This requires each new building project or major renovation to be designed to achieve an energy consumption performance standard of 50% of the regional (or country) average for that project's buildings type. For new building projects, this performance standard will increase to 60% of the regional (or country) average in the year 2010. Every five years the standard will increase by an additional 10%, achieving carbon-neutral buildings in the year 2030. Major renovations are only required to meet the 50% target throughout this timeline, but are encouraged to achieve the increased reductions.[11]

4.1.2 Third-Party Ratings

Third party rating systems provide certification and verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

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[8] Urban Land Institute. 2000. *The Practice of Sustainable Development.* Washington, DC: Douglas R. Porter, Rutherford H. Platt.
[9] NHDES. *Innovative Land Use Planning Techniques, A Handbook for Sustainable Development*. October 2008.
[10] Stretch Appendix to the Building Energy Code in Massachusetts. http://www.cityofboston.gov/Images_Documents/EOEEA%20q_and_a_stretch_code_tcm3-21504.pdf
[11] Architecture 2030. 2030 Implementation Guidelines. http://architecture2030.org/files/2030ImplementationGuidelines.pdf

Examples of third-party rating systems are:

- US Green Building Council Leadership in Energy and Environmental Design (LEED)—includes grounds and neighborhood;
- Home Energy Rating System (HERS) – home energy rating program for residential dwellings;
- Building Performance Institute (BPI) - a national standards development organization for residential energy efficiency and weatherization retrofit work;
- EnergyStar - energy performance rating system for homes and businesses; and
- ASHRAE's Building Energy Labeling Program - Building Energy Quotient (bEQ) is a building energy labeling program that lets commercial building owners zero in on opportunities to lower building operating cost and make informed decisions to increase value.

4.1.3 Self-Assessments

For individuals, a self-assessment can help determine whether there are improvements or behavioral changes that can be made to reduce energy use in their homes. Many homes use more energy than needed to keep individuals comfortable and as fuel prices continue to rise most people cannot afford to be without an energy plan to reign in these expenses. Examples of self-assessment guidelines include:

- My Energy Plan[12]
- Stepping Up to the 2030 Challenge worksheet[13]

4.1.4 Passive Sustainability

Passive sustainability allows buildings to meet occupant needs during power outages and natural disasters. Passive sustainability involves reducing demand and generating energy needed on site as much as possible. For example, passive solar and well air-sealed and insulated structures with high efficiency/low emissions wood stoves provide relatively comfortable living conditions for the occupants during times when there may not be power, water, or food available from off-site sources. This is an important adaptation strategy that will create greater community resilience, given the recent extreme weather.

4.2 Transportation

Transportation is an activity that consumes a great deal of fossil fuel. As communities grow and physically spread out, vehicle miles traveled per household and the associated energy demand have increased to support a more auto-dependent lifestyle. Strategies for reducing vehicle miles traveled and reliance on automobiles can help to create a more energy efficient transportation network. Further, recent advances in vehicle technology

[12] http://myenergyplan.net/
[13] http://architecture2030.org/

have increased auto-efficiency and outreach and education to encourage alternative vehicle technology and increased efficiency can help to reduce reliance on fossil fuels.

Strategies to reduce vehicle miles traveled should include a Complete Streets design approach. Complete Streets are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users, including pedestrians, bicyclists, motorists and public transport users of all ages and abilities.[14]

4.3 Land Use

The way communities are designed, planned, and built may influence the amount of energy used, how energy is distributed, and the types of energy sources that will be needed in the future. Energy efficiency can be incorporated into land use planning by adopting mixed-use zoning, which would allow greater accessibility to desired services without requiring greater mobility. Other ways to promote energy efficiency and conservation in land use planning include:

- Encourage livable, walkable land use policies and regulations;[15]
- Encourage alternative forms of transportation in the planning and design of the community. For Deerfield this includes park & rides, bicycle lanes, pedestrian lanes and crossing and trails;
- Encourage energy-efficient development through subdivision and site plan review regulations, zoning ordinance and building codes. Site design techniques that take advantage of sun exposure, differences in microclimate, and landscaping reduce a development's demand for fossil fuel derived energy sources and reduce overall energy consumption;[16]
- Encourage increased reliance on the local food supply in order to:
  - Reduce transportation energy needed to get food to our homes
  - Increase local economic health by keeping money in the community; and
- Encourage organic farming. Local organic farmers do not rely upon the input of petroleum-derived fertilizers and pesticides and thus save energy at the farm.

Deerfield has already implemented some recognized methods for increasing energy efficiency in land use patterns through the Deerfield Open Space Development Ordinance, the adoption of International Energy Conservation Code (IECC) 2009 and a growing local food movement and farmers market.

[14] Ritter, John (2007-07-29). *Complete streets' program gives more room for pedestrians, cyclists. USA Today*. http://www.usatoday.com/news/nation/2007-07-29-complete-streets_N.htm. Retrieved 2011-09-07.
[15] Refer to the 2012 New Hampshire Livable Walkable Communities Toolkit for recommendations and policies. SNHPC. April 2012.
[16] Model ordinance language can be found in *Innovative Land Use Planning Techniques*. October 2008. Chapter 3.5. Pgs. 371 – 388.

4.4 Energy Efficiency Resources

Local Energy Commissions (LECs)

RSA 38-D:4 ("Energy Commissions;" "Duties") describes the duties of an Energy Commission: Energy Commissions can be created for the purpose of study, planning, and utilization of energy resources for municipal buildings and built resources. The commission is charged with researching municipal energy use and costs and making this information available to the town on at least an annual basis. It is also responsible for making recommendations to local boards and committees pertaining to municipal energy plans and sustainable practices, such as energy conservation, energy efficiency, energy generation, and zoning practices.

Education Opportunities

Local Energy Commissions are a great resource for increasing education and outreach at the local level. Incorporating energy efficiency into municipal practices and into town events is a great lead-by-example approach for education and outreach as well. Communities that track progress on energy efficiency and use in municipal buildings provide visible results to their residents that the Town's efforts to reduce energy use is directly related to the effort to reduce the tax burden for town residents. Regional and State agencies and organizations provide educational opportunities for energy efficiency as well and publicizing those opportunities is another easy way to increase education on energy issues.

Current trends and initiatives in New Hampshire

- **RSA 362-F: Electric Renewable Portfolio Standard (RPS) -** New Hampshire's RPS policy was signed into law in May 2007 as the Renewable Energy Act. It requires each supplier of electricity in New Hampshire (PSNH, Unitil, National Grid, NH Electric Coop) to demonstrate that they are obtaining about 25% of their electricity from renewable energy resources by the year 2025.

- **Regional Greenhouse Gas Initiative (RGGI).** RGGI is a cooperative effort among nine states – Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont – to reduce greenhouse gas emissions. RGGI reduces CO2 emissions by establishing a regional cap on the amount of CO2 that power plants can emit through the issuance of a limited number of tradable CO2 allowances. This approach allows market forces to determine the most economic means of reducing emissions and creates market certainty needed to drive long-term investments in clean energy. Together these states have capped and will reduce power sector CO_2 emissions 10 percent by 2018.

- **Performance Contracting** - In 1993, the New Hampshire legislature created RSA 21-I:19-d which allows a municipality to sign a performance contract with an energy service company (ESCO). A performance contract allows costs of energy efficient upgrades to be financed through the ESCO and paid off over time through the energy savings. There is no upfront capital cost associated to the Town for such programs. Performance contracts also protect municipalities by requiring the ESCO to meet a certain reduction of energy use. If this level is not reached, the ESCO is required to pay the difference in the energy bill. It is a win-win situation, allowing municipalities to become more energy efficient, reduce their energy costs, and protect itself from increase costs.

- **Competitive Electricity Supply Aggregation** - Aggregation is the combination of individual electricity buyers (and their loads) into a large pool. Other factors being equal, suppliers prefer dealing with larger groups, which have more purchasing leverage with suppliers competing for their business. This purchasing power can be used to obtain cost savings, a different combination of services, or more favorable service terms. Aggregation also reduces transaction costs for the members of the buyers group and for the suppliers.[17]

- **Power Purchase Agreement -** the customer buys the output (*e.g.*, kWh or pounds of steam) of a distributed generation project, rather than the actual project.[18]

- **Net Metering**, or net energy metering, is an electricity policy which allows utility customers to offset some or all of their energy use with self-produced renewable energy. Net metering works by utilizing a meter that is able to spin and record energy flow in both directions. The meter spins forward when a customer is drawing power from the utility grid (i.e., using more energy than they are producing) and spins backward when energy is being sent back to the grid. At the end of a given month, the customer is billed only for the net energy used.[19]

- **Grants, Rebate Programs and low-interest loans** – Appendix D outlines state agencies, programs and funding mechanisms that promote energy efficiency.

[17] National Renewable Energy Laboratory. *Customer Aggregation: An Opportunity for Green Power?* February 2001.
[18] ICF International, National Assoc of Energy Service Companies. Introduction to Energy Performance Contracting. October 2007. http://www.energystar.gov/ia/partners/spp_res/Introduction_to_Performance_Contracting.pdf
[19] Calfinder Residential Solar Power. http://solar.calfinder.com/blog/solar-information/what-is-net-metering/

5. Recommendations and Action Plan

- BOS – Board of Selectmen
- EM – Energy Manager
- LEC – Local Energy Commission
- IT - Information Technology
- PB – Planning Board

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
1. Establish municipal leadership and develop an integrated education, outreach, and workforce training program				
1a.	Re-establish the Local Energy Commission (LEC) and work cooperatively with Town departments to reduce energy use and costs	*BOS, Dept. Heads*	*2012*	*RSA 38-D*
1b.	Appoint a BOS representative to the LEC to work with and coordinate on energy efficiency projects in Deerfield	*BOS*	*2012*	*N/A*
1c.	Appoint a responsible party for energy management in town facilities	*BOS, Town Admin*	*2012-2013*	*N/A*
1d.	Publicize energy savings measures the town is taking for municipal buildings and progress on reducing municipal energy and costs. Publish municipal energy use and costs in the annual Town Report.	*LEC, EM*	*Annual*	*Town website, newsletter, Town Report*
1e.	Create a page for the LEC on the Town website	*IT, LEC*	*2012*	*Town website*

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
1f.	Publish energy efficiency tips, incentives and rebates in the local newspaper and on the town website through the LEC	*LEC*	*Ongoing*	*Town newsletter and website*
1g.	Hold free events with an energy conservation focus and incorporate energy conservation measures into community events	*LEC, EM*	*Ongoing*	*Button Up, New Hampshire Workshops, NHOEP*
1h.	Revise municipal energy goals and strategy on an annual basis	*BOS, PB, LEC, EM*	*Annual*	*Annual Energy goals/strategy review*
2. Reduce energy use and increase renewable and low carbon dioxide emitting sources of energy				
2a.	Consider incorporating Architecture 2030 challenge steps into municipal policies for energy reduction targets - Reduce demand by 60% - After minimizing energy needs, provide 20% on-site renewable power - Purchase 20% green renewable energy	*BOS, Town Admin, LEC*	*2013*	*Architecture 2030 challenge steps outlined in Appendix E, see Sustainable Hanover system dynamics simulation tool to model emissions trajectory*
2b.	Investigate on-site renewable energy sources for municipal buildings as a means to stepping up to the 2030 challenge	*BOS, Town Admin, EM, LEC*	*2015*	*Energy audits and professional estimates*
2d.	Recommend energy policies and practical steps for reducing energy use in municipal buildings	*LEC, EM*	*2013*	*Architecture 2030 steps*

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
2e.	Consider innovative financing techniques for energy efficiency projects in municipal buildings	*BOS, Town Admin, EM, LEC*	*Ongoing*	*Energy Performance Contracting, Electric Aggregation, State and Utility EE Programs, Grants and low-cost loans, Appendix D*
2f.	Encourage department heads to consider energy efficiency projects within and in coordination with other departments	*BOS, Dept. Heads*	*Ongoing*	*municipal energy policies (Action 2b)*
3. Encourage new construction or renovation that encourages energy independence				
3a.	Consider instituting a renewable energy property tax exemption	*PB, BOS*	*2013*	*NH RSA 72:61-72*
3b.	Consider incentivizing a third party rating certification for all new construction, major renovations and building change of ownership	*PB, BOS, Bldg. Insp.*	*2013-2015*	*Third party rating systems outlined in Section 4.1.2*
3c.	Encourage use of the practices outlined by the US Green Building Council Leadership in Energy Environmental Design (LEED)	*PB, Bldg. Insp.*	*Ongoing*	*USGBC*
3e.	Consider incentivizing more stringent building codes than State codes to increase energy efficiency and decrease energy costs for development in town	*PB, Bldg. Insp.*	*2013-2015*	*Innovative Land Use Planning Handbook, Massachusetts Stretch Code example*
4. Reduce Municipal Energy Costs				

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
4a.	Step up to the 2030 Challenge for Deerfield Municipal Buildings	*BOS, Town Admin, LEC, EM*	*2013*	*See Action 2a. Architecture 2030 challenge steps outlined in Appendix E*
4c.	Prioritize energy efficiency recommendations from ETAP building assessment report	*BOS, EM, Town Admin, Finance Committee*	*2012*	*Recommendations outlined in Section 3.D.1 and Appendix C*
4d.	Track energy use in municipal buildings, streetlights and vehicles and require quarterly reporting	EM	*Ongoing*	*Energystar Portfolio Manager, STOCC (Clean Air Cool Planet)*
4e.	Consider establishing a green building and vehicle ordinance for municipal buildings and vehicles which incentivizes the use of alternative fuel and hybrid vehicles and new construction or major renovations for town buildings to meet US Green Building Council LEED standards when possible without increasing the budget for a given project	PB, BOS	*2013*	*Derry, NH ordinance example*
5. Encourage energy efficient land use patterns				
5a.	Consider innovative land use planning techniques for energy efficient development	*PB, Town Planner*	*Ongoing*	*Innovative Land Use Planning Techniques Handbook, NHDES*
5b.	Review the existing Master Plan, Zoning Ordinances, Regulations and other town policies to promote and incorporate energy efficient development	*PB, Town Planner*	*2013-2015*	*Keene NH Land Use and Energy Policy Audit example*

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
6. Reduce Vehicle Miles Traveled (VMT) through an integrated multi-modal transportation system				
6a.	Consider adopting a Complete Streets policy for transportation planning and construction - For Deerfield, park & rides, bicycle lanes, pedestrian lanes and crossing, trails plan	*BOS, Road Agent*	*2015*	*National Complete Streets Coalition*
7. Protect natural resources (land, water, wildlife) and maximize land uses that absorb greenhouse gases and provide local sources of food and fiber				
7a.	Protect and maintain green infrastructure in the Deerfield Open Space Plan (2010)	*PB, Cons Comm.*	*Ongoing*	*Regular review and updates of Deerfield Open Space Plan*
7b.	Promote local food supply and marketing	*Farmers Market Coordinator, Town Admin*	*Ongoing*	*Farmers market, marketing/advertising*
8. Plan for existing and potential climate change impacts and extreme weather events (adaptation)				
8a.	Incorporate the Deerfield Hazard Mitigation Plan (2012) into the Deerfield Master Plan Vision, Goals and Objectives	*PB, Hazmit Comm.*	*2015-2017*	*Master Plan updates should include Hazard Mitigation Plan incorporation*
8b.	Continue to support the Hazard Mitigation team, Welfare, and Building Inspector and work to incorporate mitigation and preparedness into town plans and actions	*BOS, PB, EM*	*Ongoing*	*Joint meetings and coordination on goals and action plans*
9. Support regional and national actions to reduce Greenhouse Gases				
9a.	Support New Hampshire's Renewable Portfolio Standard of 25% renewable energy by 2025	*BOS*	*Ongoing*	*Legislative*

Deerfield Master Plan Energy Chapter Action Plan

Goal				
	Recommendation	**Who (Leadership)**	**When (Suggested Deadline)**	**How (Resources)**
9b.	Support the Regional Greenhouse Gas Initiative (RGGI)	*BOS*	*Ongoing*	*Legislative*
9c.	Require bi-annual updates from the LEC to the BOS on regional and national actions to reduce Greenhouse Gases	*LEC, BOS*	*Bi-annually*	*N/A*

Appendices

Appendix A

Background

Deerfield Energy Chapter Background

U.S. energy policy has had the same two goals since the days of the Oil Embargo in the 1970's:

(a) Sustain economic growth for improved quality of life;
(b) Minimize oil and other energy imports.

In 1976, Amory Lovins, Chief Scientist of Rocky Mountain Institute, identified at least one reason those goals have been so hard to accomplish:

> "Underlying [all] energy choices are real but tacit choices of personal values… The most important, difficult, and neglected questions of energy strategy are not mainly technical or economic, but rather **social and ethical**."[20]

Since 1976, a lot more is known about our energy choices. More recently, Deerfield has experienced severe weather and higher prices for fossil fuels. This chapter for the first time sets out an energy strategy for the Town, building on the goals initially identified in the 2009 Master Plan.

[20] "Energy Strategy: The Road Not Taken?" Amory B. Lovins, *Foreign Affairs*, Oct 1976, pp. 94-95

Appendix B

Definitions

Definitions

Architecture 2030 – Architecture 2030, a non-profit, non-partisan and independent organization, was established in response to the climate change crisis by architect Edward Mazria in 2002. 2030's mission is to rapidly transform the U.S. and global Building Sector from the major contributor of greenhouse gas emissions to a central part of the solution to the climate change, energy consumption, and economic crises. The organization's goal is: to "achieve a dramatic reduction in the climate-change-causing greenhouse gas (GHG) emissions of the Building Sector by changing the way buildings and developments are planned, designed and constructed."[21]

Carbon sequestration - Carbon that is removed from the atmosphere and retained in a carbon sink (such as a growing tree or in soil).[22]

Climate Change – Burning fossil fuels, increased agriculture, and deforestation all emit natural greenhouse gases and are concerning due to their contribution to increased concentrations of these greenhouse gases. Human activities also increase GHG emissions that are not naturally occurring in the atmosphere. These activities include semiconductor manufacturing, refrigerant leaks, and other industrial sources. The high level of greenhouse gases trap heat close to the surface of the earth, contributing to major shifts in the global climate.[23]

Energy Conservation – the efficient use of energy or the reduction of energy use by implementing energy efficient practices, policies, technologies, construction, development or any other action aimed at reducing energy use.

Energy Efficiency – **Efficient energy use**, sometimes simply called energy efficiency, is the goal of efforts to reduce the amount of energy required to provide products and services. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Installing fluorescent lights or natural skylights reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs. Compact fluorescent lights use two-thirds less energy and may last 6 to 10 times longer than incandescent lights. Improvements in energy efficiency are most often achieved by adopting a more efficient technology or production process.[24]

[21] Architecture 2030. http://architecture2030.org/about/about_us
[22] Energy Terms Glossary. Nebraska Energy Office. http://www.neo.ne.gov/statshtml/glossarys.htm. Retrieved 2011-11-15.
[23] US Dept. of Energy. Federal Energy Management Program
[24] Diesendorf, Mark (2007). Greenhouse Solutions with Sustainable Energy, UNSW Press, p. 86.

Greenhouse Gas Emissions – Greenhouse gases are trace gases in the lower atmosphere that trap heat through a natural process called the "greenhouse effect." This process keeps the planet habitable. International research has linked human activities to a rapid increase in GHG concentrations in the atmosphere, contributing to major shifts in the global climate.[25]

GDP – Gross Domestic Product

IECC – International Energy Conservation Code. A building code created by the International Code Council in 2000. It is a model code adopted by many state and municipal governments in the United States for the establishment of minimum design and construction requirements for energy efficiency.

IPCC – International Panel on Climate Change. The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC.

The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

IR – Infrared

kWh/yr – Kilowatt hours per year

LEED - Leadership in Energy and Environmental Design. Developed by the U.S. Green Building Council (USGBC) in 2000. LEED certification provides independent, third-party verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

Life-cycle emissions – The term 'lifecycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery

[25] US Dept. of Energy. Federal Energy Management Program.

and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.[26]

Net Zero – A Net Zero building minimizes the need for energy inputs, and then uses renewable energy from a mix of off-site and on-site power sources to heat, cool, light, ventilate, and power appliances. Because of the design challenges and sensitivity to a site that are required to efficiently meet the energy needs of a building and occupants with renewable energy (solar, wind, geothermal, etc..), designers must apply holistic design principles and take advantage of the free naturally occurring assets available, such as passive solar orientation, natural ventilation, daylighting, thermal mass, and night time cooling.

Net Zero Community – A net zero community aims for net zero energy, water and waste. When you look at the term "net zero" or a hierarchy of net zero you must start with reduction, then progress through repurposing, recycling, energy recovery, disposal being the last. The Army is piloting five installations to be Net Zero Energy, five installations to be Net Zero Waste, five installations to be Net Zero Water, and one that is all three by 2020. The Army goal is to have 25 Net Zero Installations by 2030.[27]

Renewable Energy – Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Included in the definition are electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, biofuels and hydrogen derived from renewable resources.[28]

Vehicle miles traveled – Vehicle Miles Traveled (VMT) is the total number of miles driven by all vehicles within a given time period and geographic area.

Wind turbines – A wind turbine is a device that converts kinetic energy from the wind into mechanical energy.

[26] US EPA. Clean Air Act Section 211(o)(1)
[27] *Army Energy Program, Army Vision for Net Zero, Net Zero is a Force Multiplier, army-energy.hqda.pentagon.mil/netzero/* 1 Mar 2012

[28] International Energy Agency

Appendix C

Peregrine Energy Group.
Energy Efficiency Opportunities
for Town Buildings Deerfield, NH
April 4, 2011

Energy Efficiency Opportunities
For
Town Facilities
Deerfield, New Hampshire

Preliminary Assessment

April 4, 2011

Prepared by:
Peregrine Energy Group, Inc.
Boston, Massachusetts

Provided by:

New Hampshire's Office of Energy and Planning

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

1.0 Introduction and Executive Summary

Peregrine Energy Group, Inc. ("Peregrine") has prepared this preliminary energy efficiency and renewable energy investment assessment for the facilities we visited on Wednesday, December 15, 2010 in Deerfield, NH. We've prepared this report on behalf of the New Hampshire Office of Energy and Planning with support from the Energy Technical Assistance & Planning for New Hampshire Communities program ("ETAP"). Funding for this project comes from the American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant program of the U.S. Department of Energy. Peregrine gratefully acknowledges the assistance that Leslie Boswak: Town Administrator, Mark Tibbetts: Facility Manager, and volunteer Fire Chief, Mike Greeley: Police Chief, Alex Cote: Highway Agent, and Evelyn DeCota: Librarian who coordinated the site visit and helped answer questions for our initial assessment and assisted us with utility data and building information.

The primary goal for this report is to identify cost-effective energy efficiency and renewable energy investments that Deerfield may want to consider as part of its long term energy management plan. The report includes Peregrine's recommendations for energy cost reductions that Deerfield may want to pursue and a summary of building energy use and cost information we were able to collect.

Findings and Recommendations

In order to generate our list of recommendations, Peregrine's site visit and staff interviews focused on:

- Observations of existing facility conditions
- Current operating practices and facility uses
- Short term and long term facility plans
- Potential building and mechanical equipment energy efficiency upgrades
- Potential renewable energy upgrades

After our site visit, Peregrine reviewed utility bill information for each facility to corroborate our site visit observations and ground our recommendations against actual energy consumption.

Drawing on our site visit observations and discussions with town staff, Peregrine has identified several energy saving opportunities in facilities we visited. Many of our recommendations focus on opportunities to improve energy management practices in day to day operations that the Town can implement within existing town budgets using existing staff resources. More capital intensive energy efficiency recommendations that Peregrine identified include:

- Air Leakage and Insulation diagnostics and remediation for four facilities
- Window replacement at George B. Wright

Table 1. Energy Reduction Program Potential Results

Facility	Approximate Installed Cost ($)	Utility Incentive Available[1]	Potential Utility Savings			Annual Cost Avoidance ($)	Simple Payback Yr
			Other Benefits	Electric kWh/yr	LP or Oil Gal/yr		
George B. Wright	18,000	-	-	-	887	2,693	6-7
Central Fire Station	4,000	-	A	-	177	354	10+
Town Hall	7,000	-	A	-	355	708	10+
Library	5,000	-	A,B,C	-	177	354	10+
Highway Shed	-	-	-	-	-	-	
Total	$34,000		A,B,C	-	1,596	$4,108	8-9

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$58,434 /yr***

Percent Reduction: ***7%***

Summarizing our Major Findings and Recommendations:

- Air sealing and targeted insulation would reduce energy consumption for heating in most of the buildings Peregrine inspected. Peregrine can help Deerfield prepare a Request for Proposals for this work.
- The George B. Wright building has windows in poor condition with poor air leakage control and failed window seals. Replacement windows will improved the office building's thermal comfort and reduce oil consumption in the building. Peregrine can review Deerfield's Request for Proposals for this work that was approved at Town Meeting.
- Heating controls should be reassessed and documented to make sure they are set for maximum efficiency. Peregrine can work with Deerfield to review and confirm heating control target settings.

In general, we found that

Town staff is very conscientious about operating the existing equipment. Energy use for the buildings we assessed would be significantly higher without this level of due diligence. Short of major capital upgrades, air sealing, insulation, window upgrades and heating control review measures are the most cost effective measures for Deerfield to consider at this time.

Suggested Next Steps

Within the context of the ETAP program, Peregrine can continue to support the Town to help plan and execute these recommendations. All projects indentified in this report will require further development and analysis to obtain firm pricing and tighten up the saving projections.

Immediate next steps include:

- Select which measures the Town would like to proceed with and establish an implementation schedule.
- Authorize further engineering activity, if necessary, to develop detailed specifications and/or generate more accurate savings projections.
- Develop request for proposal documents and/or select preferred air sealing, insulation, and window installation vendors.
- Secure quotes for the proposed projects from contractors.

2.0 Utility Cost and Consumption

Energy Cost

The total energy cost for the buildings Peregrine visited is about $58,434. The cost per square foot varies from a high of $2.68 at the George B. Wright building down to $1.04 at Town Hall.

Table 2. Annual utility cost and energy cost intensity

Facility	Square Feet	Electric Cost ($)	Oil Cost ($)	Propane Cost ($)	Waste Oil Cost ($)	Total Cost ($)	st ($) per uare Foot
George B. Wright	13,774	25,091	11,792	-	-	36,883	2.68
Central Fire Station	6,442	3,205	-	4,360	-	7,566	1.17
Town Hall	6,820	3,251	3,861	-	-	7,112	1.04
Library	2,120	2,031	825	-	-	2,856	1.35
Highway Shed	2,800	2,001	731	1,285	-	4,018	1.43
Total	31,956	$35,580	$17,209	$5,646	$0	$58,434	$1.83

Energy Use

Total energy use for the buildings Peregrine visited is about 233,285 kWh for electricity, 8,999 gallons for oil, 3,569 gallons for Propane, and 1,100 gallons for waste oil. The total energy intensity units are expressed in site[1] kBtu[2] per square foot. The George B. Wright building's energy intensity is quite high. In addition, propane use at the Highway Shed is quite high and should be investigated further. The energy use intensity for the three other buildings is low.

Table 3. Annual utility consumption and energy use intensity

Facility	Square Feet	Electric kWh	Oil Gallons	Propane Gallons	Waste Oil Gallons	Total kBTU	kBtu per Square Foot
George B. Wright	13,774	173,257	5,910	-	-	1,418,726	103
Central Fire Station	6,442	18,790	-	2,840	-	323,138	50
Town Hall	6,820	16,254	2,106	-	-	350,315	51
Library	2,120	12,720	470	-	-	109,213	52
Highway Shed	2,800	12,264	413	729	1,100	303,662	108
Total	31,956	233,285	8,899	3,569	1,100	2,505,055	78

[1] Site energy = All electric and fuel consumption in the building as measured "after the meter".
[2] kBtu = 1,000 British Thermal Units. 1 kilowatt hour of electricity = 3,413 Btus, 1 gallon of #2 oil = 140,000 Btus, 1 gallon of Propane = 100,000 Btus, 1 gallon of waste oil = 125,000 Btus.

3.0 George B. Wright

Deerfield's Town Offices and Police Station are located in the George B. Wright building. Originally an elementary school, the town converted the building in 1993 to house the Town Manager, Selectmen, Town Clerk's offices, and the Police Department. An addition constructed in 1970 houses several private companies. Peregrine's assessment only includes a review of the front two buildings that have utility bills paid by the Town. The total heated area for the front two buildings is about 13,744 square feet.

Building shell

The George B. Wright complex includes two structural brick buildings with flat roofs and a structural steel building with a low-pitched roof. The original building, located closest to Raymond Road was constructed in 1951. The two additions, located directly behind the original building, were constructed in 1966 and 1970.

The original building includes a full basement with offices and a meeting room/ walkway. The main floor includes town offices and meeting rooms with an extra office above the main stairwell for the Town Manager. Exterior walls are uninsulated masonry. Peregrine was unable to inspect the roof for insulation. Town staff reports that new membrane roofs were installed four years ago and 2-4 inches of rigid insulation was added under the roofing. Windows in this building include the original single-pane wood windows in the Town Manager's office and replacement non-thermal break double-pane aluminum window walls in the rest of the building. Fixed windows in many rooms have been painted black and insulated with fiberglass insulation. According to site staff, the fixed windows in front of the building face southwest and many have expanded and cracked in the afternoon sun. The operable double hung windows are in poor shape and have condensation build up inside the thermal glass.

Figure 1. George B. Wright Building

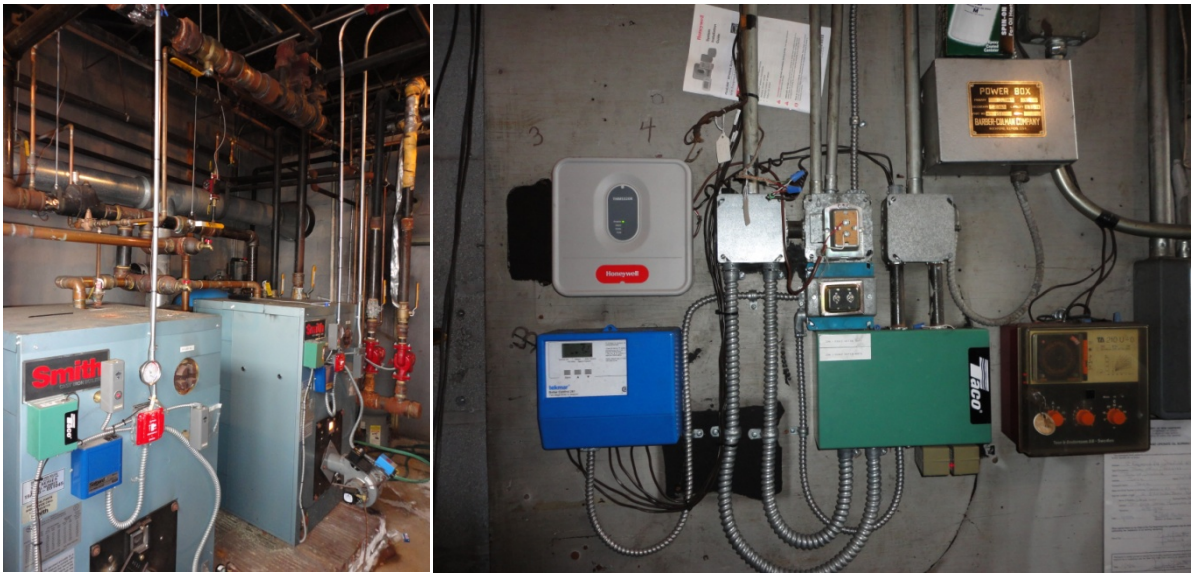
The first addition is slab on grade and includes the police department, building-related departments and financial collection-related departments. Exterior walls are uninsulated masonry. Peregrine was unable to inspect the roof for insulation. Exterior windows are Kalwall fiberglass window walls with single-pane operable glass casement windows located about three feet above the slab height.

Figure2. George B. Wright – first addition

Heating

Two new (three-years old) oil-fired H.B. Smith (19A Series) boilers, individually rated at I=B=R Water 500 Million Btu's per Hour (MBH), provide heat for the building. Boiler water circulates through the building to individual wall-mounted fin-tube cabinet radiators. Each of the original classrooms has a single zone with a dedicated wall-mounted thermostat and zone valve assembly that opens and closes the flow of hot water to the radiators. Occupants manually set the temperature. The Police Department, for example, sets the room temperature for their offices at 70 Degree F during the day and 50 Degree F at night. A "floating" thermostat controls the zone valve operation in the front offices and is placed in the coldest office. Overall control of the building is governed by a number of control boxes shown in Figure 3. According to town staff, the Town's service electrician understands how the controls operate.

Figure 3. George B. Wright boilers and control system



Domestic Hot Water

A 30 gallon electric water heater provides domestic hot water for the building. Hot water use in the building is minimal – primarily two sets of men's and women's lavatories and janitorial services.

Mechanical ventilation

Peregrine was unable to locate any mechanical ventilation that was turned on during our site visit. Town staff open and close windows for fresh air. Roof-top mushroom fans exist, but they are turned off.

Air conditioning

Four Sanyo ductless air conditioning systems provide air conditioning for the Police Department and the Town Clerk and Assessing Departments. Occupants set the level of air conditioning provided by wall mounted air handlers (on the wall next to the clock in Figure 4) using remote controls.

Figure 4. Wall mounted air handler in Police office

Lighting

Public Service of New Hampshire (PSNH) recently upgraded all the lighting in the facility, primarily with T5 fluorescent lighting, through the utility company's "Smart Start program," and Deerfield is paying for the lighting upgrades with "on-bill" financing. Lighting levels measured during the site walk varied significantly from one room to another (see table 10).

Recommendations

If Deerfield started from scratch and built an energy efficient town facility for the town's Administration and Police Department services, it would probably not resemble the George B. Wright Building. The structure is poorly insulated with a space design for teaching children, not for providing town services. That said, given the limitations of the building, town staff does a respectable job attending to and managing thermal comfort and the overall building performance.

Except for minor air leakage reduction opportunities, quick economic payback measures are limited. Longer term operations and capital improvement projects, however, are worth planning for. Peregrine offers the following three measures for the town's long-term planning consideration:

Table 4. Summary of energy reduction opportunities for the George B. Wright building

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Review heating controls	low cost				296	$590	<1
2	Upgrade windows	$4,000				177	$354	10+
3	Air seal and targeted insulation	$14,000				414	$1,750	7-8
	Estimated Program	***$18,000***	***$0***		***-***	***887***	***$2,693***	***6.7***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$36,883 /yr***
Percent Reduction: ***7%***

1. Review heating control operation

Energy use in the building is high[3]. With limited opportunities to improve the insulation level of the building due to the high cost to add insulation, Deerfield should focus its attention on improved heating system control. The town appears to have all the components for a good control system, however, Town staff was unable to explain how it works or what the control settings should be. Deerfield should work with the Town's service electrician to document the controls logic and recommended settings for each of the control components and leave a copy of this information in the boiler room. This will allow Town staff to check the system's performance and control settings on a regular basis and help ensure that the equipment is set to run efficiently.

The other heating control measure to consider is more aggressive temperature setback scheduling. Honeywell manufactures a programmable and non-programmable version of the wireless thermostat used to control the temperature in the Town offices. If the existing thermostat is non-programmable it should be upgraded to the programmable version. If the existing thermostat is programmable then it should be taken off "hold" and programmed for automatic night setback. Deerfield should make sure to request a setback thermostat that with daily setback options. Some thermostats only offer two schedule setting options – weekday and weekend. The town's use of these facilities varies enough during the week to warrant the daily setback option.

<u>Next Step</u>: Deerfield's facility manager should work with the Town's electrician to confirm and document the operation of the building controls and to determine if the wireless thermostat is programmable.

2. Upgrade windows

The insulated glass windows in the original building are at or past the expected life. The insulated glass seals have failed in many windows and will need to be replaced at some point. From an energy perspective, the existing frames are low quality and inefficient. The window frames have no thermal break, tired hardware, and allow significant air leakage. Deerfield's fire chief scanned the building with the fire department's infrared camera and confirmed the thermal deficiencies of the windows.

[3] Compared to similar buildings – see table 9 in section 8.0 Building Performance

Peregrine investigated several operable window upgrade options for the town to consider. The least expensive solution is to continue to cover the windows each winter with clear plastic film taped to the window edges. This will improve the window assembly's energy efficiency; however, it won't clear up the condensation in the failed window panes ($2/ window plus labor[4]). A middle of the road solution is to replace the failed insulated glass panes with new insulated glass panes. This will improve the window assembly's energy efficiency slightly and will eliminate the condensation in the failed window panes. It will not correct the air leakage, tired hardware, or lack of a thermal break problems associated with the existing windows ($210/ window plus labor[5]). The most expensive solution is to replace the existing window frame assemblies with new, energy efficient window assemblies. This would correct all the existing window problems ($500 - $1,000/ window installed[6]).

<u>Next Step</u>: Integrate Peregrine's window upgrade options into the Town's long range plans for the building. Plastic film interior storm windows would suffice for a one or two year "fix" for the existing window problems. Replacement insulated glass would suffice for a 5 to 10 year "fix" for the window condensation problems. Replacement high efficiency window assemblies would be the best long term (10-20 year) solution to the existing window problems.

3. Assess and plan for building thermal upgrades

The thermal integrity of the George B. Wright building is poor. Walls are uninsulated, windows are near or beyond their life expectancy, and air leakage is a concern. Town staff, for example, uses the wireless thermostat to increase or decrease the room air temperature to address thermal discomfort complaints. Wall insulation and window upgrades will most likely need to be installed as part of capital upgrade program due to the high cost of these measures. The insulation work will require removing the existing ceiling and wall finishes or adding new walls on the inside of the existing walls. Air leakage control could be done separately because this measure is less expensive and can be performed with limited disruption to town services. A more detailed assessment of existing conditions would include an in-depth thermal analysis with infrared camera equipment, air leakage measurement with building pressurization equipment (blower door and associated pressure diagnostics), and simple building energy modelling and benefit/cost analysis to determine appropriate thermal upgrades.

<u>Next Step</u>: Request a proposal from a qualified energy services vendor to perform the site assessments and associated building energy modelling and cost analysis.

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[4] Assumes 15 square foot window. Cost source: http://www.amazon.com/Window-Insulation-Plastic-Windows-Weathersealing/dp/B002WCJA46

[5] Assumes 15 square foot window. Cost source: http://www.askthebuilder.com/385_Window_Glass_Replacement.shtml

[6] Assumes 15 square foot window. Cost source: numerous websites.

4.0 Central Fire Station

Deerfield's Fire Station, constructed in 1932 and renovated and expanded 6 times, totals about 6,442 square feet. The facility includes garage space for fire and emergency service equipment and a small office on the first floor and a meeting room upstairs. The fire hose drying tower has been converted for storage.

Figure 5. Central Fire Station

Building shell

The facility is slab on grade with vinyl siding, an asphalt gambrel roof in front and pitched roof in back, and standard wood stud and roof frame construction. The ceiling and walls have fiberglass batt insulation. Volunteers renovated the walls in 2007 with vinyl siding over 1" Styrofoam insulation and replaced the existing windows with new vinyl windows. In 2008 the volunteers rewired the whole building, added ½" sheetrock and plywood on the inside of the walls over 1" Styrofoam insulation, and 5/8" sheetrock over 6" batt insulation in the garage ceiling. The attic and knee walls above and around the second floor meeting room have loose-fill Rockwool insulation.

Heating

As part of the 2008 renovations, The Fire Station added four Reznor ceiling-mounted propane-fired space heaters in the garage bays. Previously, the Fire Station had an old oil-fired Williamson furnace that required as long as two days to reheat the building after fire equipment came back from a fire in the winter. The new furnaces and additional insulation have reduced the time required to heat the garage to a few hours. The Fire Chief runs one Reznor space heater set at a constant 64 Degree F. as the lead heating system and pulls in addition heaters as needed to maintain temperature in the garage. The Fire Chief sets the thermostat lower in the spring and fall. The Fire Department installed a new combination heating and cooling furnace and air handler system in the attic space above the meeting room as part of the 2008 building upgrades.

Air conditioning

The garage bays are not air conditioned. The combination heating and cooling system located in the attic provides chilled air for the meeting room and is used four times a year for major events. The compressor is located outside on the roof. Prior to this installation the meeting room was very hot during the summer. Insulated ductwork located in the attic distributes heated and chilled air to ceiling registers in the meeting room.

Domestic Hot Water

A 40 gallon electric water heater provides hot water for the Fire Station.

Mechanical ventilation

The building does not have mechanical ventilation

Lighting

Fluorescent T8 bulbs and fixtures provide lighting for the garage and meeting room. The Fire Chief leaves two lights on 24/7 and the rest of the fixtures are off most of the time. Outside lighting is minimal and includes a few metal halide fixtures that operate from dusk to dawn.

Other electric Loads

Other electric loads include a 5 H.P. air compressor and commercial laundry machine as shown in figure 6, kitchen appliances upstairs in the second floor kitchen, and minimal plug loads.

Figure 6. Air compressor and laundry machine

Recommendations

Table 5. Summary of energy reduction opportunities for the Central Fire Station

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Air seal	$4,000		A		177	$354	10+
2	Review mechanical ventilation	N/A					$0	
3							$0	
	Estimated Program	***$4,000***	***$0***	***A***	***-***	***177***	***$354***	***11.3***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$7,566 /yr***
Percent Reduction: ***5%***

Peregrine did not identify immediate opportunities for low cost/ high return energy efficiency investments in the fire station. The staff and volunteers at the Fire Station have done an excellent job over the past three years to upgrade the facility and reduce total energy consumption. The Fire Station could potentially benefit from an air leakage and thermal integrity assessment of the second floor meeting room if the Town proceeds with this type of assessment for the George B. Wright building. The focus on this assessment would be to identify attic bypass air leakage and confirm if additional insulation may be warranted above the existing rock wool insulation. In addition, the fire station will eventually need to consideration mechanical ventilation system options to address vehicle exhaust management in the garage.

1. **Investigate attic air leakage and thermal bypasses**

   Deerfield should include the fire station if the town performs any instrumented air leakage or thermal bypass assessments.

   <u>Next Step</u>: Peregrine can help Deerfield prepare a Request for Proposals for pressure diagnostic technical and thermal bypass investigation services if the Town would like to pursue this measure.

2. **Review mechanical ventilation requirements**

   Fire Stations nationwide are reviewing ventilation options to manage fire equipment combustion exhaust in garage bays. Options Peregrine has seen and researched include opening the garage bays for extended periods of time, installing “odor eater” smoke control devices, installing large exhaust fans, and installing computer controlled, magnetically attached vacuum exhaust ventilation systems. Short term, a manually operated large volume exhaust fan set to run 10-20 minutes after equipment leaves the fire station probably makes the most sense. The exhaust fan should be equipped with a fast-acting, low air-leakage damper. Longer term, if the town eventually builds or upgrades the existing building to accommodate more or larger equipment, the fire department will need to consider the more elaborate computer controlled exhaust ventilation systems in order to meet higher building code standards.

   <u>Next Step</u>: Peregrine can help Deerfield research and monitor combustion exhaust ventilation system options for the Fire Station.

5.0 Town Hall

Deerfield's Town Hall, a Greek revival style building constructed in 1865, totals about 6,820 square feet. Town Hall provides meeting and auditorium space in the two-story structure. The building has been adapted slightly to make it ADA compliant on the first floor with a wooden ramp that leads up to one of the three large front doors.

Figure 7. Deerfield's Town Hall

Building shell

The Town Hall is constructed on a granite foundation with a shallow crawlspace. To provide central heating, dirt was cleared out of a small portion of the crawlspace with access through a bulkhead and a concrete pad was poured and walls installed to make a small, low-clearance room for two oil-fired furnaces. The crawlspace was very cold and drafty at the time of our site visit.

Figure 8. Crawlspace

Exterior walls are wood frame with wood clapboards and horse hair plaster and wood wainscoting interior finish. Asphalt shingles cover the pitched roof. Peregrine was unable to confirm the level of insulation in the walls or the attic.

Windows and Doors are original to the building and oversized consistent with the style of Greek revival buildings. The windows and doors have two interesting energy-related features. The windows have triple track storm windows, however, unlike similar large storm window installations Peregrine has seen, the upper half of the storm window is fixed and the lower half of the storm window functions similar to a normal storm window - essentially a storm window installed in a storm window. Peregrine's experience with similar windows with full size glass installed in the upper and lower windows is they are usually left open or closed permanently because the glass is too heavy to lift. Deerfield's solution to this problem allows occupants to open and close the lower window sash and storm windows easily and provide fresh air to the building as needed.

The interesting energy feature for the handicap access door is the door within a door design that allows the town to leave the front door open during public events and use a smaller, easier to open and close door in its place for residents who cannot open and close the larger doors. This is an elegant solution that allows the town to preserve the historic character of the doors and also provides a solution to weatherize the front doors. Inserting the door in the winter would reduce the amount of air leakage through the door significantly.

Figure 9. Inside storm door

Heating

Two oil-fired furnaces, one for the first floor and one for the second floor, provide heating in the building. Town staff keep the indoor temperature set at 50 Degree F most of the winter and 65 Degree F. if the weather is extremely cold. Town staff or residents turn the heat up to 68 Degree F. when the building is occupied for civic events. If Deerfield drained the pipes and shut down the building during the winter, the Town would save about $4,000 per year. This would require a solution to protect the sprinkler pipes from freezing. Potential sprinkler freeze protection solutions include maintaining the building above 40 Degree F., draining the sprinkler system and adding a "fire watch", or adding heat tape or antifreeze to the system. Any change to the sprinkler system the town considers should be reviewed first by the proper authorities.

Air Conditioning and Ventilation

The building does not have air conditioning or mechanical ventilation.

Domestic Hot Water

Peregrine did not see the domestic hot water system, however, we assume that it is a small electric water heater similar to the water heater installed in other buildings that Peregrine assessed.

Lighting

Lighting in Town Hall includes dimmable incandescent light fixtures. Normally this would be an automatic opportunity to recommend higher efficiency lighting measures. As shown in figure 10, however, the existing lighting provides an extraordinarily warm feel to the elegant, recently renovated second floor auditorium that would be difficult to replicate. In addition, the total hours the lights are on each year is very low.

Figure 10. Second floor auditorium

Other Electric Loads

Other electric loads include the furnace blower motors, minimal plug loads and a water pump to supply well water to the building.

Recommendations

Table 6. Summary of energy reduction opportunities for Town Hall

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Air Seal and insulation	$7,000		A		355	$708	10+
2	Weatherstrip windows and doors	N/A		A				
3								
	Estimated Program	***$7,000***	***$0***	***A***	***-***	***355***	***$708***	***9.9***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$7,112 /yr***
Percent Reduction: ***10%***

1. Air seal and insulate crawlspace

As mentioned previously, the crawlspace is cold and drafty. This is a problem from an energy perspective both because the crawlspace is a source for air leakage for the rest of the building and the heating ductwork runs through the crawlspace. Air sealing and insulating the crawlspace foundation walls will address both of these issues. This will be a tough, miserable job, however, it will make a noticeable improvement both to reduce energy consumption and improve heat delivery in the building.

Next Step: Peregrine can help Deerfield prepare a Request for Proposals for air sealing and insulating the crawlspace.

2. Weatherstrip windows and doors

Deerfield is investigating opportunities to restore the historic windows. A component of this work should include upgrades to each window's thermal performance. For historical integrity and practical reasons, the town should reuse the existing wood frame and single glazed window panes. Potential air leakage reduction measures include painting or caulking the upper sash for each window in place, window pulley seals[7], and weatherstripping for the four sides of the lower sash[8]. Energy upgrades for the doors should focus on air leakage reduction with weatherstripping. In addition the town should consider installing a door that swings in for the ADA access ramp door that could be left in place in the winter.

Next Step: Include window weatherstripping and add door weatherstripping to the specifications for the proposed window rehabilitation work.

[7] Pulley seals are available at http://www.andersonpulleyseal.com/

[8] Peregrine recommends spring copper weatherstripping for the meeting rail and lower frame. This is available at http://www.aresource.com/springbronze.html . For the side frames Peregrine recommends self adhesive pre-formed v-type weatherstripping installed in the window jambs. Schlegel manufactures an excellent plastic version of this weatherstripping that is available at http://www.energyfederation.org/consumer/default.php/cPath/21_392_74. Kel-eeze manufactures a high quality self adhesive brass version of this weatherstripping that is available at http://www.kel-eezweatherization.com/KEL-EEZbrass.htm

6.0 Library

Deerfield's Public Library, constructed in 1914, totals about 2,031 square feet. The library trustees added an annex for a elevator in 2009 to meet ADA requirements and installed a new oil-fired furnace and forced air distribution system. The building includes a children's room on the right side of the building, an adult room on the left side of the building, and a youth room, mechanical room, and storage in the basement.

Figure 11. Library

Building Shell

The building has a full basement, structural brick walls, and a pitched roof with slate (or slate-like) shingles. The exterior walls are uninsulated with an air space and horse hair plaster as an interior finish upstairs. The walls in the basement are insulated and finished with sheetrock. The attic floor is insulated with a minimal amount of vermiculite insulation[9]. Peregrine's visual inspection of the attic identified numerous air leakage sources with an example shown in Figure 12.

[9] Peregrine understands that the attic insulation tested negative for asbestos

Figure 12. Attic air leakage source

Windows in the library are original single pane wood with aluminum triple track storm windows and are prominent features of the building. A public service oriented volunteer has begun to weatherstrip and caulk the doors, windows, and other sources of air leakage in the building. His next project may include adding honeycomb style window shades to improve the insulation level of the windows.

Heating

The Library Trustees installed a new oil-fired furnace for the building in 2009 as part of the elevator construction project. Staff confirmed that heating has improved significantly with the new system. As it turned out the old system died the day that the new furnace was up for budget approval. Library staff has set the touch screen Honeywell thermostat to turn up to 67 Deg F a half hour before the library opens and down to 60 Deg F a half hour before the library closes. Library staff reports that the 7 day programmable thermostat was very difficult to set initially. One minor problem that Peregrine noticed during our site visit was frequent short cycling of the air circulation fan motor. Town staff contacted the service contractor who replaced a defective switch.

Air Conditioning and Ventilation

Two window air conditioners provide cooling in the summer. In addition, the new furnace installation is configured to accept central air conditioning equipment if the library decides to add this amenity to the building in the future. The Library does not have any mechanical ventilation

Domestic Hot Water

A small instantaneous electric water heater provides domestic hot water for the rest room.

Lighting

The library has upgraded all the lighting in the library. The book stacks and reading rooms have T8 fluorescent ceiling light fixtures. Can-style spotlights provide lighting highlights in the rooms and have compact fluorescent light bulbs installed in them. Lighting at the circulation desk in the children's room is low and could benefit from some task lighting.

Other Electric Loads

Other electric loads include several computers with flat screens, a dehumidifier in the basement, and other office-related plug loads.

Recommendations

Table 7. Summary of energy reduction opportunities for the Library

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Troubleshoot furnace	Done		B,C		-		
2	Air seal and insulation	$5,000		A		177	$354	10+
3	Add electric outlet	N/A				-		
	Estimated Program	***$5,000***	***$0***	***A,B,C***	***-***	***177***	***$354***	***14.1***

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$2,856 /yr***
Percent Reduction: ***12%***

1. **Troubleshoot furnace**

   As mentioned above the furnace air circulation fan turned on and off rapidly during our site visit.

   <u>Next Step</u>: Town staff contacted the service contractor during our site visit and had the problem corrected.

2. **Investigate attic air leakage and thermal bypasses**

   Deerfield should include the library if the town performs any instrumented air leakage or thermal bypass assessments as part of the attic insulation currently under consideration at the library

   <u>Next Step</u>: Peregrine can help Deerfield prepare a Request for Proposals for pressure diagnostic technical and thermal bypass investigation services if the Town would like to pursue this measure.

3. **Install attic insulation**

   Peregrine supports the Library's plan to add more insulation in the attic. This work should be coordinated with air sealing that is much easier to perform before insulation is added to the attic[10]. Peregrine investigated the potential impact of installing radiant foil on the attic framing members. A radiant barrier trade organization references a study performed by the Florida Solar Energy Center that radiant barriers only increases the peak condition roof shingle temperature 2-5 degree F. and should not affect roof system warranties and most likely will not affect the durability of the existing slate shingles.[11]

   <u>Next Step</u>: Proceed with the attic insulation.

4. **Install a floor outlet for circulation desk**

[10] Peregrine would like to see additional wall insulation as well, however, this would be difficult to install in the small air cavity between the horse hair plaster and the structural brick wall.
[11] URL: http://www.rimainternational.org/technical/tb103.html

As mentioned above the lighting level at the circulation desk is low. A floor outlet installed below the desk would allow the circulation librarian to plug in a table lamp for high quality task lighting and other electrical devices like a computer if needed.

Next Step: Request a quote from an electrician to install a floor outlet if the Library Trustees agree this is a reasonable investment.

7.0 Highway Shed

Existing Conditions

Deerfield's Highway Shed was constructed in 1971 and is located next to Town Hall. The facility totals about 2,800 square feet and houses equipment temporarily for repairs or maintenance. Most equipment remains and is worked on outside in order to keep combustion exhaust levels in the garage to a minimum.

Figure 13. Department of Public Works

Building shell

The facility is a slab-on-grade steel frame structure with steel exterior panels on the wall and roof with vinyl covered fiberglass insulation. A small addition houses the superintendent's office and a storage room. These rooms are finished with sheetrock. Three large garage doors allow access for the Department of Public Work's (DPW) vehicles into the garage space although they are a tight fit for some of the equipment. Two of the rollup garage doors are lightweight with double pane fiberglass windows. The doors provide very good daylighting with the fiberglass windows, however, the doors are difficult to keep closed tightly because they are very light. The third garage door is insulated steel. Windows are single pane aluminum with no thermal break.

Heating

DPW collects waste from its own equipment and oil that is recycled from the transfer station. DPW stores the oil in 55 gallon drums then fills a 250 gallon storage tank located underneath an industrial grade waste oil furnace manufactured by Clean Burn. The waste oil furnace is designed specifically run hotter than standard oil-fired burners to burn off undesirable material in the waste oil. DPW staff cleans the furnace regularly[12] to remove combustion byproducts from the further heat exchanger services. Deerfield received assistance from the NH Waste Oil program to purchase the furnace.

[12] Clean Burn recommends cleaning its equipment every 1,000 hours of operation. The Town can burn used vegetable oil as well if it filters out food debris well. URL: http://www.cleanburn.com/

Figure 14. Waste oil furnace and Williamson furnace

Air conditioning and ventilation

Air conditioning is limited to a window air conditioner located in the office. The building does not have any mechanical ventilation.

Domestic Hot Water

A 5 gallon electric water heater provides domestic hot water for the DPW Garage.

Lighting and other electric loads

High efficiency T5 fluorescent light fixtures provide lighting in the garage bay and the office. Pole-mounted street lights owned by PSNH provide exterior lighting. PSNH charges a fixed monthly fee for the outdoor pole lights.

The highway department owns a 5 horsepower reciprocating air compressor that is turned off at night and when not in use. Other electric loads include the blower and burner motors for the two hot air furnaces. Plug loads include computers, electric tools, and a small “college” style refrigerator.

Recommendations

Following are two recommendations for the Highway Shed. In addition to these recommendations, the Highway Agent has several in-house projects that he can work with the Selectmen and the Town's Energy Committee to develop including a replacement entry door, replacement windows, and other energy-related upgrades that DPW staff can install as schedules permit.

Table 8. Summary of energy reduction opportunities for the Highway Shed

	Description	Approximate Installed Cost ($)	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance ($)	Simple Payback Yr
					Electric kWh/yr	LP or Oil Gal/yr		
1	Upgrade garage doors	N/A					$0	10+
2	Review ventilation options	N/A					$0	
3							$0	
	Estimated Program	*$0*	*$0*		*-*	*-*	*$0*	*#DIV/0!*

Notes
(1) Subject to Utility Incentive Policy and Screening Analysis
(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: *$4,018 /yr*
Percent Reduction: *0%*

1. Upgrade garage doors

Town staff shared that the Highway Shed doors should be weatherstripped and Peregrine concurs that this is a cost effective measure to install. When the time comes to replace the garage doors, new foam-core garage doors would increase the insulation value of the doors from an R value of about R2 for the double pane fiberglass panels to an R value of about R10 for an insulated panel. DPW staff will need to consider the amount of light the current doors provide and how many windows should be included in new garage doors. At a minimum a single set of windows should be installed at eye level to provide a visual connection outdoors. Solar light pipes, available online or at most hardware box store outlets, could provide an alternate source of natural light for the garage of multiple glass panes in the garage doors increase the cost of the doors significantly.

2. Review ventilation system options

The DPW garage does not have mechanical ventilation and town staff report high relative humidity levels in the winter due from snow that melts off the equipment when it is brought in to be serviced. DPW may want to add mechanical ventilation in the future if it elects to run equipment in the garage. An exhaust-only fan as recommended for the Fire Station would be acceptable for short duration combustion exhaust control. A higher quality, more energy efficient solution to provide fresh air, would be to install a heat exchanger ventilation system. Bradford, NH installed a heat exchanger ventilation system manufactured by Environmental Air Solutions, Inc (http://keeptheheat.com/). The design is very simple and from Bradford's DPW staff feedback, is very effective. A y-shaped assembly mounted on the outside of the building houses two fans, one for stale exhaust air and one for fresh intake air. The exhaust fan draws stale air from the building at the ceiling level into the metal ductwork. The warm stale air preheats cold outside air drawn into the building by the intake fan through corrugated PVC drain pipe in the metal ductwork. Schedule 20 PVC piping delivers warm air from the corrugated drain piping at about waist height next to each structural support. DPW staff turns the fans on and off as needed with

manual switches located on the main wall near the office/ boiler room. Another potential option is to install a solar make up air system such as the system manufactured by Conserval[13].

Next Step: Peregrine can review ventilation system options for the DPW Garage with town staff.

[13] Conserval URL: http://solarwall.com/en/home.php

8.0 Building Performance

The chart below provides an opportunity for Deerfield to compare the performance of its buildings against comparable buildings that Peregrine has assessed as part of the NH ETAP program. The score is based on total energy use per square foot[14]. In addition to total use, the chart includes the energy use per square foot for each major utility.

Table 9. Comparable buildings performance

Location	Building	SF	Building Type	Total Site kBtu/ SF	Elec Site kBtu/ sf	Oil Site kBtu/ SF	Propane Site kBtu/ SF	Natural Gas Site kBtu/ SF	Waste Oil Site kBtu/ SF	Wood Pellet Site kBtu/ SF	Corn Site kBtu/ SF
		5,988	Fire Station	150							
		3,236	Fire Station	131	9	122					
		5,125	Fire Station	98							
		2,438	Fire Station	77	10	67					
		5,543	Fire Station	77	17	60					
		7,000	Fire Station	69							
		6,579	Fire Station	63		53	10				
		9,300	Fire Station	54							
		6,688	Fire Station	52	21	24	7				
Deerfield	Central Fire Station	6,442	Fire Station	50	10		40				
		3,960	Fire Station	45	11	34					
		1,200	Garage	158							
Deerfield	Highway Shed	2,800	Garage	108	15	21	24		49		
		2,180	Garage	95	14	81					
		5,108	Garage	95	12	83					
		6,000	Garage	73	10				63		
		6,000	Garage	70							
		9,507	Garage	65	10					35	21
		6,448	Garage	61	14	47					
		7,000	Garage	11							
		13,243	Library	161							
		1,200	Library	150							
		3,936	Library	120		120					
		16,500	Library	87							
		9,984	Library	86	27	59					
		19,100	Library	74	28	46					
Deerfield	Library	2,120	Library	52	20	31					
		3,762	Library	50	26	24					
		6,276	Library	40		38	2				
		17,500	Office	183							
		3,749	Office	128	44	85					
		30,300	Office	114	38	47		30			
		2,060	Office	106	22	84					
Deerfield	GBW Building	13,774	Office	103	43	60					
		28,000	Office	86							
		3,718	Office	82	14	69					
		15,360	Office	73							
		12,000	Office	72							
		6,000	Office	69							
		15,750	Office	65							
		15,300	Office	61							
		8,436	Office	55	9	38	4		5		
Deerfield	Town Hall	6,820	Office	51	8	43					
		7,563	Office	50	16	34	0				
		9,500	Office	48							
		3,000	Office	35							

[14] 1,000 Btus per Square Foot or kBtu/ SF. The higher the energy use per square foot the more inefficient the building.

9.0 Light Level and Temperature Readings

Measured and Target Light Levels

Following are light levels measured by Peregrine and Town staff during the site assessment. The table includes target light levels for the Town's consideration[15].

Table 10. Light levels measured by Peregrine and Town staff

Building	Room	Low Reading Foot Candles	High Reading Foot Candles	Target Reading Foot Candles
Police Dept	Patrolman's office	14	41	35-50
Police Dept	Office by door	48	99	35-50
Police Dept	Interview room	38	80	35-50
Police Dept	Detective's office	21	45	35-50
Police Dept	Secretary's office	10	60	35-50
Police Dept	Rear patrol office	21	61	35-50
Police Dept	Chief's office	15	65	35-50
Police Dept	Copy room	35	55	35-50
Police Dept	Booking Room	15	52	35-50
Police Dept	Locker room	15	88	35-50
George B. Wright	Assessor	29	82	35-50
George B. Wright	Town Clerk	23	84	35-50
Central Fire Station	Garage bays	2.3	21	15-30
Central Fire Station	Training room	6	30	35
Highway Shed	Highway Agent's office	15	75	35-50
Highway Shed	Break room	20	68	35
Highway Shed	Garage bay 1	20	50	60-80
Highway Shed	Garage bay 2 and 3	10	18	15-30
Library	Childrens	6	21	35-50
Library	Reading	7	70	35-50
Library	Evelyn's office	12	20	35-50
Library	Adult	5	54	35-50
Library	Entry	5	17	20
Library	Young adults	8	106	35-50
Library	Reference	6	120	35-50

[15] The target light levels come from a number of different sources that are available online. The primary source for light level standards in the United States is the Illuminating Engineering Society of North America (IESNA) Lighting Handbook.

Measured and Target Temperature Levels

Following is a summary of temperature readings taking during our site assessment. Target temperatures are more difficult to define than target lighting levels because there are more variables to consider. Variables include occupant thermal comfort, temperatures required to maintain equipment and protect buildings from potential damage in severe winter conditions.

Table 11. – Measured and target room temperatures

Building	Room	Measured Temperature	Target High Temperature	Target Low Temperature
George B. Wright	Police	75	70	65
George B. Wright	Assessor	68-70	70	50
Highway Shed	Break Room	62	65	50
Highway Shed	Garage	66	55	55

Table 12. – Measured refrigerator temperatures

Building	Room	Refrigerator Temperature	Freezer Temperature
George B. Wright	Police	46	18
Central Fire Station	Kitchen	36	8
Highway Shed	Break Room	35	27

Refrigerator and freezer temperatures should be maintained below 40 Deg F. and 0 Degree F. respectively for optimum food preservation.

10.0 Waste Oil

DES has conducted a study of typical recycled oil burner emissions in order to simplify the compliance determination process. The study examined RTAP emissions from typical recycled oil burners using a variety of recycled oil characteristics, fuel use rates, and installation configurations. The results of this study show that recycled oil burners are in compliance with the provisions of Air Toxic Rule Env-A 1400 provided they meet all of the following criteria.

- Unit is rated at 500,000 BTUs/hour or less heat input.
- Unit is rated at 3.6 gallons/hour or less of fuel use.
- Unit burns 8,640 gallons or less per year of used oil.
- Exhaust stack is 8 inches or less in diameter.
- Exhaust stack outlet is 20 feet or more above the ground.
- The exhaust stack is vertical.
- The unit is operated and maintained in accordance with manufacturer's specifications.

If your facility operates a recycled oil burner meeting all of the above criteria, DES has determined that its emissions are in compliance with Env-A 1400 and the unit does not require a permit. However, records such as annual fuel use, number of days of operations, and maintenance records must be kept on-site to document that the above criteria are being met. Owners/operators of recycled oil burners that do not meet all of the criteria listed above should contact DES and conduct a source specific compliance determination as soon as possible in order to verify the compliance status of the installation.

All used oil burners, regardless of their compliance status with the NH Air Toxics Control Program, are required to submit a Notification Form to the DES Waste Management Division, (603) 271-2921. For more information also go to Reporting and Information Management Section.

Appendix D

State Energy Statutes, Plans, Agencies, Programs and Funding Mechanisms

State Statutes and Plans Related to Planning, Zoning and Energy

RSA 672:1 ("Planning and Zoning"; "Declaration of Purpose")

The General Court hereby finds and declares that:

III. Proper regulations enhance the public health, safety and general welfare and encourage the appropriate and wise use of land.

III-a. Proper regulations encourage energy efficient patterns of development, the use of solar energy, including adequate access to direct sunlight for solar energy uses, and the use of other renewable forms of energy and energy conservation. Therefore, zoning ordinances should not unreasonably limit installation of solar, wind, or other renewable energy systems or the building of structures that facilitate the collection of renewable energy, except necessary to protect the public health, safety, and welfare.

RSA 674:2, III ("Local Land Use Planning and Regulatory Powers"; "Master Plan")

The master plan may also include the following sections:

(n) an energy section, which includes an analysis of energy and fuel resources, needs, scarcities, costs, and problems affecting the municipality and a statement of policy on the conservation of energy.

RSA 38-D ("Energy Commissions")
Enables the appointment of an energy commission by either the local legislative or the local governing body of 3-10 members with staggered three year terms. The purpose of an energy commission is "…for the study, planning, and utilization of energy resources for municipal buildings and built resources of such city or town", to research municipal energy use, and recommend to local boards pertaining to municipal energy plans and sustainable practices, such as energy conservation, energy efficiency, energy generation, and zoning practices.

RSA 155-A:2, VI ("State Building Code") permits communities to adopt stricter measures than the New Hampshire State Building Code.

RSA 72:61-72 ("Persons and Property Liable to Taxation"; "Solar Energy Systems Exemption") permits municipalities to offer a property tax exemption on solar, wind and wood heating energy systems. These systems include solar hot water, solar photovoltaic, wind turbine or central wood heating systems (not stovetop or woodstoves).

A plan for energy efficiency and compliance with state statutes relating to energy allow Deerfield to be eligible and prepared for grants and funding mechanisms which help the town to conserve energy and reduce operating costs.

New Hampshire Climate Action Plan

The 2009 NH Climate Action Plan was developed by the state-authorized, bipartisan Climate Change Policy Task Force composed of representatives from all sectors of New Hampshire. It aims at achieving the greatest feasible reductions in greenhouse gas emissions while also providing the greatest possible long-term economic benefits to the citizens of New Hampshire.

The Task Force concluded the most significant reductions in both emissions and costs will come from substantially increasing energy efficiency in all sections of the economy; continuing to increase sources of renewable energy; and designing our communities to reduce reliance on automobiles for transportation. The Climate Action Plan recommends that New Hampshire strive to achieve long-term reductions in greenhouse gas emissions of 80 percent below 1990 levels by 2050. The Climate Change Policy Task Force also recommends 67 specific actions to achieve the following goals:

- Reduce greenhouse gas emissions from buildings, electric generation, and transportation;
- Protect natural resources to maintain the amount of carbon sequestered;
- Support regional and national initiatives to reduce greenhouse gases;
- Develop an integrated education, outreach and workforce training program; and
- Adapt to existing and potential climate change impacts.

It is envisioned that with participation from all communities, the NH Climate Action Plan will benefit the economy, increase state and regional energy security, and improve environmental quality. In order to meet the recommended goal of reductions in greenhouse gas emissions statewide, it states that NH communities must engage in local energy planning that includes strategies for decreasing their overall emissions.

State-Level Energy Agencies and Organizations

- **NH Office of Energy and Planning:** NHOEP is a cabinet-level division of the New Hampshire Executive Branch and reports directly to the Governor. It is charged with overseeing and carrying out a wide array of energy-related activities, including but not limited to the following:
    - Coordination of programs funded by the 2009 American Recovery and Reinvestment Act (ARRA), popularly known as the "Stimulus"
    - Statewide administration of the Fuel Assistance Program (see below)
    - Management of the State's "25 by '25 Program," which seeks to ensure that at least 25 percent of NH energy comes from renewable sources by 2025
    - Administration of the State's Weatherization Program (see below)

- **NH Climate Collaborative**: The New Hampshire Energy and Climate Collaborative (NHECC) was established in 2008 to track and facilitate the implementation of the recommendations of the 2008 NH Climate Action Plan. The Collaborative brings together leaders from all sectors of society – government, business, not-for-profits, and academia – to focus our collective attention on reducing greenhouse gas emissions.

- **NH Public Utilities Commission (PUC):** A watchdog agency also affiliated with the Executive Branch, whose job is to make sure that customers of regulated utilities receive safe, adequate and reliable service at just and reasonable rates. Some of the responsibilities of the PUC include:
    - Monitoring and inspecting gas utilities for safety and proper construction
    - Acting as a mediator in disputes between customers and regulated utility companies
    - Initiating public hearings, audits of public utilities, and other forms of inquiry and investigation

- **Office of Consumer Advocate (OCA):** An independent state agency administratively attached to the PUC. However, while the PUC is charged with balancing the interests of ratepayers and utility shareholders, the role of OCA is to advocate exclusively for residential ratepayers

- **Energy Efficiency and Sustainable Energy Board (EESE):** The EESE is a relatively new agency, created in 2008 to help promote and coordinate programs relating to energy efficiency, demand response, and sustainable energy in NH
    - Investigates potential sources of funding for energy efficiency and sustainable energy development
    - Works with local communities, non-profits, and civic engagement groups to increase statewide knowledge about energy efficiency
    - Provides recommendations to the PUC about how to spend energy efficiency and renewable energy funds

State-Administered Energy Programs and Funding Mechanisms:

- **ARRA (Stimulus) Grants:** Between 2009 and 2012, stimulus grants provided $72 million towards NH energy efficiency projects.
- **State Energy Efficient Appliance Rebate Program (SEEARP):** Offers residential consumers rebates for the replacement of existing hot water heaters, boilers and furnaces to more energy efficient models
- **Enterprise Energy Fund (EEF):** A low-interest loan and grant program to help finance energy improvements in buildings owned or leased by businesses and nonprofits of all sizes
- **State Weatherization Program:** Provides insulation and heating efficiency improvements, carried out by public utility companies and NHOEP
- **RGGI:** The Regional Greenhouse Gas Initiative is a cap and trade program aimed at reducing carbon dioxide emissions across ten participating states in the northeast. It uses sales of emissions permits to fund a wide variety of state-wide energy programs.
- **Low Income Home Energy Assistance Program (LIHEAP):** Offers home-heating assistance to qualifying low-income NH residents
- **Pay For Performance Program:** Helps business owners improve energy efficiency in large commercial and industrial buildings

- **Retail Merchant's Association of NH (RMANH) Energy Program:** Offers detailed energy efficiency audits along with free energy awareness seminars and printed materials to RMANH members
- **NH Community Loan Fund:** Has provided deep energy efficiency retrofits in approximately 425 manufactured homes located in a score of resident-owned communities throughout the state
- **Municipal Energy Reduction Fund:** CDFA's Municipal Energy Reduction Fund is available to help municipalities improve the energy efficiency of their municipal buildings, street lighting, water and sewer treatment facilities, and where appropriate, electrical distribution systems.
- **New England Carbon Challenge:** A joint initiative of the University of New Hampshire and Clean Air - Cool Planet which works to educate, inspire and support sustained reductions in residential energy consumption.
- **Systems Benefits Charge (SBC):** The SBC is a tax on all public utilities, a portion of which is used to fund energy efficiency projects.
- **CORE Energy Star Program:** Helps homes and businesses reach the Energy Star standards adopted by the federal government. So far, approximately 4 percent of NH households have participated in this program with the help of their public utilities provider
- **Electric Assistance Program (EAP):** Provides low-income residents with assistance on their electric bill
- **Property Assessed Clean Energy (PACE)**: In 2010, the NH legislature passed HB1554 that enables municipalities to create Property Assessed Clean Energy (PACE) Districts. Through PACE programs, residents and business owners are able to finance energy efficiency and renewable energy improvements through an additional assessment on their property tax bills or other municipal bill.

Appendix E

Global and National Energy Consumption and Greenhouse Gases

Global and National Energy Consumption and Greenhouse Gases

D.1 Global

World energy consumption (primarily of fossil fuels) has increased by dramatic proportions over the past 200 years. In turn global greenhouse gases (primarily CO2) have reached unprecedented levels, never seen before in the last 400,000 years.

Figure D.1

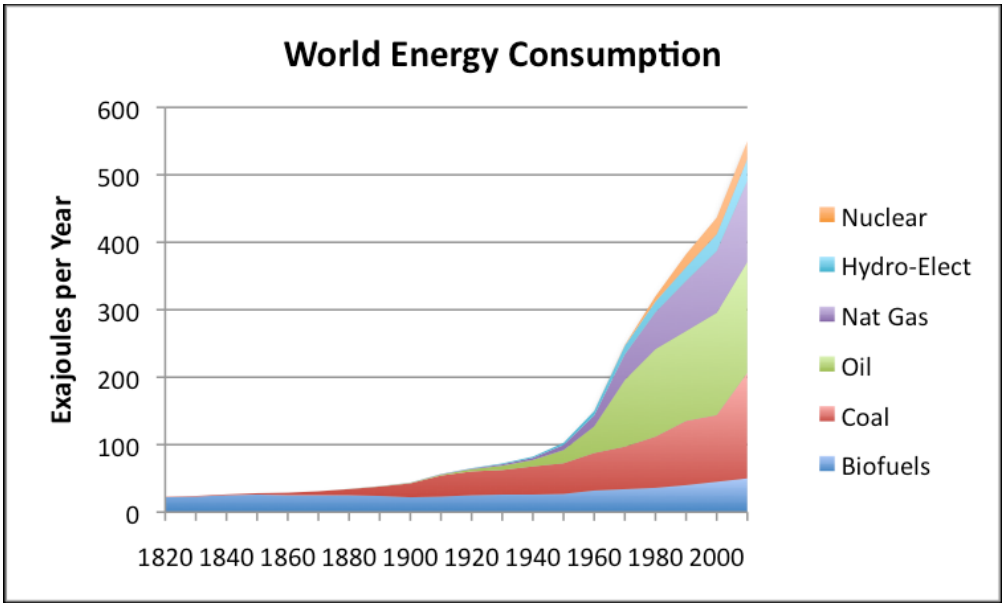
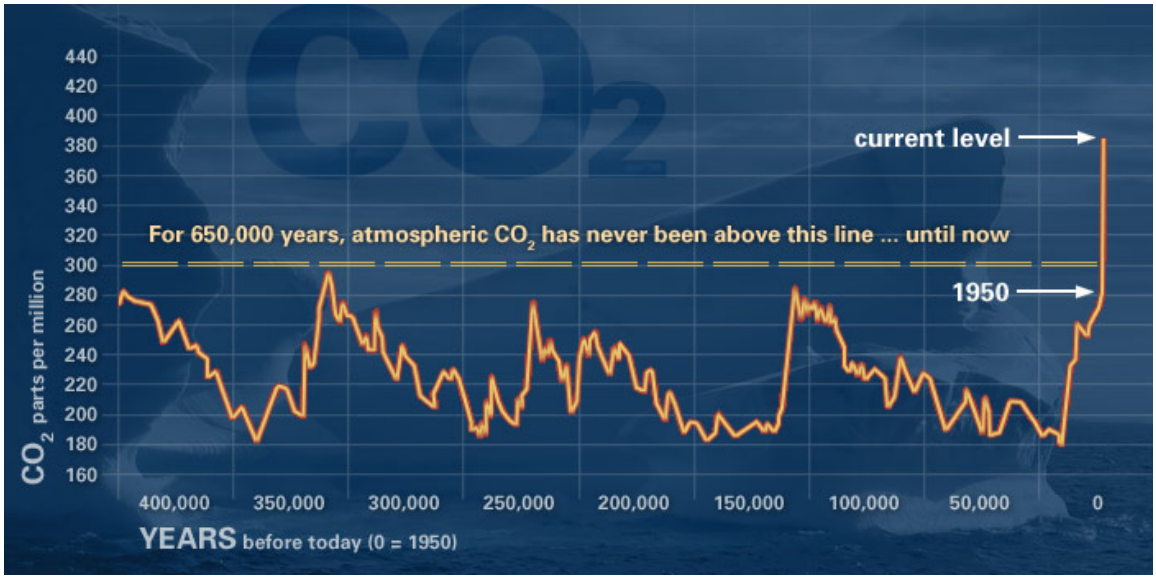


Figure D.1. World Energy Consumption by Source, Based on Vaclav Smil estimates from Energy Transitions: History, Requirements and Prospects together with BP Statistical Data for 1965 and subsequent. [29]

Figure D.1 shows the huge increase in world energy consumption that has taken place in roughly the last 200 years. This rise in energy consumption is primarily from increased fossil fuel use.

[29] Gail Tverberg, The Oil Drum. March 12, 2012. http://ourfiniteworld.com/2012/03/12/world-energy-consumption-since-1820-in-charts/

Figure D.2 – Global Atmospheric CO2



This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO_2 has increased since the Industrial Revolution. (Source: NOAA)

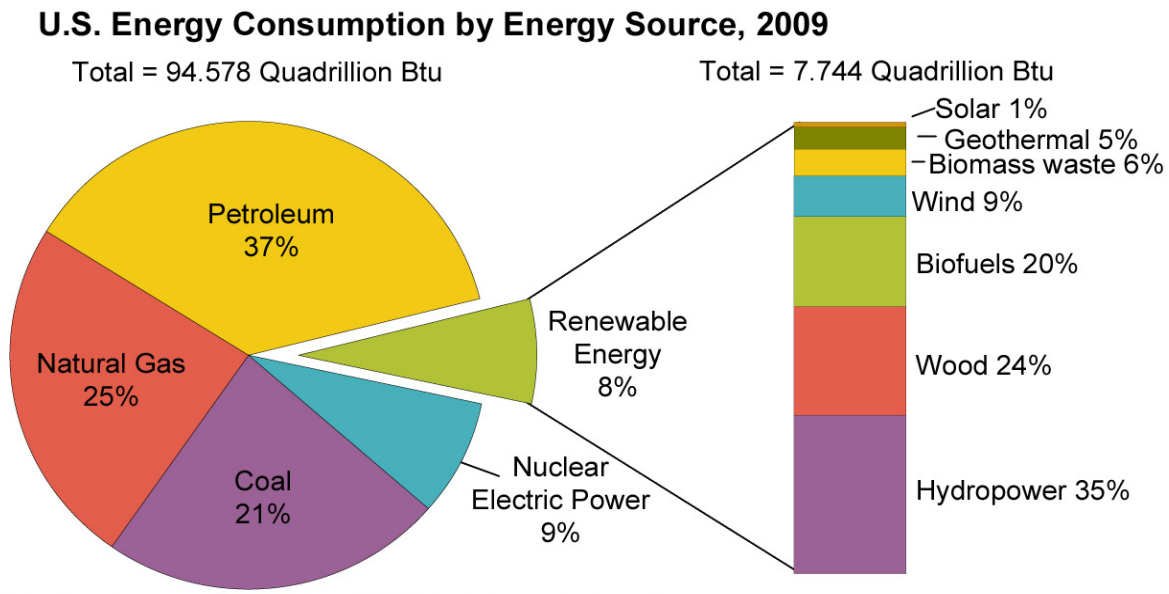
Scientists working with the Nobel prize winning Intergovernmental Panel on Climate Change (IPCC), including NASA's James Hansen, tell us that we must rapidly lower the level of carbon dioxide in our atmosphere "if we wish to preserve a planet similar to that on which civilization developed." As of April 2012 the level of carbon dioxide in our atmosphere is at 396 parts per million.[30] 350 (parts per million) has been deemed the red line for human beings and "the most important number on Earth."[31]

[30] co2now.org/
[31] 350.org

D.2 National

Primary sources of energy in the US are fossil fuels. Renewable energy accounts for only about 8% of our energy consumption by source. The US is the second greatest emitter of CO2 emissions behind China, with 18% of the total global CO2 emissions.[32]

Figure D.3 – U.S. Primary Energy Consumption by Source, 2009[33]



Note: Sum of components may not equal 100% due to independent rounding.
Source: U.S. Energy Information Administration, *Annual Energy Review 2009*, Table 1.3, Primary Energy Consumption by Energy Source, 1949-2009 (August 2010).

Figure D.3 shows US primary energy production by source for 2009. From this graph we can see that the primary sources of energy in the US are fossil fuels. Renewable energy accounts for only about 8% of our energy consumption by source.

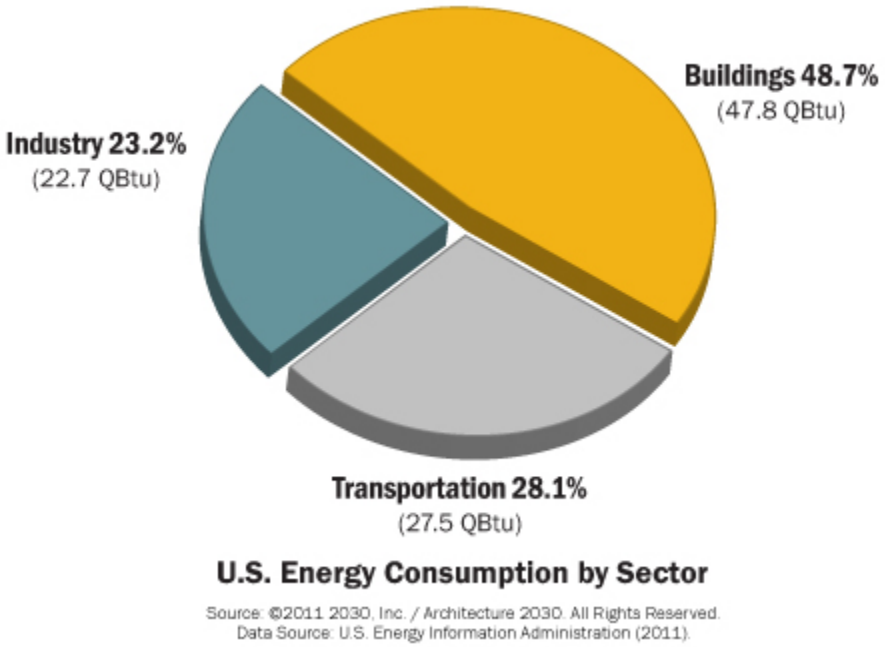
Technologies that save energy and replace fossil fuels (with cleaner renewable sources) are a global business with revenues of over $200 billion per year. Many of the best jobs are associated with the transition to a new economy and new technologies. New Hampshire excels in small business creativity and entrepreneurship, so the opportunities are even greater here.[34]

"According to the U.S. Energy Information Administration (EIA), the Building Sector consumes nearly half (48.7%) of all energy produced in the United States. Seventy-six percent (75.7%) of all the electricity produced in the U.S. is used just to operate buildings. Globally, these percentages are even greater." The percentage is about 59% in New

[32] United Nations Framework Convention on Climate Change GHG emissions data
[33] EIA. 2009. http://www.eia.gov/energy_in_brief/renewable_energy.cfm
[34] Rocky Mountain Institute

Hampshire, because we have relatively little industry, and up to 68% in some New Hampshire cities.[35]

Figure D.4 – U.S. Energy Consumption by Sector, 2011



Architecture 2030, a nonprofit organization established in 2002 in response to the climate change crisis by architect Edward Mazria, asks the global architecture and building community to step up to the 2030 Challenge and adopt the following targets:

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% below the regional (or country) average for that building type.

- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% of the regional (or country) average for that building type.

- The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:
    - 70% in 2015
    - 80% in 2020
    - 90% in 2025
    - Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

[35] NHOEP

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy.

Figure D.5[36] - U.S. Energy-related CO2 Emissions, 1990-2035 (billion metric tons)

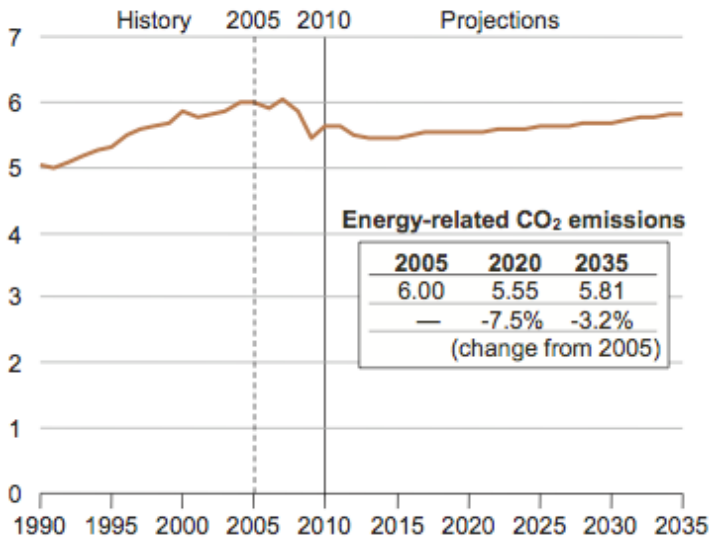
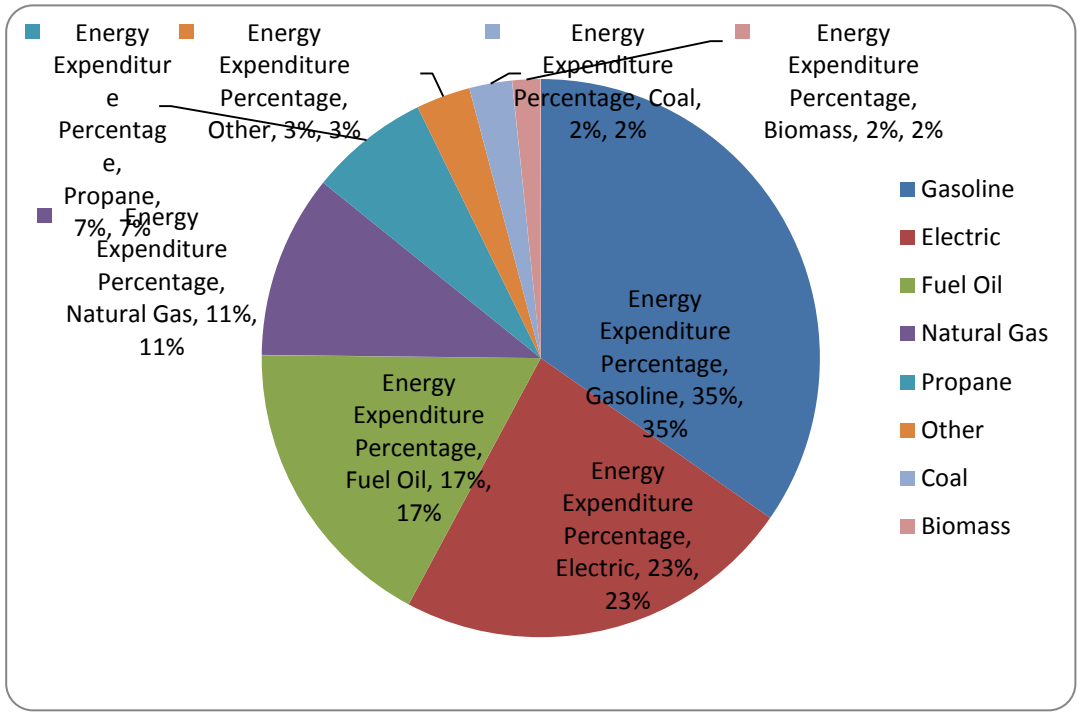


Figure D.5 shows US energy-related CO2 emissions from 1990 – 2010 and projected through 2035. Projections show emissions growing by more than 3 percent from 2010 – 2035, although they are still below 2005 levels by approximately 3 percent. The White House announced on November 25, 2009 that President Obama is offering a U.S. target for reducing greenhouse gas (GHG) emissions in the range of 17% below 2005 levels by 2020. Congress has not been able to pass comprehensive energy and climate change legislation that would help ensure the target is met, but the administration hopes a combination of federal regulations and state emission-reduction programs can achieve the cuts.

[36] Energy Information Administration (EIA). 2012 Annual Energy Outlook.

4.1.2 New Hampshire

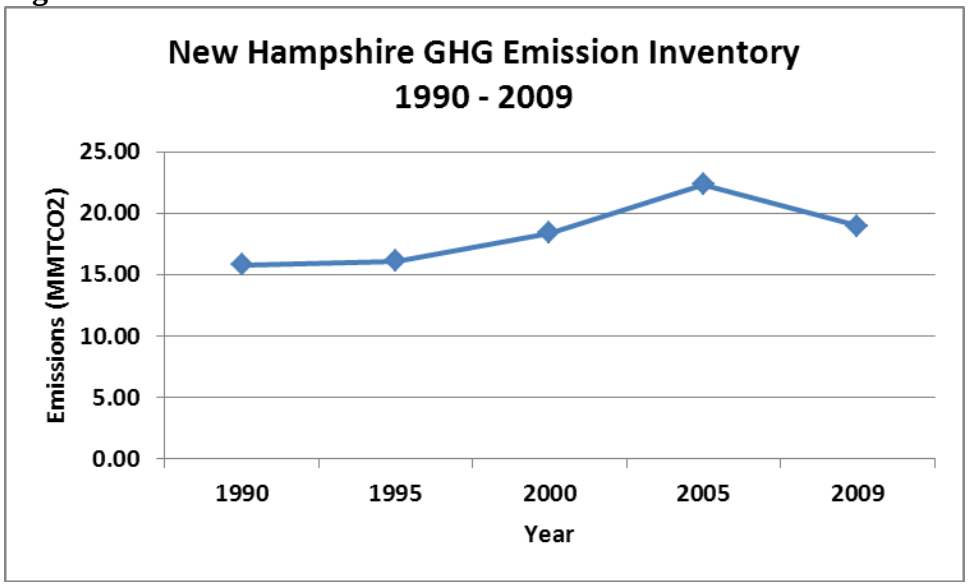
Figure 3.1 – 2009 New Hampshire Energy Expenditure Estimates by Source



New Hampshire citizens, businesses, and industries spent almost $5 billion on energy in 2009[37]. Of this money, more than two-thirds of it left the state immediately, much of it to pay for fossil fuels and nuclear fuels imported from overseas.[38] This outflow of dollars represents nearly 7 percent of New Hampshire's GDP and has been identified as a major drain on the economy. Investments in more efficient energy use could cost up to $2 billion. However, savings would offset the investments in less than 4 years. According to a 2009 study, if all state households achieved the highest level of energy efficiency, residents would save $309 million per year.[39] Commercial and industrial buildings would save $220 million per year.[40] In May 2007, New Hampshire adopted a renewable portfolio standard that requires 25 percent of the State's electricity to be generated from renewable sources by 2025. According to the 2012 Renewable Portfolio Standard White Paper in New Hampshire, 84 percent of the electricity produced (2008 data) comes from non-renewable fuels: coal, natural gas, oil, & nuclear. The remaining 16 percent of the electricity produced comes from the following renewable fuels: biomass, hydropower, landfill gas.

[37] Energy Information Administration, State Energy Data System 2009, "Table S1b Energy Expenditure Estimates by Source, 2009," http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_sum/plain_html/sum_ex_tot.html.
[38] New Hampshire Office of Energy and Planning, "2007 New Hampshire Energy Facts," http://www.nh.gov/oep/programs/energy/nhenergyfacts/2007/introduction.htm.
[39] This represents energy savings of around 20%, as defined as cost-effective in the study *Additional Opportunities for Energy Efficiency in New Hampshire*, Final Report to the New Hampshire Public Utilities Commission, GDS Associates, Inc., 2009
[40] Independent Study of Energy Policy Issues. Vermont Energy Investment Corporation, Jeffrey Taylor and Associates, Optimal Energy Inc. June 30, 2011

Figure 3.2

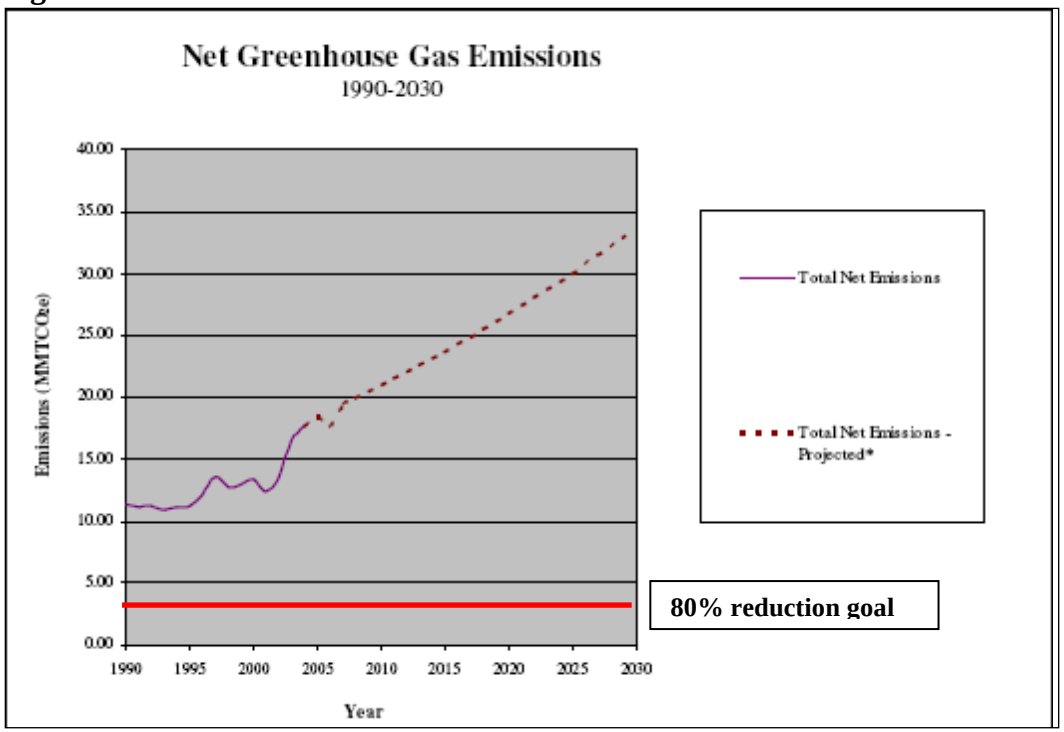


Source: NHDES, An analysis of EIA Energy Consumption Estimates By Sector for New Hampshire from 1960-2009 using EIA emission factors for all fossil fuels with NON-ENERGY emission calculations developed through the EPA's State Inventory Tool.

Figure 3.2 shows the net greenhouse gas emissions from 1990-2009 in New Hampshire. The New Hampshire Climate Action Plan recommends that New Hampshire strive to achieve long-term reductions in greenhouse gas emissions of 80 percent below 1990 levels by 2050. As the graph shows, emissions went up approximately 20% from 1990-2009. The New Hampshire Greenhouse Gas Emissions Reduction Fund (GHGERF) started in 2009. In the first year emissions were reduced by 4,600 metric tons from the projects that were implemented. Details on reductions made in the first year (July 2009 – June 2010) can be found in the Year 1 Evaluation published by Carbons Solutions New England, University of New Hampshire.[41]

[41] Carbon Solutions New England, University of New Hampshire. *The New Hampshire Greenhouse Gas Emissions Reduction Fund Year 1 (July 2009–June 2010) Evaluation*. 2011.

Figure 3.3*



Source: NHDES, EIA. *New Hampshire Greenhouse Gas Emissions Inventory and Projections*, 2008.
*Greenhouse gas emissions from 1990-2005 differ from Figure 3.2 as the uptake of CO2 by forests (carbon sequestration) was subtracted from emissions in Figure 3.3

Figure 3.3 shows net greenhouse gas emissions in New Hampshire from 1990-2004 (with carbon sequestration subtracted) and projections through 2030 for a "business as usual" scenario with no major changes from current trends. Projections are considered to be mid-range estimates and do not account for impact of economic recession, expansion of renewable or clean energy sources, potential shift to fuels with higher life-cycle emissions, loss of forests, or impacts of climate change on heating and cooling loads. Emissions for New Hampshire in 1990 were 14.7 million metric tons of carbon dioxide. To achieve the 80 percent reduction, levels will have to fall to 2.94 million metric tons by 2050. This shows how all municipalities in New Hampshire play an integral part in working towards energy conservation and reducing greenhouse gas emissions while New Hampshire works toward the goals in the New Hampshire Climate Action Plan.

Appendix F

2009 Deerfield Master Plan Energy Vision, Goals and Objectives

2009 Deerfield Master Plan Energy Vision, Goals and Objectives

Housing, Goal H-2 (pg. 9): "Review the existing land use regulations to identify where revisions can be made to encourage the use of energy efficient planning techniques."

Strategies:
H-2.1 Phase in adoption of the 2030 Challenge of making all buildings carbon neutral by the year 2030 over the next two years, using the Code Equivalents provided by Architecture 2030.

H-2.2 Consider requiring a Home Energy Rating System (HERS) sticker for all new construction and major renovations.

H-2.3 Encourage use of the practices outlined by the US Green Building Council Leadership in Energy Environmental Design (LEED), and certification for all major projects.

H-2.4 Review the Energy Efficient Development Ordinance developed by the state of NH's REPP in light of Strategies H-2.1 through 2.3 for additional ideas, or to suggest modifications to that ordinance.

Community Facilities, Goal CF-1 (pg. 11): "Continue to plan for and provide the best available community services at the least expense to the taxpayer."

Objectives: Utilize energy efficient materials, products and equipment when replacing or updating community facilities buildings and/or equipment.

Natural Resources, Goal NR-2 (pg. 14): "Update the Town's local land use regulations to encourage energy efficiency and "green" design and building practices."

Objective: Identify how local regulations can be modified to require high performance construction and renovation practices for buildings, grounds, and neighborhoods.

Strategies:
NR-2.0 Over time, work to phase in adoption of the 2030 Challenge of making all buildings carbon neutral by the year 2030, using the Code Equivalents provided by Architecture 2030.

NR-2.1 Encourage use of the practices outlined by the US Green Building Council Leadership in Energy and Environmental Design (LEED), and certification for all major projects.

NR-2.2 Promote the construction of Platinum and Gold certified buildings under the LEED program within the community.

NR-2.3 Utilize local media to educate the community on climate change and the importance of energy conservation (via Town Newsletter, website, etc.).

NR-2.4 Update the Town's local land use regulations to require the use of energy efficient appliances and green building practices.

NR-2.5 Make businesses aware of potential incentives in order to encourage the use more energy efficient appliances throughout the office.

NR-2.6 Review the Energy Efficient Development Ordinance prepared by the State of NH for additional ideas and approaches.