

**City of Keene, New Hampshire
Cities for Climate Protection Campaign**

Local Action Plan

**Formally Adopted by City Council on:
February 19, 2004**

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The Cities for Climate Protection Steering Committee:

Paula Philips, City Councilor; Michael E. J. Blastos, Mayor; John A. MacLean, City Manager; Katherine Delanoy, Antioch New England Graduate School; Matthew Morrison, Connecticut River Bank; Patrick Eggleston, Keene State College; Duncan Watson, Solid Waste Manager Keene N.H.; Jeff Porter, Southwest Regional Planning Commission; Richard Berry, Markem Corporation; Steven K. Bernier, Public Service Co. of New Hampshire; W. Rhett Lamb, Planning Director; Joanne Morin, NH Department of Environmental Services; Barbara Skuly, Cheshire Medical Center/Dartmouth Hirschcock Keene;

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EXECUTIVE SUMMARY

The fact that Earth has an average surface temperature comfortably between the boiling point and freezing point of water, and thus is suitable for our sort of life, cannot be explained by simply suggesting that our planet orbits at just the right distance from the sun to absorb just the right amount of solar radiation. Our moderate temperatures are also the result of having just the right kind of atmosphere. A Venus-type atmosphere would produce hellish, Venus-like conditions on our planet; a Mars atmosphere would leave us shivering in a Martian-type deep freeze.

Instead, parts of our atmosphere act as an insulating blanket of just the right thickness, trapping sufficient solar energy to keep the global average temperature in a pleasant range. The Martian blanket is too thin, and the Venusian blanket is way too thick! The 'blanket' here is a collection of atmospheric gases called 'greenhouse gases'. These gases, mainly water vapor (H₂O), carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), all act as a global insulator, leaving the Earth's surface temperature at about 60 F warmer than it would be without the greenhouse effect.

Atmospheric scientists first used the term 'greenhouse effect' in the early 1800s. At that time, it was used to describe the naturally occurring functions of trace gases in the atmosphere and did not have any negative connotations. It was not until the mid-1950s that the term greenhouse effect was coupled with concern over rapidly increasing concentrations of greenhouse gases, which are causing a rise in global temperature – global warming.

The scientific community is warning that rapid increases in the concentration of greenhouse gases in the earth's atmosphere is caused by human activity - mainly fossil fuel combustion and deforestation - and is introducing the risk of fundamental and costly changes in the earth's climate system. The risks include more severe drought/precipitation cycles; longer and more extreme heat waves; spread of tropical diseases; damage to vegetation and agricultural systems; threats to coastlines and property due to higher sea levels and storm surges. Independent of the scientific debate, the perception that global warming presents a problem that needs to be addressed is widespread.

Many large companies now acknowledge the very real threat of global warming as well and argue that some kind of early response is appropriate. Fortune 500 companies such as IBM, Dupont, Toyota, Hewlett-Packard, Boeing, and British Petroleum are working to reduce their greenhouse gas emissions and capitalize on their carbon savings through the organizations such as the Chicago Climate Exchange and the Pew Center's Business Environmental Leadership Council (BELC). For example, British Petroleum reduced its greenhouse gas emissions by over nine million tons, eight years ahead of target, and said it will peg net future emissions at this new, lower level despite plans to grow its oil and gas

production by 5.5 per cent a year. Chief executive Lord Browne said that BP's pledge, made four years ago, to cut emissions from its own operations by ten per cent from 1990 levels by 2010 had already been achieved - and at no net cost to the company.

The Keene City Council realized that local actions taken to reduce greenhouse gas emissions and increase energy efficiency provide many local benefits: decreasing air pollution, creating jobs, reducing energy expenditures and saving money for the City government, its businesses and its citizens. Consequently, in the spring of 2000, our City Council committed Keene, its government, businesses, and residents to reducing the emissions of greenhouse gases. By passing *Council Resolution R-2000-14*, the City of Keene joined a family of more than 300 cities and counties around the world in the **Cities for Climate Protection Campaign**.

By joining the campaign, the City of Keene committed to:

- conducting a greenhouse gas emissions analysis for 1995 and a forecast for 2015,
- setting a greenhouse gas reduction target, and
- developing and implementing plan to meet the target.

Please see Chapter 2 entitled 'Climate Change and New Hampshire' of the Local Action Plan to see how climate change can directly affect our area.

Keene Greenhouse Gas Emissions Analysis

A greenhouse gas emissions inventory was conducted for the baseline year of 1995. This inventory includes only carbon dioxide, generated by combustion of fossil fuel, and methane from landfill waste decay. The inventory covers residential, commercial/industrial, waste and transportation sector emissions of CO₂. In 1995, the entire Keene community was responsible for approximately 204,529 tons of CO₂, or 9.02 tons per person. By 2015, in the absence of actions to reduce emissions, our emissions are predicted to increase 26% to 257,716 tons, or 10.3 tons per person.

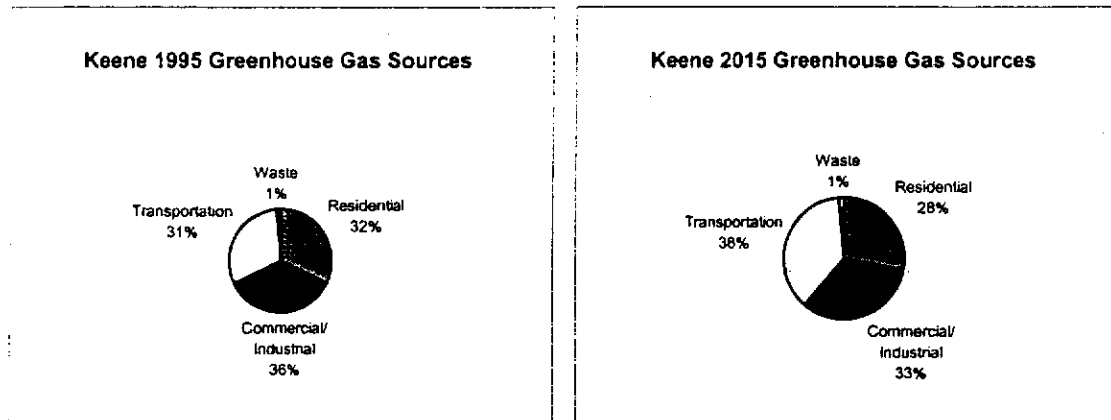


Figure 1. Keene Greenhouse Gas Emissions Estimates for 1995 and 2015

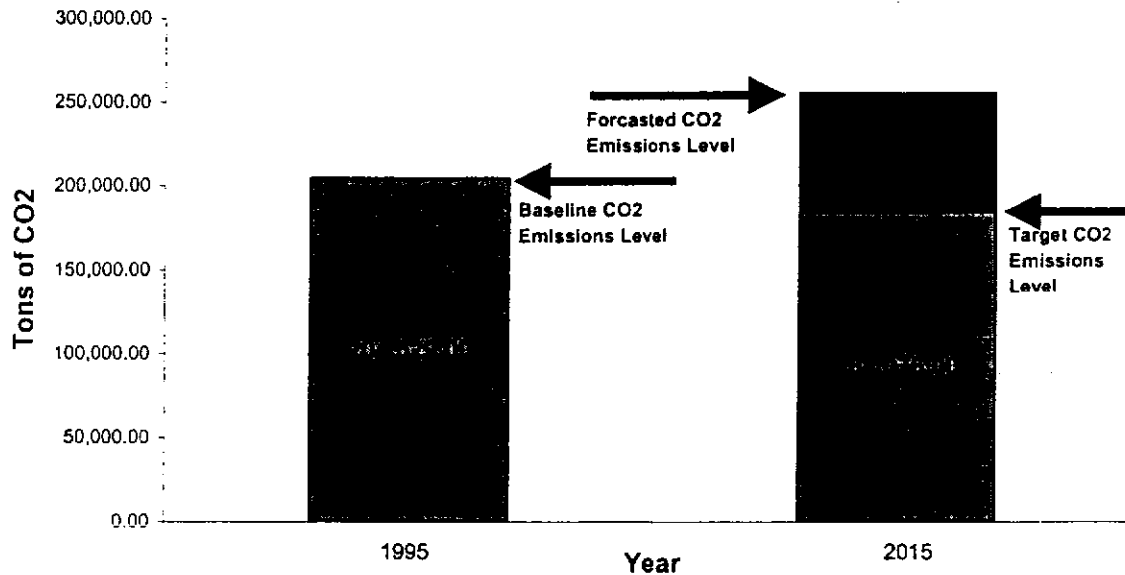
Role of Project

The role of this project is not to debate the issue of global warming. In recent years, the scientific community has reached a nearly unanimous consensus that global warming is occurring and the potential consequences could be severe. The role of this plan is to identify local actions we can take to reduce greenhouse gas emissions caused by human activity in and around Keene.

Keene Greenhouse Gas Reduction Target

In order to reach our target goal of 10%, the City of Keene will have to reduce 70,860 tons of CO₂ to reach the 2015 target level of 184,076 tons of CO₂. The following chart illustrates our target goal.

Chart 1. Target Emissions Reductions Chart



Measures To Reduce Greenhouse Gases

Table A illustrates a short summary on the reduction measures the Cities for Climate Protection and Keene community have suggested. For details on each measure, please refer to the indicated page number where an in depth description of each measure can be found.

Existing measures are those that already exist in the community or City organization although they are not necessarily completed.

New measures are those that emerged initially though greenhouse gas reduction discussions and are primarily intended to reduce greenhouse gases.

The annual financial savings are quantified as a return on investment and are not always immediate.

The following measures address building energy efficiency, reduction of solid waste, alternative power options, policy options, and other ways the community can reduce their greenhouse gas emissions. The annual financial savings is representative of what could possibly be saved after a return on investment is

reached. Some measures do not have an up front capital cost while others require initial funds. The measures that have an initial investment would be paid through the acquisition of grants or by money saved through the implementation of measures that generate savings for the City. Please see each measure individually for a complete explanation of monetary benefit.

Table A. New and Existing Municipal Measures

EXISTING & NEW MEASURES	Page	Tons CO ₂ reduced in 2015	Payback Year	Potential Annual Financial Savings/ Cost Avoidance
Immediate Savings				
Energy Efficient Equipment	18	182	0	\$27,915
Methane Recovery at Landfill	23	140	0	\$55,000
10% Awareness Challenge	17	226	0	\$39,317
Trees & Shrub Expansion	21	6	0	-
Purchase Green Power	22	1	N/a	(\$3)
Environmentally Preferable Products	25	-	0	-
Police Units on Bicycles	26	6	0	\$805
Biodiesel Project	29	417	N/a	(\$10,231)
Streetlight Conversions	15	14	0	\$3,854
Electric Vehicles for Police	31	5	0	\$599
Internal Recycling Program	24	<u>83</u>	<u>0</u>	<u>\$3,140</u>
TOTAL:		1,080		\$120,396
Short Term Savings 1-5 years				
Police Units on Bicycles Expanded	26	6	1	\$805
Bike Path Outreach	34	5	N/a	*\$563
Employee Parking Reimbursement	32	37	N/a	*\$4,173
Employee Telecommuting	34	<u>5</u>	<u>N/a</u>	<u>*\$569</u>
TOTAL:		53		\$6,110
Long Term Savings 10+ years				
Solar Panel Installation	16	2	70	\$641
Compressed Natural Gas	28	28	10	\$7,023
Hybrid Car Replacements	27	23	15	<u>\$2,532</u>
Retrofit City Buildings	18 & 19	-	-	-
Traffic Calming	35	<u>190</u>	-	-
Mixed Use Development	36	-	-	-
TOTAL:		243		\$10,196
Responsible for Previous Measures				
Energy Efficiency Coordinator	37	-	-	-
Climate Change Education & Outreach	38 & 39	-	N/a	(15,000)
TOTAL		-	-	-
TOTAL		1,376		\$121,702

* Indicates Savings to Keene Residents or City Employees instead of the municipality.

Table B. Community Measures

NEW MEASURES	Page	Tons CO ₂ reduced in 2015	Annual Financial Savings
Solar Hot Water Installation	47	134	\$60,589
Lobby for Renewable Portfolio Standard	48	1,907	\$-133,162
Lighting Replacements	45	429	\$194,750
10% Challenge - Energy	46	7,314	\$1,402,887
Recycling Outreach	49	12,927	\$1,292,700
Multi-Unit Outreach	50	148	\$14,800
Backyard Composting Program	53	359	\$42,003
10% Transportation Challenge	55	6,511	\$7,756
Lobby for Increased CAFÉ Standards	54	19,632	\$2,223,061
	TOTAL:	49,361	\$5,105,384
Lobby for Renewable Portfolio Standard	60	5,819	\$-609,328
10% Challenge - Energy	62	7,001	\$2,071,883
Lighting Replacements	61	6,692	\$2,802,912
School Bus Conversion to Biodiesel	30	467	-
Recycling Program	63	4,600	\$460,000
	TOTAL:	24,011	\$4,728,467
NEW MEASURES TOTAL		73,473	\$9,833,851

The Challenge

Achieving a 10% reduction below 1995 levels will be challenging. It will take each new and existing measure to reach it. It will take the commitment of the City government to provide adequate funding to implement the actions outlined here. It will take the commitment of businesses, small and large, to pay attention to energy consumption and waste generation, and strive to reduce it. It will take the commitment of each individual citizen to make the choices to drive less, conserve energy, produce less garbage, and recycle more. No one entity has the responsibility or the ability to do it alone. The City has decided to pursue their own goal of reducing Municipal emissions by 20%. The City Government is taking a leadership role for the community in pursuing a higher target. Together, if we embrace the actions laid out in this plan, we can achieve our greenhouse gas reduction goal and realize the multiple additional benefits of improved air quality, reduced energy consumption and associated cost savings. **If you would like to see how you can help protect our climate and the New Hampshire way of living, please read Chapter 4 or 5 depending if you are a resident or a business. Each chapter illustrates ways you can reduce greenhouse gas emissions through energy use, transportation and waste.**

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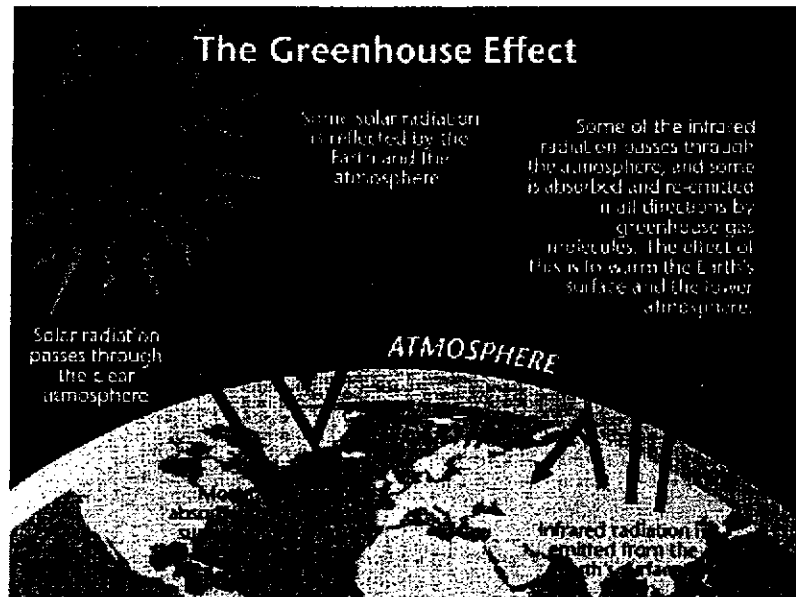
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CHAPTER 1

Climate Change

A. GREENHOUSE GASES AND THE GREENHOUSE EFFECT

The greenhouse effect is the process whereby energy from the sun is trapped by the atmosphere to cause warming. Much of this energy is infrared radiation emitted from the earth's surface.



The natural greenhouse effect helps keep the Earth's average temperature at around 59 degrees Fahrenheit (F). Without the natural greenhouse effect, the Earth's temperature would be around 0 degrees Fahrenheit, and the planet would be largely uninhabitable.

A greenhouse gas is any gas in the atmosphere that contributes to the greenhouse effect. The major greenhouse gases are carbon dioxide, methane, nitrous oxide, and water vapor.

Carbon Dioxide: Results from the burning of fossil fuels (such as oil, coal or gas) for transportation and industrial operations and from the destruction of carbon sequestering forests. The destruction of these forests eliminates their carbon storing capacity and releases CO₂ into the atmosphere.

Methane: From landfills, fuel production, livestock production and farming

Nitrous Oxide: Emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Ozone (ground level): Formed as a result of chemical reactions between oxygen, volatile organic compounds (VOCs), and nitrous oxides. Sources include vehicles, factories, landfills, industrial solvents, and miscellaneous small sources such as gas stations, lawn equipment, etc.

Fluorocarbons: From refrigerants and other industrial products

B. GLOBAL WARMING POTENTIAL (GWP)

Each greenhouse gas differs in its ability to absorb heat in the atmosphere.

Hydroflourocarbons (HFC's) and Perflourocarbons (PFC's) are the most heat-absorbent. Methane traps over 35 times more heat per molecule than carbon dioxide, and nitrous oxide absorbs 260 times more heat per molecule than carbon dioxide.

Often, estimates of greenhouse gas emissions are presented in units of millions of metric tons of carbon equivalents (MMTCE), which weights each gas by its Global Warming Potential (GWP) value. For more information on GWP, please visit the EPA web site at:

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsNationalGlobalWarmingPotentials.html>

Table C. Global Warming Potential (GWP)

GHG		Natural % Gas is found in the Atmosphere	Lethal Strength Relative to 1 Carbon Dioxide	Years it can persist in Atmosphere
Water Vapor	H2O	1-3%	*	
Carbon Dioxide	CO2	.037%	1	50-150 yrs
Ozone	O3	.00003-.010%	*	
Methane	CH4	.0017%	35	10.5 yrs
Nitrous Oxide	N2O	.003%	260	132 yrs
Fluorocarbons	CFC's & PFC's		4,500-6,100	55-500 yrs

*Water vapor and ozone are greenhouse gases. They do not have global warming potentials because they do not persist in the atmosphere long enough. Water vapor levels are determined by the natural balance between evaporation and rainfall, and are not considered to be directly influenced by human activity (although there are some indirect effects). Ozone is formed when VOC and NOx interact in the presence of sunlight, and the residence time it spends in the atmosphere is relatively short (weeks to months). CO2 stays in the atmosphere 50 - 200 years.

C. CLIMATE CHANGE & GLOBAL WARMING

The terms climate and weather are often used interchangeably. In fact, they are different: Climate is the average pattern of weather in a given place, while weather is a condition of the atmosphere at one particular place and time. The measures of weather are wind speeds, temperature, humidity, atmospheric pressure and precipitation. The weather often changes substantially from day to day. Climate, on the other hand, refers to the big picture and includes the broader overall relationships between the earth's atmosphere, oceans, land, and solar radiation. Weather patterns are a product of climate. While humans are more or less used to dealing with changes in the weather, we do not have experience with rapid climate change. The direct effects of climate change will include changes in weather, soil moisture, and sea level. These changes are likely to have long-lasting and widespread adverse impacts on ecological systems, human health, and economies. The lag time between the emissions of greenhouse gases and their full impact on the climate can be decades or even centuries. The time

required to reverse any effects is similarly long. **Global Warming** refers to the overall rise of the Earth's temperature due to **Climate Change**.

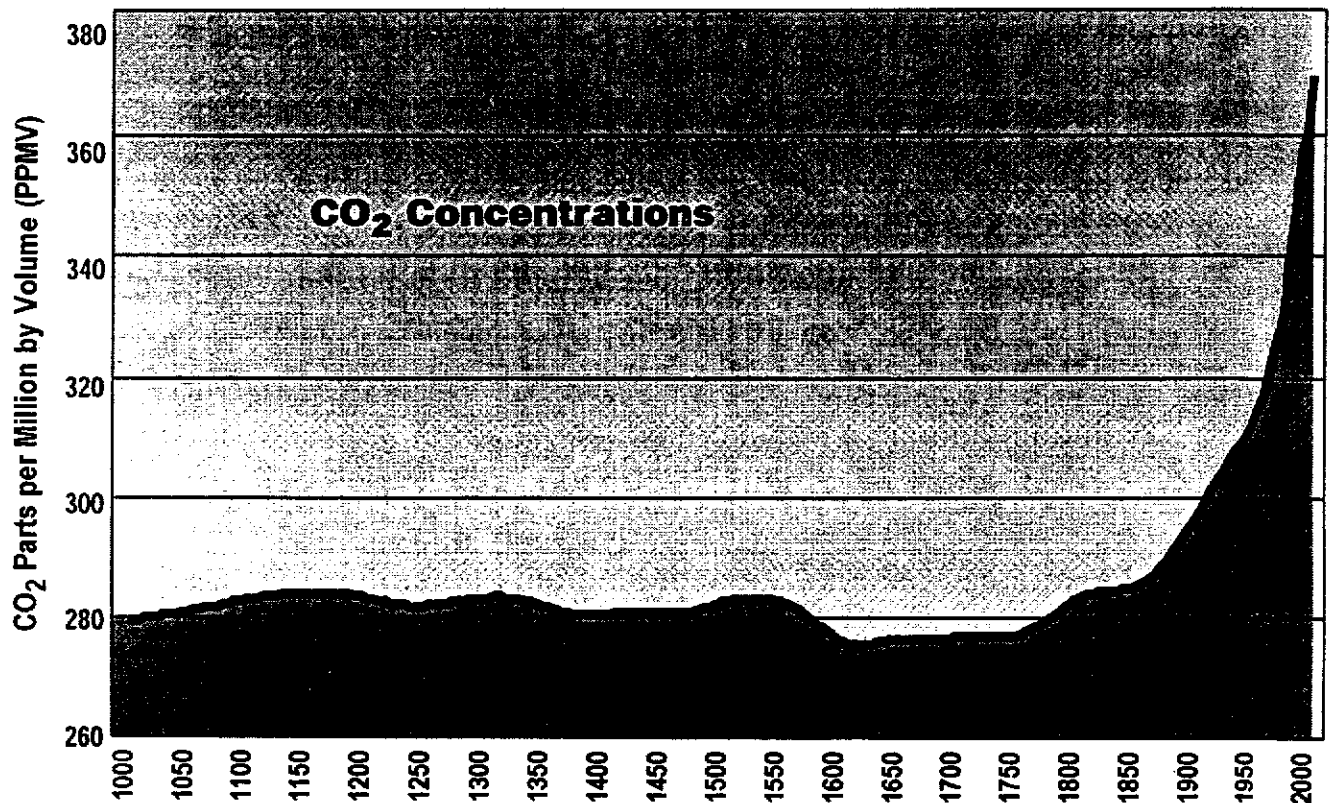
1. The History of Climate Change

Scientific evidence clearly tells us that the earth is warming, and that humans are influencing this trend. This was the conclusion of the second scientific assessment by the United Nation's Intergovernmental Panel on Climate Change. The panel was established in 1988, at the request of the world's nations. Its assessment took two years and involved approximately 2,000 scientists from around the world. This conclusion was a breakthrough because scientists had earlier insisted that even though changes in the world's climate were being observed, the natural variability of earth's climate could not be ruled out as their cause. The conclusion reached in the 1988 panel is that the primary cause of global climate change is modern industrial society's dependence on fossil fuels. Increased burning of fossil fuels has dramatically raised the concentration of greenhouse gases in the earth's atmosphere. Among the human-produced greenhouse gases, the most significant is carbon dioxide.

Changes in the earth's climate have occurred many times throughout the planet's history as a result of changing atmospheric conditions. Concentrations of CO₂ in the atmosphere are presently estimated to be 370 ppm. At no time in the past 160,000 years have CO₂ concentrations exceeded 300 ppm (Antarctic ice data). Other data analyzed by well-known scientists indicates the current concentrations of CO₂ are significantly higher than those estimated at any time during the last 400,000 years.

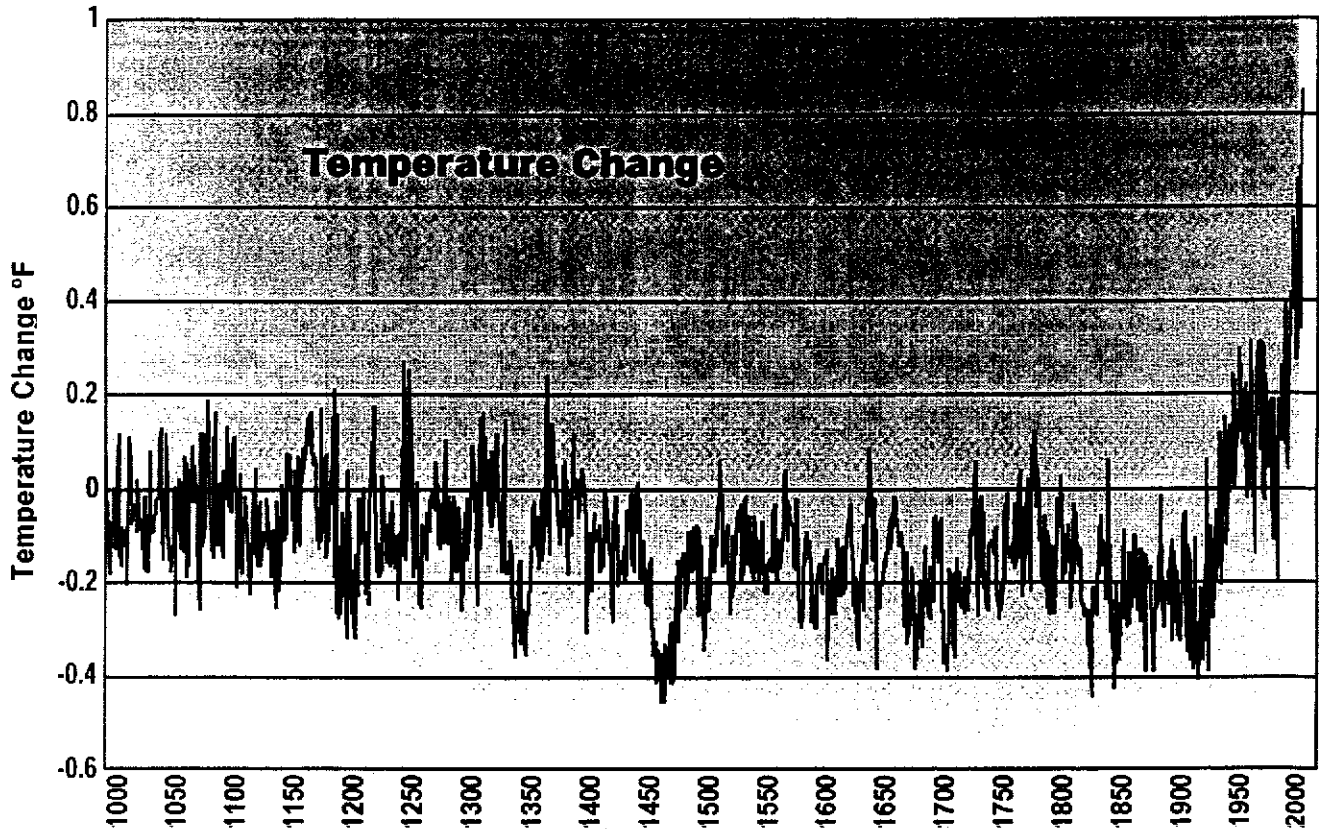
Figure 2 illustrates changes in CO₂ levels in atmospheric concentration over the last 1,000 years. The graph clearly illustrates the correlation between CO₂ concentrations and the timing of the Industrial Revolution.

Figure 2



This next graph illustrates the temperature change in the last 1,000 years.
Figure 3

1000 Years of Global CO₂ and Temperature Change



It is important to note that the global average temperature difference between the last glacial maximum (2 miles of ice) and the current interglacial period is only a 10-12 degree F difference!

An increase in the frequency and intensity of extreme weather events is an often-cited potential impact of global warming. The past few years in **New Hampshire**, extreme weather events, including droughts and flooding, are consistent with observations from around the world. These extreme weather events contribute to the growing body of evidence supporting predictions by climate scientists that our world's weather is becoming more volatile and more intense. A host of other impacts and indicators—among them rising sea levels, an expansion of the range for tropical diseases, and losses from polar and glacial ice-packs—further demonstrates that human-driven climate change is very real.

CHAPTER 2

Climate Change and New Hampshire

A. HOW WILL CLIMATE CHANGE AFFECT NEW HAMPSHIRE?

Although it is now understood that human caused emissions of greenhouse gases are directly tied to recent warming, the global climate system is large, complex and dynamic. Predicting the impacts of climate change for a specific small area, such as New Hampshire, is much less certain. Scientists are, however, increasingly confident that the impacts over the next 50 – 100 years promise to be significant. On a global scale, projecting the impacts of global climate change is less certain. Anticipated climate related challenges are likely to involve rising sea levels, water resources, food security, human health, and disruptions to natural ecosystems. The frequency and severity of extreme weather events is also expected to increase.

For New Hampshire, the effects may be devastating to the local economy and the environment. The effects include:

1. Potential Impacts to the New Hampshire Ski Industry

- **Job Loss:** Lost revenue translates to lost jobs. Approximately 17,000 New Hampshire residents are employed directly by the New Hampshire ski industry.
- **Lost Revenue:** New Hampshire ski industry represents 8.6 percent of total direct visitor spending, approximately \$190 million. Total ski spending, including indirect spending such as meals, overnight accommodations and the like, totals \$420.7 million.
- **Ski Conditions:** Potential mid-season rain and significantly more freeze-thaw cycles could result in icier, granular conditions. Ski conditions in general may deteriorate.
- **Water Supply:** Warming will be more pronounced during winter nighttime. Snowmaking may be adversely affected. To cover one acre of ski trails with one foot of snow takes 150,000 to 180,000 gallons of water. Water supply will be an issue, as will be environmental impacts from such large water withdrawals.

2. Potential Impacts on New Hampshire Cold Water Fishing

- **Lost Revenue:** Fishing in New England is big business. Two million fishermen in 1991 spent an average of \$674 per person annually. Thirty-five percent of those traveled to New England from out-of-state. Revenue loss from lost cold-water fishing would be significant.
- **Lower Fish Stocks:** The temperatures of streams in New Hampshire may increase to levels exceeding tolerances for most cold-water fish such as brook, brown, and rainbow trout. Warm water fish may have difficulty moving into vacated cold-water fish habitat because they are unable to tolerate fast stream rates. Temperature is critical to reproduction in many cold-water fish species. Even though some adult fish may tolerate higher stream temperatures, they will not reproduce.

- **Habitat Loss:** A recent EPA study for New England indicated that some states could potentially lose all habitat important for cold-water fish. Estimates as high as a 50 percent loss were predicted for northern New Hampshire.

3. Potential Impacts on New Hampshire's Forests

- **Lost Revenue:** The forest product industry is the fourth largest employer in New Hampshire and third in terms of revenue. Gross revenues may be affected. Sugar maple, ash, and yellow birch, all northern hardwoods, are sensitive to extreme weather events and may decline or even collapse.
- **Forest Migration:** In general, ecological models predict that warmer temperatures and extreme weather events associated with climate change would move optimal conditions for the growth of northern hardwood forest species northwards by at least 100 to 300 miles by the end of the next century.
- **Tree Loss:** Disturbances will increase including pest and pathogen outbreaks, flooding, and wind damage. Disturbances such as these can kill a large number of trees and forests. Extreme events such as periods of winter thaw followed by intense cold; spring and summer drought; and summer heat stress, have been associated with die-backs and declines in several northern hardwood species in New England in the last 100 years.

4. Potential Impacts on Foliage

- **Lost Tourism:** Revenue from New Hampshire foliage visitors is approximately \$292 million annually. On average foliage visitors spend 16 percent more than non-foliage visitors. Economic loss to the tourism industry from foliage losses may occur. Potential summer drought conditions will cause trees to drop their leaves prematurely.
- **Lost Revenue:** Sugar maples are extremely susceptible to mid-winter thaws and summer droughts. The maple syrup industry, an annual \$3 million to 3.5 million industry may collapse. Consequently, sugar maples, a source of brilliant fall leaf colors may sicken, decline and disappear, or their geographic distribution may migrate north.

5. Potential Impacts on Human Health and Emergency Events

- **Flooding:** remains a crucial issue in Keene. Recent estimates reveal that the assessed value of buildings in the 100-year flood plain exceeds \$125 million. Precipitation in winter may bring more frequent and more violent storms.
- **Insurance:** Many insurance companies such as Swiss Re, a leading multi national re-insurance company, have stated that future insurance risks due to the changing climate will raise premiums or will lead to a denial of coverage in many areas.
- **Human Health:** Increased precipitation and warmer average temperatures can lead to northward migration of diseases such as West Nile Virus, Malaria, and Lyme Disease.

Even though no one is sure which climate model predictions will be correct, the risks and impacts associated with most predictions are a very clear cause for concern.

B. WHAT IS KEENE DOING ABOUT CLIMATE CHANGE?

The City Council of Keene has joined local business and political leaders, along with other communities, in recognizing the need for action and the dangers posed by global climate change. In the spring of 2000, the City Council voted to participate in the "Cities for Climate Protection" campaign organized by the International Council For Local Environmental Initiatives.

In 2001, Mayor Michael Blastos formed the Cities for Climate Protection Committee. He charged it with developing an action plan and setting a percent target for Keene to reduce CO₂ emissions.

This action plan is a tool for both the city government and the community to launch a campaign to reduce greenhouse gas emissions. The committee hopes this plan inspires and assists you to take actions that reduce your production of greenhouse gases, and thereby benefit everyone's future.

1. Keene's Action Plan Setting a Goal for Reducing Emissions

The first step in helping the City to meet a Climate Action objective was to estimate historical and projected emissions of greenhouse gases. Having carefully assessed the baseline emissions for Keene and the potential opportunities to achieve the city's goal, the committee suggests an annual emissions reduction goal of 10% below 1995 emission levels by the year 2015.

The City then decided to set a higher reduction rate for municipal operations. The City of Keene will reduce their CO₂ emissions by 20 percent below 1995 levels. The following page illustrates charts from the Inventory:

Figure 4

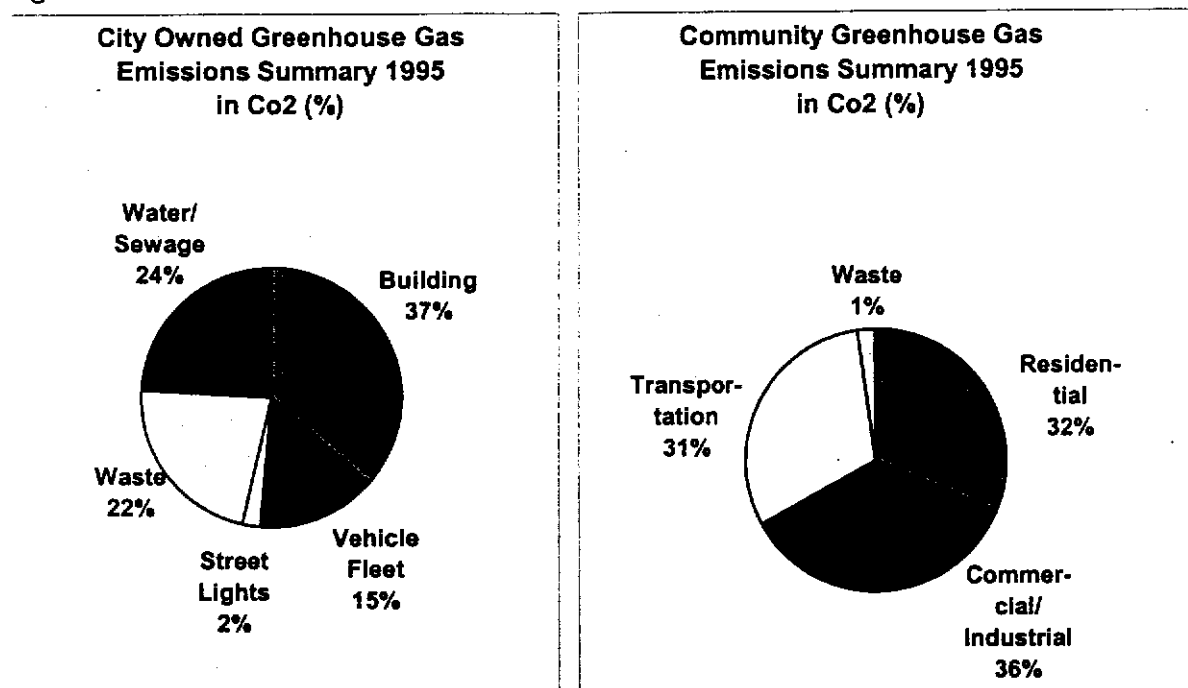


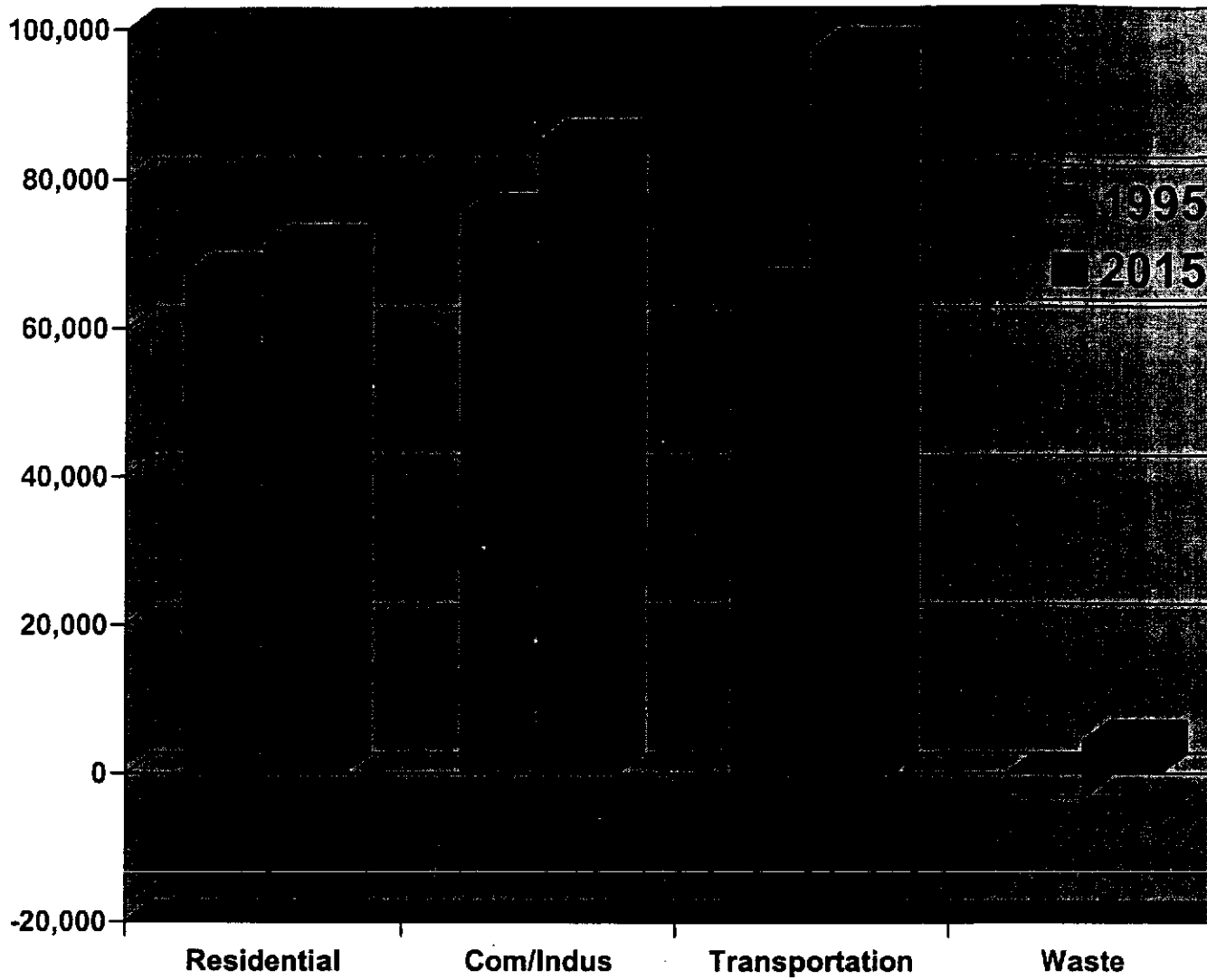
Table D

**Community Greenhouse Gas Emissions 1995
Base Year Detailed Report**

	Equivalent CO2 (tons)	Equivalent CO2 (%)	Energy (million Btu)
Commercial/Industrial			
Electricity	47,124	22.7	498,709
Light Fuel Oil	22,330	10.7	282,562
Propane	4,616	2.2	66,415
Subtotal Commercial/Industrial	74,070	35.7	847,687
Residential			
Light Fuel Oil	44,389	21.4	561,680
Electricity	18,197	8.8	192,576
Propane	2,596	1.2	37,359
Subtotal Residential	65,182	31.4	791,615
Transportation			
Gasoline	48,151	23.2	578,414
Diesel	15,996	7.7	194,410
Subtotal Transportation	64,147	30.9	772,824
Waste			
This includes: Paper, Food, Wood/Textile & Plant Debris Waste			
Subtotal Waste	4,328	2.1	
TOTAL	207,728	100%	2,412,126

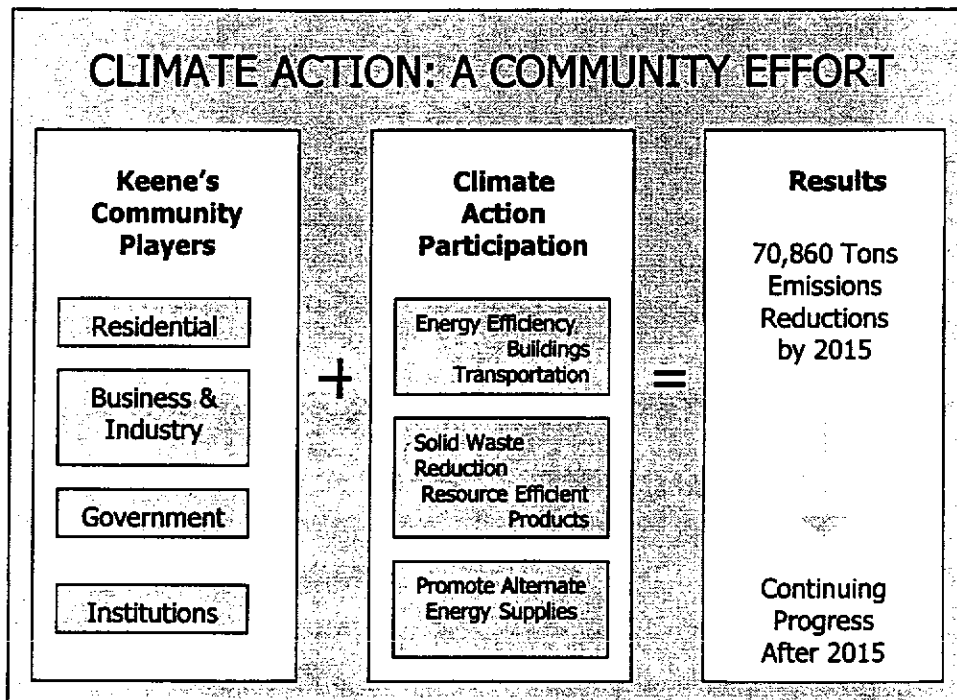
Chart 2

Community Time Series Report



2. Making a Difference through Participation

Reducing emissions in Keene alone will not solve the world's climate-change problems. But Keene can connect its efforts to those by hundreds of other cities across the globe that also joined the Cities for Climate Protection Campaign. Together, these communities can achieve a significant positive impact. In a similar way, Keene's City government is taking steps that will help make Keene a sustainable community—but it cannot achieve its goal of reducing emissions goal by acting alone. This effort needs the involvement of the whole community. Currently, the City of Keene is leading the charge in New Hampshire. Many other municipalities in the region are looking toward Keene as a leader in this area. Keene has been gaining national attention through the current policies and projects undertaken.



C. ADDITIONAL BENEFITS OF REDUCING EMISSIONS

Along with reducing greenhouse gas emissions and positively affecting climate change, the measures suggested in this plan have several important additional benefits. These include:

Cleaner air. Motor vehicles are the single largest source of urban air pollution. In addition to CO₂, cars emit millions of tons of carbon monoxide, nitrogen oxides and volatile organic compounds, including such carcinogenic toxins as butadiene, benzene and formaldehyde.

Improved human health. Fossil fuel emissions contribute to a host of respiratory and other health problems. Across the U.S., motor vehicle emissions cause an estimated 40,000 premature deaths every year.

Improved Economic Vitality. Many of the strategies and measures recommended in the Action Plan make economic sense, even if the benefits of climate protection are not considered. Energy efficiency and climate protection help to reduce New Hampshire's imports of electricity and fossil fuels. Investing in energy efficiency, and in the use of indigenous renewable energy resources, keeps dollars in the local economy and helps to improve the competitiveness of local businesses.

A more livable community. Picture Keene with less traffic, better public transportation, less pollution and a greater collective sense of pride. The city can achieve this, while helping counteract global climate change—and municipal actions can start the trend toward a community lifestyle that produces fewer greenhouse gases. But to make a real, lasting, sustainable difference, it is vital that the people, the businesses and the organizations of Keene join in putting this action plan into action.

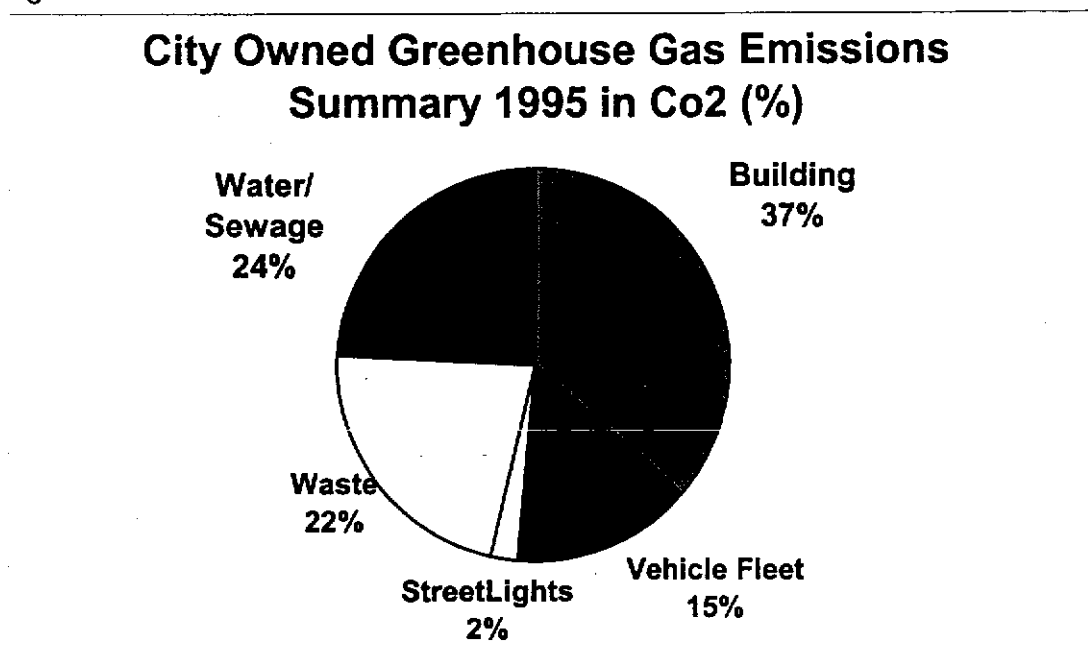
CHAPTER 3

Municipal Opportunities

A. DEMONSTRATING LEADERSHIP

The City of Keene is helping to demonstrate and lead the community's climate protection activities by adopting, implementing and monitoring climate protection action plans for municipal buildings and operations. Compared to the potential of reductions from other sectors, the estimated savings in greenhouse gas emissions from the municipal action plan are relatively small—but these actions set an important example within the community. Improving, and communicating about, the efficiency of city owned buildings, transportation use and solid waste are strategies that benefit everyone.

Figure 5



B. MUNICIPAL ENERGY USE

Energy efficiency measures reduce energy costs, enhance environmental quality, improve security and sustainability and enhance economic vitality. Energy efficiency projects can also eliminate the need for new power plants, along with distribution and transmission capacity. **Efficiency measures are among the most cost-effective ways to fill our current and growing energy needs.**

C. MUNICIPAL WASTE

There are two main impacts on climate change from the generation of solid waste, one direct and one indirect. The direct impact is due to the anaerobic decomposition of organic waste, which produces the greenhouse gas methane.

Businesses that produce significant amounts of organic waste, such as food and paper waste, can help reduce this by composting (in the case of food waste) and simple waste reduction measures such as printing double-sided copies. The indirect link to climate change has to do with embodied energy, which is the energy (and subsequent CO₂) needed to produce the raw materials required to manufacture a product. By recycling, and by purchasing products with high-recycled content, the City of Keene can cut down on this embodied energy. Recycled products can reduce by as much as 75 percent the amount of energy required to produce a product. One conservative estimate is that every ton of recycled waste prevents 1,000 pounds of CO₂. Adopting management policies that require green or climate friendly purchasing wherever possible, along with conscientious use of office supplies as well as waste reduction in the lunchroom (providing reusable dishware and coffee mugs as well as recycling bins), can also lead to significant reductions.

1. Climate Neutral Products

Some visionary businesses are starting to take their climate protection efforts to a new level by working on “climate neutral” products. Climate neutral status comes from eliminating or offsetting all greenhouse gas emission associated with a product’s life cycle. Businesses usually achieve this through a combination of on-site activities (energy efficiency, waste reduction) and off-site activities (such as sponsoring reforestation projects). In New Hampshire, for example, Stonyfield Farm is developing “climate neutral” yogurt. By supporting and purchasing products like this, municipalities can encourage climate protection while increasing their citizens’ awareness and demonstrating environmental leadership.

D. MUNICIPAL TRANSPORTATION

1. Fleet-Scale Demonstrations

Vehicle fleets, whether public or privately operated, often provide good opportunities to demonstrate alternative-fuel vehicles and reduce emissions. Fleets are often good candidates because of limited range requirements and the opportunity for central refueling infrastructure. Alternative fuel options for fleets include electric, natural gas and fuel cell power.

2. Transportation Demand Management (TDM)

Policies and public investments aimed at reducing vehicle miles traveled are collectively referred to as ‘transportation demand management’ strategies. Priority transportation demand management (TDM) strategies now being evaluated by regional and local planners in Keene include:

- Expanding and further developing park-and-ride lots to encourage ride-sharing and shuttle services
- Expanding public transit system routes, increasing the frequency of service, and providing free shuttles for large events

- Encouraging increased employer initiatives that promote ridesharing, telecommuting and bicycling.

3. Changes in Transportation Policy

Significant reduction in emissions will also require some major modifications to transportation policy at the federal, state, and local levels.

Some additional policies that have not been quantified but could provide significant CO₂ reductions include:

- Shifting funding for transit from the property tax to new funding sources.
- Developing tax incentives to further encourage vanpools, carpools and public transportation.
- Establishing carbon-based or transportation fuel sales taxes. Carbon tax or the removal of sales tax exemptions for transportation fuels can be designed to be revenue-neutral, with the revenues generated returned to taxpayers in the form of reductions in other tax burdens (e.g., income, property or social security).
- Developing a revenue-neutral sales tax structure for new vehicle sales. Vehicles significantly more efficient than the fleet average receive a rebate, those with average efficiencies are not impacted, and those significantly worse than average pay an extra sales tax which offsets the rebates paid for the more efficient vehicles.

4. Building a Strong Transportation Infrastructure

Changes in individual transportation behavior, business strategies, TDM techniques, and transportation policy will not be adequate unless the City is concurrently updating and improving its transportation infrastructure.

Transportation Demand Management Strategies

1. Increase federal minimum vehicle efficiency standards to 45 mpg for cars, and 30 mpg for light trucks by 2005.
2. Adopt higher density mixed use planning
3. Shift hidden transportation costs to motor fuel taxes
4. Shifting fixed-cost fees for transportation to variable-costs fuel taxes

E. MUNICIPAL CHALLENGE & MEASURES

The following pages illustrate summaries of existing actions the City of Keene has taken and future measures that are recommended by the Cities for Climate Protection Committee. In order to meet our 20% target goal, the city will need to implement and actualize each of these measures.

Existing Achievements in the Municipal Energy Sector

1. LED Traffic Signals

Measure Status: Existing, Could be expanded

Responsible Department: Police

CO₂ Savings: **15 tons**

Annual Financial Savings: **\$3,854**

The Keene Police Department installed LED (light emitting diode) lights for the red and green signals at most of the traffic signals in Keene. LED lights use 80 to 90% less energy than conventional incandescent bulbs. In addition, LED lights require 1/6 the maintenance of conventional bulbs, only needing replacement every eight to ten years. The street light conversion will eliminate 15 tons of CO₂ in 2015.

- Cost of converting traffic signals to LED: \$19,000 after PSNH Rebate
- Financial savings from reduced energy use \$3,854 a year
- Payback: 5 years (However, this does not include the projected savings that occurred as a result of growth in the traffic signal area. If this is taken into account, the **payback period becomes 1-2 years.**)

Co-Benefits

- Saves tax payer dollars
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)
- Reduces preventative maintenance costs
- Reduces costs of emergency relamping
- Reduces liability of accidents due to burned out signals
- Saves in disposal of many used light bulbs per year
- Excellent opportunity to lead by example, investing in a highly cost-effective energy savings measure

Success Stories

- After a successful pilot project, the city of Philadelphia decided to install red LED's in all 2,900 intersections. The new signal used 83% less energy and required 6 times less maintenance than incandescent lights. These savings amounted to \$800,000 annually and have a simple payback of about 4 years. This measure resulted in a 41,490 – ton decrease in CO₂ emissions.

Future Measures in the Municipal Energy Sector

1. Municipal Use of Solar Electricity

Measure Status: Proposed

Responsible Department: Buildings

CO₂ Savings: **2 tons**

Annual Financial Savings after Payback Period: **\$641**

The installation of solar photovoltaic panels on municipal buildings could provide many environmental and economic benefits to the City. Photovoltaic provide electricity from the sun's rays using semiconductor technology. PV systems can be used to power lights, appliances and business equipment. A PV system is a way to guarantee reliable and uninterrupted power at a time when energy shortages are becoming commonplace. While the technology for municipal solar use exists today, there are many barriers, due mostly to the high cost of installation, that stand in the way of this measure. However, programs like the federal Million Solar Roofs initiative are working to overcome barriers such as the lack of consumer and professional knowledge about solar technologies, limited number of qualified solar installers, high system cost, limited financing options and infrastructure barriers to grid tied systems. This measure anticipates that two city buildings, Parks and Recreation and City Hall will explore the possibility of installing 2 kw PV systems. Since this measure has an unrealistic payback period, the city would consider this measure if grant money could be obtained to shorten the payback period and lower the cost of installation.

- Average implementation cost of PV system \$11.25/watt. Two 2 kw PV systems would cost $\$11.25 \times 2,000 \times 2 = \$45,000$ to install
- Financial Savings from reduced electricity use: \$640.8
- **Payback: 70 years.** There are many funding opportunities available to municipalities that make the installation of solar technology more economically feasible

Co-Benefits

- Creates market for renewable energy
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)
- Sets example for residents and other municipalities
- Promotes local and independent sources of electricity
- Decreases dependency on foreign fossil fuels
- Saves on utility bills, reduce vulnerability to fuel price spikes
- Reduces adverse environmental impacts associated with conventional forms of electricity generation

Success Stories

- Massachusetts Electric Company teamed up with the city of Medford, Massachusetts to encourage businesses and residents to install solar energy panels on their roofs. Photovoltaic systems were installed at Medford City Hall and Medford High School. Students learn about solar electric systems through solar demonstrations at the high school while officials at city hall are using their systems to learn how the sun can help them save money on their electric bills.

Future Measures in the Municipal Energy Sector

2. Energy Audits of all City Owned Buildings & Rewards Program

Measure Status: Proposed

Responsible Department: Buildings

CO₂ Savings: **226 tons**

Annual Financial Savings: **\$39,317**

The City should consider implementing a program of regular energy audits for all municipal buildings with the authority given to the building manager. Simple awareness of energy use and subsequent adjustments will possibly result in 10-15% energy use reductions. (Heidelberg, Germany) Yearly savings of \$39,317 are immediate and do not involve any direct economic input. The costs already associated with the Energy Efficiency Coordinator position account for the upfront staff time to perform the audits and the rewards program listed below.

- Electricity reduced= 160,036.6 kwh for a savings of= \$21,670
- Oil reduced= 12,491.5 gals for a savings of= \$8,445
- Propane reduced= 5,009 therms for a savings of= \$9,202

To supplement the actions outlined above, the city encourages municipal employees to help identify further emissions reduction opportunities. The City of Keene could establish an employee education and reward program. Employees that demonstrate leadership and initiative in reducing the city's greenhouse gas emissions would be rewarded and recognized by the entire community. Part of the employee education program would come in the form of direct mandates by the City Manger. An example of this would be a mandate from the City Manger to all City Employees to shut down their computers at night. This can be incorporated into the city's broader promotion and adoption of the 20 percent reduction goal.

See the following page for more details on building retrofits

Existing & Future Measures in the Municipal Energy Sector

3. Performance Contract with an ESCO for Building Efficiency Upgrades

EXISTING

There have been numerous measures implemented by the City in order to create energy efficient buildings.

Waste Water Treatment Plant

Variable Frequency Drives are an electronic device that controls motor speed by varying the frequency of the electrical supply. Variable-speed drives vary the frequency of AC electricity in response to an electrical signal. When coupled to a fan or pump motor, the change in frequency will result in a corresponding change in motor speed. Large reductions in electricity are achieved when fans or pumps operate at reduced speeds. These drives have been installed at the waste water treatment plant. The new energy efficient equipment has achieved a **634,424 KWH** reduction in energy use per year. This has created a cost avoidance amount of **\$27,914** to the City of Keene. These energy savings reduce **182** tons of carbon dioxide per year.

Library

In November of 2001, a project was instituted because of the increase in electrical demand from the renovations that had been completed in the prior spring months. Costs were about \$6k above the projected previous years projections. After meeting with WV engineering, who had done the HVAC for the approximately doubled square footage, we requested some options to address the issue. The system had been installed as much bare bones as more resources were directed to esthetics and HVAC and energy conservation were not priorities. The project resulted in an energy reduction for the library.

The following page illustrates future measures that can take place in terms of building efficiency.

FUTURE

The following table illustrates proposed building efficiency measures the City of Keene will implement. These measures can be achieved with the help of an ESCO. An ESCO is an Energy Services Company that helps put all of the pieces in place for creating energy efficient buildings. The financing for such projects can be paid through a shared savings performance contract. This will eliminate the need for money allocated for these retrofits from the budget.

General Municipal Building Efficiency Measures Proposed for 2015

Building Component	Recommendation Highlights
Heating, Ventilation and Air Conditioning Systems	Bring all systems up to a minimum operating efficiency level, perform building and system seal-up, install efficient control systems, analyze cost-effectiveness of heat recovery ventilation, establish a comprehensive maintenance protocol and train/inform building employees on energy efficiency strategies.
Water Heating Systems	Analyze systems for cost-effective efficiency improvements and fuel conversions, insulate piping and tanks, reduce temperature set-points where appropriate and install low-flow fixtures.
Lighting	Perform lighting assessment and implement alternate lighting strategies where appropriate, improve task lighting, install occupancy sensors and lighting controls where appropriate.
Motors	Implement protocol to install premium efficiency motors at time of replacement, and analyze motors larger than 1HP for proper sizing and efficiency, replace where cost-effective.
Office Equipment	Implement buying strategy of Energy Star equipment and Products and environmentally sensitive office products, and implement awareness campaigns to encourage "thoughtful" consumption of equipment and products.
New Technologies	Investigate and support cost effective heat recovery, renewable fuel and cogeneration opportunities, support and provide leadership for the development of a municipal energy system.

It is anticipated that these savings will result in large CO₂ reductions for the City of Keene. We will have CO₂ reduction calculations available once preliminary energy audits are done on each city owned building.

Future Measures in the Municipal Energy Sector

4. Energy Efficient Equipment

Measure Status: Proposed
Responsible Department: Various
CO₂ Savings in 2015: not quantified

ENERGY STAR labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity, reducing a copier's annual electricity costs by over 60%. High-speed copiers that include a duplexing unit that is set to automatically make double-sided copies can reduce paper costs by \$60 a month and help to save trees*

ENERGY STAR labeled fax machines are equipped with a power-management feature that can reduce energy costs associated with the use of the machines by almost 50%. A medium-speed ENERGY STAR labeled fax machine uses 25% less energy in sleep mode than in standby mode when it is immediately ready to send or receive faxes. ENERGY STAR labeled fax machines can also scan double-sided pages. This will reduce both your copying and your paper costs.

There are approximately 12 fax machines and 15 photocopiers used by the City of Keene. If Energy Star machines slowly replaced all of these machines, the city would realize potential energy savings, which would equate to CO₂ reductions.

Future Measures in the Municipal Energy Sector

5. a. Expanding and Maintaining Trees and Shrubs

b. City Owned Nurseries and Gardens

Measure Status: Proposed

Responsible Department: Parks & Rec

CO₂ Savings in 2015: **6 tons**

Trees play an important role in our community that goes well beyond aesthetics. Their shade helps to offset air conditioning use in the summer, and they can reduce heating costs by blocking cold winds in the winter. Storm-water absorbed by city trees can lock up pollutants that would otherwise end up in the Ashuelot River. And because of their ability to absorb carbon dioxide and produce oxygen, trees have aptly been called the "lungs of the planet." For these reasons, it is important that the city and the community support the parks and recreation department in its development of a comprehensive urban forestry master plan.

The California Energy Commission has estimated that on average, mature urban trees reduce the amount of CO₂ in the air by approximately 115 pounds per year. In 2003, Elm Research Institute donated 100 Liberty Elm Trees for the City of Keene to plant, leading to the sequestration of approximately 6 tons of equivalent CO₂ annually.

The city should explore the possibility of operating a community garden in order to encourage local agriculture and the possibility of green roofs on city owned buildings where appropriate.

Co-Benefits

- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)

Success Stories

- A City of Tucson, Arizona study demonstrated that for every dollar spent to maintain trees, \$2.62 worth of benefits are returned in energy savings, dust reduction and the slowing of storm-water runoff.

Future Measures in the Municipal Energy Sector

6. Green Power

Measure Status: Proposed

Responsible Department: Public Works

CO₂ Savings in 2015: 1 ton

Green Power: Cities such as Santa Monica have passed ordinances that mandate the purchase of 100% renewable energy to power all city facilities. Keene is not considering purchasing 100% of its electricity as renewable. Calculations therefore assume that the City will consider to purchase 20% of its total electricity needs from green sources in 2015. According to the GHG Inventory, electricity use in Municipal buildings, facilities, operations and streetlights is forecasted to be 9346 kwh at a cost of \$1,642.37.

- 20% of 9346 is 1869.2 kwh.
- Municipal average = \$0.1757297
- Electricity rates in 2015 estimated to be 10% less than 2002 rates dues to increased competition.
- Municipal average 2015 = \$0.15815673. Green electricity estimated to be 2/10 of a cent higher than conventional rates.
- Municipal average for green electricity in 2015 = \$0.16015673

Implementation costs: 1869.2 kwh at green electricity rates = .16015673 *
1869.2 = 299 versus 1869.2 * .15815673 = 296
\$3.00 difference

Co-Benefits

- Extends equipment life
- Reduces electricity consumption
- Creates demand for high tech industry in the region
- Improves fan or pump control
- Creates a market for renewable resources
- Limits our dependence on foreign energy supplies

Existing and Future Measures in the Municipal Waste Sector

1. Landfill Gas Management

Measure Status: Proposed
Responsible Department: MSW
CO₂ Savings in 2015: **140 tons**
Annual Financial Savings: **\$55,000**

The City of Keene installed a landfill gas-to-energy generator at the Keene Municipal Landfill, in part to provide three-phase power for the adjacent Materials Recovery Facility. The decision to install the landfill gas-to-energy generator was made because of the cost savings of self-generated power versus utility supplied power as well as the environmental benefits of reduced air emissions. The City of Keene operated Caterpillar G-3412-SINA, 250 kW electric generator, powered by landfill gas through five interconnected wells combusts more than 98% of the volatile constituents of the inlet gas and eliminates approximately 140 tons of hydrocarbons per year, which would otherwise be released by the landfill. In addition, the landfill gas-to-energy generator burns methane as its primary fuel. Methane is known to be 20-30 times worse than carbon dioxide as a greenhouse gas. The size of the Keene landfill required only a passive gas venting system; however, the City of Keene installed an active gas collection system to reduce the effects of landfill gas.

In 1999, the well field was expanded to seventeen interconnected wells, and a transformer was installed to supply single-phase power needs. The materials recovery facility operates "off" grid approximately 95% of the time. The estimated the gas collection rate is 372,600 standard cubic feet per day or 260 standard cubic feet per minute. The landfill gas composition by volume is approximately 35% carbon dioxide, 1% oxygen, 58% methane and 6% nitrogen.

The estimated savings are approximately \$55,000 per year in electrical costs. The system initially cost \$280,000.

Co-Benefits

- Saves tax payer dollars
- Reduces methane emissions
- Encourages lower markets to reduce packaging on consumer products

Success Stories

Prince George's County, Maryland, installed a methane recovery system at a landfill and uses the methane to provide heat, hot water, and electricity to a nearby correctional facility. The county sells the leftover landfill methane, a renewable energy source, to a utility company. Annual energy revenues are nearly \$1.3 million and methane emission shave been reduced by 45,000 tons – a greenhouse gas reduction equivalent to that achieved by planting almost 83,000 acres of trees.

Existing and Future Measures in the Municipal Waste Sector

2. Internal Recycling Program

Measure Status: Proposed
Responsible Department: MSW
CO₂ Savings in 2015: **83 tons**
Annual Financial Savings: **\$3,140**

In July of 2002, the City started an internal recycling program. The program involved education and blue bins for all paper recycling. It is anticipated to divert 20 tons of paper per year through this formal program.

- The Environmental Protection Agency has found that making paper from recycled materials results in 74% less air pollution and 35% less water pollution. This means that every ton of recycled paper keeps almost 60 pounds of pollutants out of the atmosphere that would have been produced if the paper had been manufactured from virgin resources.
- One ton of recycled paper uses 64% less energy and 50% less water, saves 17 trees, and creates five times more jobs than one ton of paper products from virgin wood pulp.
- Every ton of recycled paper saves approximately 4 barrels of oil, 4,200 kilowatt hours of energy and enough energy to heat and air-condition the average North American home for almost 6 months.

The City of Keene will realize a savings of approximately \$2,340 in avoided disposal cost by recycling paper. In addition, the City of Keene will receive approximately \$800 in revenue from selling the paper in the recycling commodities markets.

Future Measures in the Municipal Waste and Energy Sector

3. Purchase of Environmentally Preferable Products

Measure Status: Proposed
Responsible Department: MSW
CO₂ Savings in 2015: Unknown

Purchasing policies can greatly affect the environmental impact of operations from government entities. State and local governments purchase more than \$1 trillion in goods and services each year, according to *Governing Magazine*. Products made from recycled materials should be preferred over those made from virgin materials when impacts of quality and cost are not excessive.

There does not exist sufficient data to calculate the impact of the Town's environmentally preferable purchasing measures in terms of reduced emissions. However several amendments to Town purchasing policies as listed below would significantly lessen the environmental impact of its operations. These recommendations could be developed into a formal Environmentally Preferable Products Policy.

- Products made from recycled materials should be preferred over those made from virgin materials when considerations of quality and cost are similar.
- The Town should expand EPP purchases to include janitorial and cleaning products, environmentally friendly vehicle products (oil, traffic cones, recycled antifreeze) and building products (recycled plastic lumber).
- Municipal departments should practice bulk purchasing of energy efficient and recycled content products.

Co-Benefits

- Saves tax payer dollars
- Good opportunity to lead by example, showcase Keene's commitment to energy efficiency and solid waste reduction
- Encourage market for green products
- Educates City's staff about energy efficiency

Success Stories

In 1998, Metropolitan King County, Washington, saved an estimated \$600,000 by purchasing recycled materials such as toner cartridges (\$300,000 savings), re-treaded tires (\$77,000 savings), and shredded wood-waste for temporary road surfaces, landscaping, and erosion control (\$65,000 savings).

Existing Achievements in the Municipal Transportation Sector

1. Police Units on Bicycle

Measure Status: Existing, Could be Expanded

Responsible Department: Police

CO₂ Savings: **6 tons**

Annual Financial Savings: **\$805**

The Keene Police Department currently has two bicycles that are used for patrols. These patrols operate the most of the year, with 2 bicycle units out on patrol. The police bicycle program has resulted in many benefits for Keene. Moving police out of cars and onto bicycles reduces municipal fuel use and provides visible evidence that bicycling is a legitimate option for transportation. Bike police also have a positive impact on crime, as bicycles are more difficult to spot than cruisers, and allow access to areas inaccessible to cars. In addition, the patrols are good for public relations, as they make police more approachable and can be used for special events. However, while there are numerous advantages to bike officers both in terms of police operations and environmental impact there are also some noteworthy limitations. Bike officers require a cruiser to assist in transporting people or property. Bikes do not have the visibility of a cruiser at an accident scene, they cannot cover great distances quickly to back up another officer or respond to an emergency they cannot effectively pursue a fleeing motor vehicle. Because of this, the bike patrol program is seen as a supplement rather than a replacement for traditional car patrols. It would be accurate to say that a bike patrol unit displaces a cruiser approximately 25% of the time. The two mountain bikes purchased have contributed to the elimination of 6 tons of CO₂ and savings of \$805 in avoided fuel costs.

- Cost of bike $\$1.00 \times 2 = \2.00
- Average maintenance cost of automobile: $24,777.13 \times \$0.13(\text{cost per mile}) = \$3,221 * .25 = \$805.25$
- Total Implementation Cost: \$2.00
- Financial Savings from avoided fuel costs - $\$805.25 - 2.00 = \803.25
- Payback: Immediate

The City of Keene should explore the possibility of expanding this program to include 2 more police officers on bicycle patrol, the savings and CO₂ reductions would be doubled for a grand total of 12 tons of CO₂ reduced and \$1,610 saved in fuel costs.

Co-Benefits

- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)
- Good for community relations, police officers become more approachable
- Police able to patrol areas unreachable by car
- Can influence helmet use and adherence to bicycle traffic and safety rules

Success Stories

- The City of Los Angeles has 250 officers who patrol on bicycles. These bicycles have displaced 125 squad cars and resulted in an annual reduction of 1,111 tons of CO₂

Please view the appendix to see how each measure was calculated

Future Measures in the Municipal Transportation Sector

1. Hybrid Gas/Electric Vehicles in the Town Fleet

Measure Status: Proposed
Responsible Department: Fleet Services
CO₂ Savings in 2015: **23 tons**
Annual Financial Savings: **\$2,534**

The City should consider requiring that all new vehicles purchased by the City for municipal use are the most fuel-efficient vehicle allowable for the job. Additionally, current vehicles in every department shall be evaluated to determine if the size and the fuel type of the vehicles are appropriate based on the frequency and the type of usage. Where feasible, the City of Keene could purchase smaller vehicles for each department. When upgrading the fleet, the city could take into account the main use of the vehicle and will purchase the smallest and most fuel-efficient vehicle in the class required for the job. Keene should explore the possibility that by the year 2005, 50% of all new vehicles purchased for the City are Alternative Fuel Vehicles. Although hybrid vehicles are not nationally considered AFVs due to the fact that they utilize gasoline, the City of Keene believes they could be useful in certain positions within the City. Hybrid and electric vehicles are ideal for most of the inspectors within the City that utilize a vehicle if they are traveling locally at slower speeds and do not need to carry a significant amount of materials. This plan calls for 9 vehicles (1 Crown Victoria, 3 Ford Taurus, 3 Ford Contours and 2 Luminas) to be displaced by the Toyota Prius in 2005.

- In 2000, these vehicles in the fleet used 3,347 gallons of gas to drive approximately 62,229 miles per year. In contrast, a Prius would only require 1,296 gallons of gas to drive the same distance, resulting in annual savings of \$2,534.
- Difference in car costs would be \$40,050
- Payback: 15 years

Co-Benefits

- More efficient use of tax payer dollars
- Fuel cost savings can be used for other Fleet Services projects/needs
- Reduces consumption of non-renewable resources
- Encourages market for alternative fuels
- Sets example for residents and other communities – Showcase Keene as innovative leader
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)

Success Stories

- Denver, Colorado's 'Green Fleets Executive Order' is the first comprehensive policy in the country designed to reduce greenhouse gas emissions from municipal fleets. A key feature is the inclusion of optimum fuel efficiency in new vehicle bid specifications. The estimated effects of Denver's Green Fleets program by year 2005 are annual cost savings of \$106,000 and a reduction in CO₂ emissions of 22% relative to 1992 levels, even though the number of vehicle miles traveled will have increased by 19%. Since May of 2001, the City of Denver has purchased 39 Toyota Prius.

Future Measures in the Municipal Transportation Sector

2. Conversion of Fleet Vehicles to CNG

Measure Status: Proposed

Responsible Department: Fleet Services

CO₂ Savings in 2015: **28 tons**

Financial Savings in 2015: **\$7,023**

Annual Savings After 2015: **\$3,040**

At present, the Toyota Prius is an excellent vehicle with which to start an alternative fuel vehicle-purchasing program. In the future however, Keene may decide to consider converting some fleet vehicles, such as light vans or trucks, to CNG (compressed natural gas). CNG is the cleanest burning alternative fuel vehicle, and on a gallon-equivalent basis, costs an average of 15 to 40% less than gasoline or diesel. While natural gas vehicles do emit methane, a greenhouse gas, any slight increase in methane emissions would be offset by the substantial reduction in CO₂ emissions even considering the different global warming potentials (GPW). GPW comparisons can be found in the Action Plan Introduction on page two.

The main obstacle to the use of CNG vehicles is the lack of local refueling stations. This measure evaluates the impact of converting 10 light vans or trucks in the fleet to CNG but does not assume the construction of a refueling station.

- While conventional gasoline costs \$1.235/gallon on average, the price of CNG per gasoline gallon equivalent is \$0.89. In 2000, DPW light vans and trucks used 10,994 gallons of gasoline to travel 153,916 miles at a cost of \$13,577.59. CNG vehicles have a lower fuel economy requiring 11,839.69 gallons of fuel to travel the same distance costing \$10,537.33 since the fuel is cheaper. Savings: \$3,040.26 a year in fuel costs.
- The cost of converting a vehicle to CNG is \$3,250, so the implementation cost of the measure would be 10 x \$3,250 = \$32,500
- Payback: 10 yrs

Co-Benefits

- Financial savings from cheaper fuel
- Reduces ozone and air toxics emissions
- Reduces consumption of non-renewable resources
- Encourages market for alternative fuels
- Reduces dependence on imported fossil fuels because CNG is a domestic resource
- Reduces smoke, noise and smell

Success Stories

- The Johnstown, PA region of American Red Cross Blood Services opened the area's first public compressed natural gas refueling station. The Red Cross will use the station to fuel 22 natural gas vehicles that will be converted during a state-funded, 2-year program. The program is expected to save \$22,000 a year in fuel costs and reduce 94 tons of CO₂

Existing Measures in the Municipal Transportation Sector

3. Conversion of Fleet Vehicles to Biodiesel

Measure Status: Proposed
Responsible Department: Fleet Services
CO₂ Savings: 417 tons

Another emissions reduction measure the City of Keene implemented is the conversion of heavy trucks used by the DPW to biodiesel fuel. Biodiesel is a clean, renewable diesel fuel substitute produced from agricultural resources such as soybeans or rapeseed. It can be burned in any standard, unmodified diesel engine. Current biodiesel fleets have reported operational consistency over extended periods of use – engine performance, payload power and range are completely unaltered. Keene's 57 heavy trucks and equipment vehicles are currently running on biodiesel reducing 417 tons of CO₂. The city should also investigate low sulphur diesel, which reduces the particulate emissions associated with conventional diesel.

- There is no cost to convert engines to run on biodiesel fuel.
- Biodiesel costs an average of \$0.20/gallon more than petroleum diesel. However, when the cost of meeting tougher emissions standards is considered, an emissions management system based on biodiesel may be the best option. Meanwhile, there is a great deal of research underway that is exploring ways to reduce the cost of biodiesel.
- The City has also received a grant, which has lowered the cost of the biodiesel fuel. Implementation appears to cost \$10,230.73 annually without grant money.

Co-Benefits

- Lowers particulate emissions
- Does not require special storage
- No engine modifications necessary
- Non-toxic to plants, animals & humans
- Biodegradable fuel
- Renewable source of energy

Success Stories

- The Green Team, a San Jose recycling and garbage company runs 95 trucks on 100% biodiesel. A spokesperson for the company says that the conversion cuts 50,000 pounds of air pollution each year

Future Measures in the Municipal Transportation Sector

4. Conversion of School Buses to Biodiesel

Measure Status: Proposed
Responsible Department: Planning
CO₂ Savings: **467 tons**

The proposed measure showcases the Keene area school bus fleet for several reasons. It is sizeable and comprises of roughly 21 buses that are highly visible and on the road for long periods of the day when traffic congestion is an issue. By encouraging the school district and their bus carrier to switch from standard diesel to either (B20) or Ultra-Low-Sulfur-Diesel (ULSD) the city will do much to improve the air quality for the community, especially children, who are particularly vulnerable to diesel exhaust, which is commonly amplified inside the school bus.

The proposed measure explores the option of having the City adopt the position that it is in the best interest of the entire community for the school district and their private carrier to consider switching from standard diesel to either (B20), or (ULSD). In passing the proposed measure the city would in effect, be making a statement of support and encouragement for voluntary action. The city would further offer its assistance to both parties, which could come in the form of pursuing grant money for the project, which has been successfully accomplished elsewhere. There is also the possibility that the City could partner with both parties to create a pilot project whereby a certain number of school buses that operate in or near the city, could refuel at the City's Fleet Services (B20) tank, which according to Steve Russell, the department's manager, "Has more than enough capacity to launch such a great idea."

In addition to encouraging a switch to a cleaner fuel, the city would also recommend that both parties explore the possibility of retrofitting the school bus fleet with pollution control devices, like interior air filters, particle traps, and catalytic converters. The two types of devices currently recommended by the U.S. EPA, are Diesel Oxidation Catalysts and Diesel Particulate Matter Filters. To learn more about the harmful affects that untreated diesel exhaust pose for children and air quality in general, please see the Appendix for Biodiesel.

- Diesel exhaust contains 40 compounds that are classified as "hazardous air pollutants" under the Clean Air Act
- Children riding buses are exposed to 5-15 times more particulate matter than that found at nearby monitoring sites (Wargo Study, Yale University 2003)
- Each child will typically spend-90 full 24-hour days riding on a school bus (UCS 2002)
- Biodiesel reduces the compounds linked to cancer by 80-90%

Future Measures in the Municipal Transportation Sector

5. Conversion of Police Vans to Electric Vehicles

Measure Status: Proposed

Responsible Department: Fleet Services

CO₂ Savings: **5 tons**

Annual Financial Savings: **\$599**

This measure will consider replacing two of the three Parking Police Vans with electric vehicles. These vehicles are perfect for use around town. The parking police have test driven these vehicles with favorable results. The 1989 van has accumulated 30,985 miles and gets 10.81 MPG. The 1991 van has accumulated 33,831 miles and gets 10.80 MPG. Therefore this measure will displace 2,942 per year (1991) and 2,295 per year (1989) for a total of approximately: 5,237 miles per year. The financial savings listed above is from gasoline reduction. The payback is immediate based on acquiring grant money to purchase the vehicles. If the grant required matching funds, then there would be a payback period based on the cost of the vehicle. This number would be quantified and explored when possible vehicles were identified that would fit the parking police requirements for transport.

- The EV Ford Think! cities get 32 kwh / 100 miles (in the city highway=41 kwh / 100 miles).
- 32 kwh / 100 miles = 3.13 miles / kwh and 1 kwh = 0.021594 equivalent gallons gasoline
- $(3.13 \text{ miles / kwh}) \times (1 \text{ kwh / } 0.021594 \text{ equivalent gallons gasoline}) = 144.72 \text{ miles per equivalent gallons gasoline}$

Co-Benefits

- More efficient use of tax payer dollars
- Fuel cost savings can be used for other Fleet Services projects/needs
- Reduces consumption of non-renewable resources
- Encourages market for alternative fuels
- Sets example for residents and other communities – Showcase Keene as innovative leader
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)

Future Measures in the Municipal Transportation Sector

6. Parking Cash-Out for City Employees

Measure Status: Proposed

Responsible Department: Personnel, Police Permit Office

CO₂ Savings: **37 tons**

Annual Financial Savings for Employees (gas): **\$4,173**

Parking Cash-Out is a measure that would give municipal employees who have reserved parking in the City the option to give up their parking space in exchange for its cash value. This measure could be implemented in conjunction with an expanded bus transit system or carpooling program. The calculations to quantify the impact of this measure on greenhouse gas emissions focuses on 19 Parking pass holders who park in the Wells Parking Lot. If this measure applied to all City employees who drive to work, its impact would be much greater. This measure eliminates 37 tons of CO₂ and avoids \$4,173 in fuel costs.

- 19 Parking spaces valued at \$760/month would cost \$9,120/year
- The City could regain the cost of 'buying-back' the parking passes by renting the spaces to non-municipal employees.
- Fuel costs avoided: $67,584$ (potential mileage reduction from measure)/ 20 (mpg – average fuel economy of passenger car) = $3,379.2$ gallons of fuel.

Co-Benefits

- Reduces traffic congestion
- Increases employee morale and education
- Financial savings for employees
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)

Success Stories

- The City of Santa Monica, CA implemented parking cash out program as an element of their Transportation Management Plan Ordinance. 26 of Santa Monica's 105 employers with 50 or more employees had implemented cash-out programs by February 1999 resulting in a Vehicle Miles Traveled (VMT) reduction of 544,000 miles per year. This measure resulted in a CO₂ reduction of 196 tons pr year

Future Measures in the Municipal Transportation Sector

7. Telecommuting for City Employees

Measure Status: Proposed
Responsible Department: Personnel, IMS
CO₂ Savings: **5 tons**
Annual Financial Savings (gas): **\$569**

Telecommuting, the act of working from home rather than traveling back and forth to a workplace, is thought to produce benefits for the companies and individuals involved, as well as present intangible benefits for the rest of society. Keene could provide the technology and flexibility for certain employees to take advantage of telecommunication advances and reduce their number of trips by working from home. Each department would need to evaluate where this is possible and how such a program could be firmly established. This measure is therefore based on the assumption that 10% of the 237 full-time employees will telecommute. This is approximately 24 employees that would telecommute 2 days a month.

- 48 trips per day x 24days = 1,152 of trips reduction
- 1,152 trips or (1,152 X 8) = 9,216 reduced PMT
- The average estimated commute length for city employees is 8 miles.

Co-Benefits

- Creates staffing flexibility, expanded labor pool
- Can serve as a recruitment tool
- Improves quality of life and productivity for employees
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)
- Reduces office space and parking requirements
- Reduces worker absenteeism

Success Stories

The San Francisco-San Mateo Videoconferencing/Trip Reduction Project uses videoconferencing technology to allow attorneys with San Francisco's Public Defender Office to conduct interviews with inmates at 2 County jail facilities in San Bruno, California. The program has eliminated the need for a 40-mile round trip between facilities and reduced annual vehicle miles traveled by 600,000 and annual CO₂ emissions by 351 tons.

Future Measures in the Municipal Transportation Sector (Affects Community)

8. Bicycling Outreach Program

Measure Status: Proposed

Responsible Department: CCP Coordinator

CO₂ Savings: **5 tons**

Annual Financial Savings (gas): **\$563**

The four greatest impediments for commuters choosing cycling or walking to work for errands are safety, weather, distance and inadequate facilities for storage or changing at destinations. While Keene cannot control weather or people's commuting distance, the City benefits from the walk-ability of its downtown and bike-ability along the many bike lanes, paths and trails. In locations such as downtown Keene where the infrastructure is in place, bicycling and walking trips can take the place of certain auto trips.

Improvements such as new and expanded bike paths, bicycle storage facilities and safe sidewalks and crossings can encourage more bicycling and walking in and around the City. An outreach program could be developed with the City's Bike/Pedestrian committee and other interested organizations in town to promote increased bicycling and walking. Shifting an additional 10 trips from single occupant automobiles to bicycles through implementation of the bicycle outreach program and new bike paths could reduce up to 9,234 pounds of CO₂ a year and could save Keene commuters up to \$563 a year in fuel savings.

- 10 reduced round trips per day – or 20 total auto trips reduced per day
- Trips would average 2 miles each (distance from Central Square to most residential locations)
- Each day 40 vehicle miles (20 total trips x 2 miles each) would be removed from the network.
- The 40 vehicle miles equate to roughly 1.9 fewer gallons of fuel burned each day (40 miles / 21 mpg)
- The 1.9 fewer gallons of fuel burned each day equates to 38.5 pounds of CO₂ each day, or approximately 9,234 pounds of CO₂ over eight months.
- The 1.9 fewer gallons of fuel burned each day equates to \$2.35 saved each day, or approximately \$563 per year.

Co-Benefits

- Reduces traffic congestion, increased social interaction and community building from decreased traffic.
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Decreases dependency on foreign fossil fuel resources
- Promotes a healthy form of transportation
- Increase safety for cyclists and walkers
- Showcases the city as bicycle friendly and livable.

Success Stories

- The City of Seattle, WA wrote a comprehensive Bike Plan to ensure that safe access and parking facilities would be provided for cyclists throughout the city, as well as to encourage more people to cycle. The City has 28 miles of bike trails, 14 miles of striped bike lanes and about 90 miles of signed routes. A study conducted before and after a project that added bicycle lanes to both sides of a street that linked to Seattle's downtown showed that 14,500 single occupancy vehicle miles traveled were avoided and that 7 tons of CO₂ were eliminated as a result of the improvements.

Existing & Future Achievements in the Municipal Transportation Sector

9. Traffic Calming Programs

Measure Status: Existing, Could be Expanded

Responsible Department: Engineering, Police

CO₂ Savings in 2015: **190 tons**

Traffic calming uses a variety of techniques (speed tables, islands, chicanes, humps, etc.) to promote a uniform traffic flow at a speed appropriate with the development context. By reducing the acceleration and deceleration typically found along arterials and local streets and encouraging a more uniform traffic flow, traffic calming can reduce fuel consumption and CO₂ emissions. CO₂ emissions are dependent upon fuel consumption. As fuel consumption is highest during vehicle acceleration, it would make sense that reducing the intensity and occurrences of vehicle acceleration through traffic calming would decrease overall CO₂ emissions. Assuming, on average, a 10% increase in fuel economy by promoting more uniform speeds, adding traffic calming treatments to one city block has the potential to decrease 0.05 pounds of CO₂ per vehicle per trip. Assuming an average street has 3,000 vehicles per day yields 146 fewer pounds of CO₂ per year. Reductions on Main Street, due to existing traffic calming measures (with a daily traffic volume of 22,000) would equal approximately 160,600 lbs of CO₂ reduced per year or 80.3 tons of CO₂ per year.

Follow-up: Assuming that, by 2015, Keene has added traffic calming elements to 10 city blocks, total CO₂ reductions total 1,463 pounds per year.

Calculations for one city block:

	Heavy Acceleration	Uniform Speeds
Average Fuel Economy	8.2 miles/gallon	9.02 miles/gallon
Distance	0.1 mile	0.1 mile
Fuel Burned	0.0122 gallons	0.0111 gallons
CO ₂ Emissions	0.244 lbs of CO ₂	0.224 lbs of CO ₂
Emissions reduced per car		0.020 lbs of CO ₂
Emissions reduced per year (assumes 3,000 cars/day)		21,900 lbs of CO ₂
For 10 City Blocks		219,000 lbs of CO ₂ or, 110 tons of CO ₂

Co-Benefits

- Improves livability of neighborhoods by reducing traffic congestion
- Reduce air pollution emissions that contribute to visibility degradation and health problems (the Keene smog)
- Reduces gasoline consumption
- Promotes alternative forms of transportation, makes streets more pedestrian friendly
- Makes streets and communities safer by reducing vehicular speeds
- Discourages use of non-residential streets by non-citizen cut-through traffic

Success Stories

- The City of Cambridge, MA has an extensive Traffic Calming Program. One project that involved curb extensions, raised crosswalks raised intersections and zebra crosswalk markings reduced average travel speeds from 30 to 21 mph. Before the improvement, 41 of vehicles were going at or below the 25 mph speed limit. After the project, 95% of vehicles were going at or below the speed limit. In addition, residents responded that the project was visually pleasing and enhancing to the community.

Future Measures in the Municipal Transportation Sector

10. Promote Mixed-Use and Transit Oriented Development

Measure Status: Proposed

Responsible Department: Planning Department

CO₂ Savings: Unknown (but could be very large)

Keene is characteristic of the network of compact, walkable, mixed-use centers and neighborhoods in older cities and towns scattered throughout New England. Many of these centers were historically connected by rail transit and still reflect land use patterns that were enabled by these strong connections. Keene's overall land use pattern contributes to the goals of a sustainable community and region by supporting a variety of transportation choices; creating walkable, close-knit mixed neighborhoods; and intertwining the built environment with open space, farmland and natural beauty.

There are many connections that can be made between land use patterns and climate change. Mixed-use development and zoning is designed to permit a variety of community activities, locales and services to co-exist in close proximity, thereby reducing the need for extensive automobile travel. Transit-oriented development brings potential riders closer to transit facilities rather than building away from population centers and making people more dependent on roads and automobiles. Put simply, if people live in close proximity to employment, retail, services, and entertainment, they won't need to drive as much. Fewer miles mean less greenhouse gas emissions.

Another beneficial impact of mixed use and transit-oriented development is to reduce the need for excess parking. Excess parking has costs for all of us. For an individual housing development, excess-parking requirements drive up costs and reduce the potential for amenities such as open space. Open space in Keene provides a variety of environmental and aesthetic benefits including more opportunity for landscaping with woody plants to promote the absorption of CO₂. Paved land tends to reduce adjacent property values, increases water pollution and storm water flooding, reduces visual and acoustic privacy and causes urban heat islands (increased local temperature).

On a larger scale, excess parking contributes to traffic congestion and ironically even encourages more car ownership. Numerous studies have shown that higher land use densities are essential to reduce rates of car ownership and miles driven. Generous parking requirements encourage automobile dependency and urban sprawl by increasing the amount of land needed per unit, thus making lower priced urban periphery land relatively more attractive than higher priced, but more accessible, urban locations.

Future Measures Imperative for All Sectors

1. Establish Energy Efficiency/Environmental Coordinator Position

Measure Status: Proposed

Responsible Department: Planning Department

CO₂ Savings in 2015: Accounted for in other measures

Achieving the reduction targets listed in this plan will require a strong implementation program. The Cities for Climate Protection Committee recommends that the City should hire a full or part time Energy Efficiency/Environmental Coordinator to ensure the completion of the last two milestones of the CCP Campaign. These are the implementation and monitoring phases of the program. The staff person would be responsible for exploring and/or implementing any measures set forth by this plan that are approved by City Council. The Coordinator would also assist other departments in energy, transportation and waste reduction programs. The Energy Efficiency Coordinator would seek actively seek and secure grant money for the City in order to achieve many of these goals. Another aspect of the position would be to update the emissions inventory and consistently monitor the reduction target and goals set forth in this plan. Lastly, the Coordinator would directly implement the educational outreach programs of the plan. This position would be paid for by the savings and cost avoidance generated from many of the measures listed in the plan.

As an alternative to hiring new personnel, an existing staff person in the Planning Department could assume the initial work of the Energy Efficiency/Environmental Coordinator. Under this scenario, one planner would be assigned CCP implementation. Approximately 25% of that person's time would be dedicated to the CCP program. As the measures begin to generate savings for the City, a part-time employee could be hired to further the goals of the plan and generate additional savings. Over time a full time position may be possible. In general, the role of the Energy Efficiency/Environmental Coordinator would be to protect and improve environmental quality, specifically through energy efficiency programs, in Keene through projects that prevent CO₂ pollution, encourage environmentally friendly alternatives and promote energy conservation.

The next few pages illustrate the work the Energy Efficiency Coordinator would directly oversee and accomplish that are outreach related. The Coordinator would also be responsible to coordinate the implementation of the measures listed in this plan.

Co-Benefits

- Financial Savings for Keene
- Ensures completion of CCP Campaign and achievement of emissions reduction target
- Showcases Keene as an environmental steward in the community and the State

Success Stories

- The city of Somerville, MA employs a full-time Environmental Coordinator
- The City of Medford, MA employs a part-time Energy Efficiency Coordinator

I. Climate Change Outreach and Education

A. School Partnerships

Keene should partner with public and private schools and existing local environmental education programs that have strong partnerships with schools and community organizations. Possible partner environmental education organizations are the Rachel Marshall Outdoor Learning Lab of Antioch New England Institute, Harris Center for Conservation Education, Stonewall Farm, and various after school programs. These partnerships will aid in the development and implementation of an education program on climate change that could be incorporated into the public school curriculum. The city has the opportunity to engage students or youth in solving the real-life problem of global warming by involving them in the measures outlined in the CCP plan. If incorporated into school curriculum, students will be fulfilling educational requirements while addressing the measures outlined in the CCP. Programs in school could incorporate hands-on learning projects such as monitoring light usage in school or monitoring automobile usage at home. Keene should also offer support in terms of grant writing and pursuing funding opportunities such as the "Human-I-tees" and "Schools Go Green" grants that are available for environmentally oriented projects. Keene should also encourage partnerships among organizations such as Clean Air-Cool Planet, local schools and Universities.

Building outreach and awareness of climate change can also extend beyond the classroom. In this respect, resources that provide information on specific climate change issues with a focus on positive solutions could be compiled for all Keene residents. This may include public displays, informational booths at local events, public forums, press coverage, and citizen participation in the CCP process. Such outreach activities are instrumental for generating interest in Keene's involvement with climate change efforts.

While greenhouse gas emissions reductions that might result from this measure are not easily quantified, continued efforts to expand a climate change education and outreach program will have a significant impact. The administration of such a program could become the responsibility of the Energy/Efficiency Coordinator.

B. Climate Change Outreach – The Musical

Climate Change—The Musical! (CCTM!) is a two-part program designed to help audiences identify and embrace constructive climate change actions in their own homes and institutions. The first part is a short musical drama. The second part is the Bridge to Action, which helps the audience learn about the resources and actions available in their own community.

The program has been developed by Larry Siegel, a well-known composer and producer in the Keene area. The original idea came from staff in the Keene City Planning Office and was developed by a collaboration of scientists, educators, environmentalists, and business people in partnership with the New England Science Center Collaborative.

It is proposed that the city host six productions of the two-part program. The Bridge to Action will be tailored to Keene's Climate Change Protection Plan. Participants in the program will come away with:

- understanding the goals of the Keene Climate Change Protection Plan;
- understanding the strategies of the Plan;
- knowledge of the participants in the Plan;
- access to key resources in the community;
- commitment to personal and institutional change;
- ability and incentive to enlist in the 10% Challenge and other targeted emission reduction programs.

The city should co-sponsor, with leading businesses, productions in Keene middle and high schools, Keene State College, Antioch New England, and a public setting. Six productions could reach approximately 1,000 households in Keene, raising public awareness of the Climate Change Protection Plan and enlisting homes and institutions in its emission-reduction measures. This measure specifically supports and helps achieve the 10% Challenge listed in a previous measure. The potential emission reductions are quantified and accounted for in that measure. The Bridge to Action will also generate emission reductions at institutions, which host the production.

Effective climate change action is occurring at the local level. *CCTM!* is designed to stimulate and enable local action. This program will cost the City approximately \$10,000.

C. 10% Challenge

The City of Keene will implement a 10% Challenge Campaign to all Residents, Businesses and City Employees as part of the Climate Change Education and Outreach. These measures can be found on pages 17, 46, 55 and 64. This is a Challenge to the community to reduce their energy and transportation use by 10%. Residents and businesses would be recognized and given awards for their achievements. The Energy Efficiency Coordinator would be responsible for working with community members to support their efforts. Approximately \$5,000 would be spent in educational materials for the campaign.

CHAPTER 4

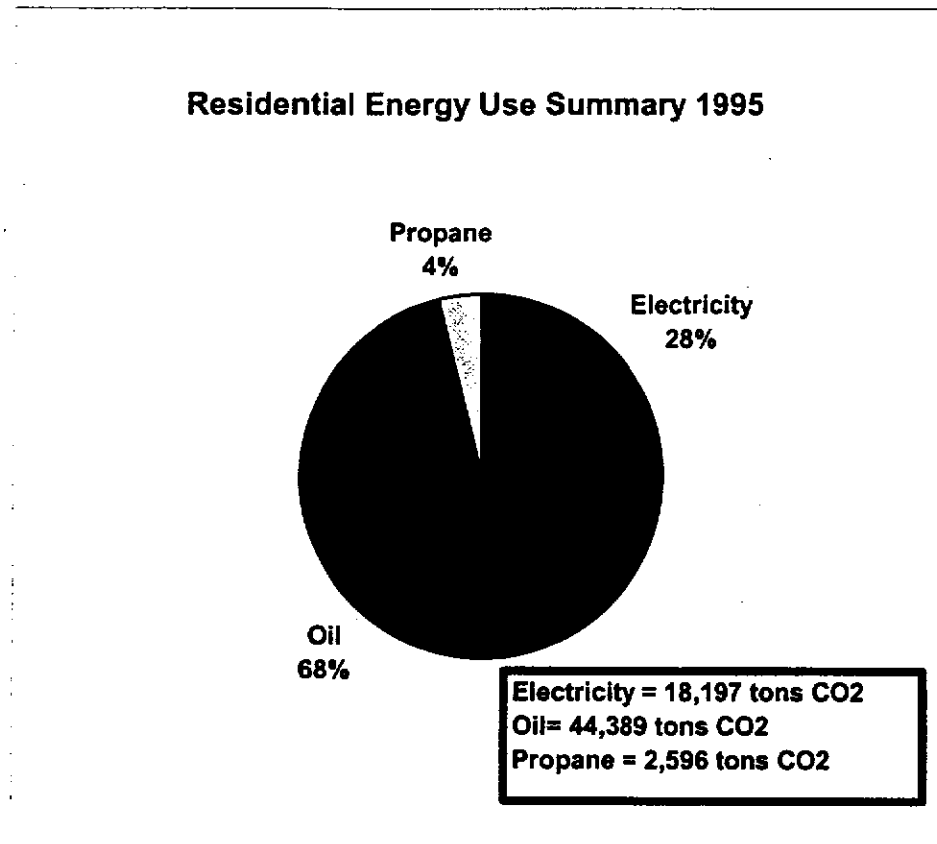
Residential Opportunities

Many daily household activities are directly related to the emissions of greenhouse gases and therefore to the threat of global climate change. The most direct link between household activities and the emissions of greenhouse gases is energy use. Investments in energy efficiency, which often save money and improve comfort, offer a powerful means for combating global climate change and other environmental impacts.

A. RESIDENTIAL ENERGY USE

The major household energy users and emitters of greenhouse gases are space heating, water heating, lighting and appliances. Residential energy use accounts for 31 percent of total community greenhouse gas emissions. In Keene, space heating is generally the largest user. Many technologies and services on the market today can help reduce your energy consumption, save money, and reduce greenhouse gas emissions. So can some simple changes in your daily practices. The following chart is a summary of CO₂ emissions from residential buildings by fuel type. It is evident that residential oil use constitutes the majority of CO₂ emissions.

Figure 6



1. Making a Household Action Plan

The Keene Climate Protection Committee is encouraging residents, businesses and institutions throughout the city to develop individual climate protection action plans. There are three basic steps to creating such a plan:

1. Use energy bills and other information on household activities to estimate your annual emissions of greenhouse gases.
2. Identify changes or investments that you can make over the next year to reduce emissions.
3. Track your progress.

If you have access to the Worldwide Web (one computer is available at the Keene Public Library for public use), you can use the personal CO₂ calculator provided by the International Council for Local Environmental Initiatives at www.iclei.org/iclei/co2calc.htm. The calculator is easy to use, but to answer its questions you will need to have information ready about your utility bills and your yearly gasoline consumption. After calculating your household's current emissions, you can set a greenhouse gas reduction target. The city's goal is to reduce emissions by 10 percent by 2015, but you may decide to choose a higher or lower figure. The following measures will reduce **49,361 tons** of CO₂ and save the community **\$3,008,504 annually**.

Alternative Energy Supplies for Residents

Solar energy reaches your roof-top every day, and you can take advantage of it. In Burlington, solar hot water and photovoltaic (PV) technologies are usually the most feasible options for home renewable energy systems. Investing in a renewable system will provide you with clean, reliable, affordable energy for years to come.

PV Systems

Photovoltaic systems produce electricity directly from sunlight. They can be tied directly to the utility grid, and they can power regular home appliances. They can also be used to charge battery banks or directly power your household in case of a utility power outage. By reducing consumption of conventionally produced electric power, each kilowatt of PV power installed in Burlington will prevent roughly 24 tons of greenhouse gas emissions over 20 years.

Solar Hot Water

Water heating is typically the second largest household energy cost. These systems also use a conventional fuel for backup—so you'll always have hot water, even when the sun isn't shining. In Keene, a new solar hot water heater will typically provide between 60 and 70 percent of a household's needs. By installing a solar water heater, a family of four, using an average of 80 gallons of hot water per day, can prevent 3,700 pounds of greenhouse gas emissions each year. Over 20 years, that adds up to 37 tons of emissions prevented!

B. RESIDENTIAL WASTE SECTOR

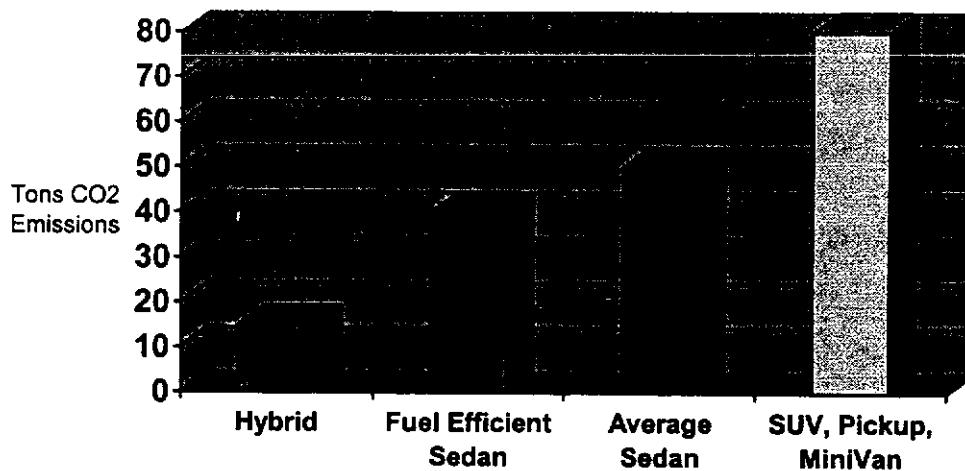
There are two main impacts on climate change from the generation of solid waste, one direct and one indirect. The direct impact is due to the anaerobic decomposition of organic waste, which produces the greenhouse gas methane. Households that produce significant amounts of organic waste, such as food and paper waste, can help reduce this by composting (in the case of food waste) and trying to buy in bulk and recycling their paper products. The indirect link to climate change has to do with embodied energy, which is the energy (and

subsequent CO₂) needed to produce the raw materials required to manufacture a product. By recycling, and by purchasing products with that have minimal packaging, a household can cut down on this embodied energy. Recycled products can reduce by as much as 75 percent the amount of energy required to produce a product. One conservative estimate is that every ton of recycled waste prevents 1,000 pounds of CO₂.

C. RESIDENTIAL TRANSPORTATION

For those who regularly drive a private vehicle, there are many personal transportation choices you can take to reduce greenhouse gas emissions. Depending on your situation, these include strategies for decreasing car-trips such as ridesharing, walking, biking, telecommuting, and the use of public transportation. You can also decide to drive a more fuel-efficient vehicle. A simple rule of thumb is that each gallon of gasoline that you can save prevents approximately 20 pounds of carbon dioxide emissions. Driving more efficient vehicles also has a tremendous potential for reducing emissions. Over a vehicle lifetime of 120,000 miles, a sport utility vehicle, pickup truck or mini-van with an average fuel efficiency of fifteen miles per gallon will emit more than 80 tons of carbon dioxide. Many of today's popular models have even lower fuel economy and will emit even more. In contrast, a typical mid-sized sedan or medium station wagon with average fuel efficiency of twenty-three miles per gallon will produce around 50 tons of carbon dioxide over its lifetime. Fuel-efficient cars (thirty-two miles per gallon) reduce emissions over the same number of miles to less than 40 tons.

Comparative CO₂ Emissions
(12,000 mile vehicle use)



1. Four Simple Ways to Cut Car Emissions

1. By making sure your tires are fully inflated, you can save up to 220 pounds of CO₂ per year.
2. Keeping your engine tuned can save up to one ton of CO₂ per year.

3. Don't let your engine idle. Restarting uses less energy than idling (even for 20 seconds).
4. Drive a fuel-efficient car!

A Multiplier Effect

How, you might ask, could a gallon of gasoline weighing somewhat less than 8.3 pounds (the weight of a gallon of water), can create 20 pounds of CO₂? The answer is that much of the carbon dioxide's molecular weight comes from the atmosphere in the form of oxygen. More specifically, carbon has a molecular weight of 12, and oxygen a molecular weight of 16. Therefore, when a gallon of gasoline, which is mostly made up of carbon molecules, is burned it is possible to generate an amount of carbon dioxide that is roughly 3 times greater (on a mass basis) than the original unit of fuel.

D. THE CITY OF KEENE CHALLENGES THE COMMUNITY TO REDUCE THEIR CO₂ EMISSIONS!

Measures the City Will Take:

Work with PSNH on Increasing the Number of Energy Audits Available to Homeowners

Explore Improving Building Codes for New Development

Pilot Program in Conjunction with EPA Energy Star

Rebuild America Partnership

10% Community Challenge Outreach Campaign

E. HERE IS A LIST OF 10 THINGS YOU CAN DO!

The Ten Things Individuals Can Do to Reduce CO₂ & Save Money:

1. **Look for the Energy Star label** when buying new home appliances, lighting products, electronic and home office equipment.
2. **Drive less.** With every gallon of gas it burns, a car's engine emits 20 pounds of carbon dioxide. Share rides, ride the bus, bike or walk.
3. **Buy a fuel-efficient vehicle.** Use a vehicle that gets 30-plus miles per gallon, especially for your most frequent driving tasks, such as the daily commute.
4. **Reduce, reuse, recycle.** Managing your household consumption patterns can significantly save on resources and energy. Most of the materials in our lives take energy to produce. You can reduce your consumption of them by using canvas shopping bags, recycling and looking for creative ways to reuse items.
5. **Improve your home's energy efficiency.** Efficiency measures can be major involving your heating system, insulation, windows, appliances and water heaters-or more modest, with electricity- saving lamps, lighting fixtures and low-flow faucets. The benefits include improved comfort, lower energy bills and fewer emissions.
6. **Invest in renewable energy.** You can use the sun's free energy to produce electricity, or to help reduce your household's fossil fuel consumption. By

reducing your consumption of conventional fuels, solar electric and solar hot water systems can reduce your emissions of greenhouse gases and other air pollutants.

7. Turn off and set back. Keep a sharp eye out for chances to turn off unused lights, TVs, stereos and home office equipment. Turn back the temperature on your water heater to 120 degrees, and set back your thermostats as much as comfort allows.

8. Support climate-friendly products and services. When shopping look for recycled content, minimized packaging, and climate neutral products.

9. Support local agriculture. Take advantage of farmers' markets, community-supported agriculture and other ways of buying from local farmers. The closer your food is grown, the less fuel is burned in getting it to you. There are also the advantages of freshness, fun, and strengthening your community.

10. Participate! Encourage your friends and associates to support climate protection activities. Schools, faith-based groups and other community-based organizations can help to motivate broader community involvement. Support national, state and local groups that are working for climate protection. Participate in local utility and community efforts to protect the climate.

F. RESIDENTIAL CHALLENGE

Often, the steps individuals can take to help protect the environment are not clear. The next few pages illustrate different measures that households can take to reduce greenhouse gas emissions. The good news is that there are many options to select from, and good resources are available to help you make the right choices. **The greatest news is that by reducing your energy consumption, you can save a ton of MONEY!**

The City of Keene challenges the community to reduce their greenhouse gas emissions by 10%! Please take on this challenge to reduce greenhouse gas emissions and protect our New Hampshire way of life.

Future Measures in Residential Energy Sector

1. Use of Compact Fluorescent Light Bulbs in Residences

Measure Status: Proposed

Responsible Department: PSNH & CCP Coordinator

CO₂ Savings: **429 tons**

Annual Financial Savings: **\$194,750**

This measure evaluates the impact of Keene residents converting conventional incandescent light bulbs to compact fluorescents for their home lighting needs. Incandescent light bulbs waste a lot of electricity through the heat that the bulbs produce. A fluorescent bulb produces much less heat and as a result can be four to six times as efficient as incandescent bulbs. A 15-watt compact fluorescent provides the same amount of light as a 60-watt incandescent. In addition, compact fluorescents last at least nine to ten times longer than an incandescent. Approximately 9% of a home's energy budget is used for lighting. Collectively, Americans could save \$750 million if everyone switched to compact fluorescents. If Keene residents converted their light bulbs to compact fluorescent, it could result in the elimination of 429 tons of CO₂ and \$194,750 in annual financial savings. Please visit PSNH's web site: <https://online.psnh.com/smartliving> or call the Planning Department at 352-5474 to get you a paper copy of the catalogue.

- Life-cycle cost comparison of incandescent vs. compact fluorescent: For 10,000-hour life, ten 60-watt incandescent bulbs cost \$5 to purchase and have an estimated energy cost of \$36 for a total cost of \$41. For a 10,000-hour life, one 15-watt compact fluorescent costs \$14 to purchase and has an energy cost of \$9 for a total cost of \$23. (Source <http://www.mge.com/business/saving/lighting.htm>)
- Payback: 1.1 year for purchase of compact fluorescent bulb.

Co-Benefits

- Financial savings for residents
- Light bulbs last longer than conventional bulbs, saves time and money spent replacing burnt-out bulbs
- Compact fluorescents operate at a lower temperature than incandescent bulbs; can help to lower cooling costs.

Success Stories

- Harmony Library in Fort Collins, CO installed 26-watt Energy Star compact fluorescents in place of 75-watt incandescent bulbs. The project saves \$12,000 in annual operating costs.

Future Measures in Residential Energy Sector
2. 10% Challenge
Residential Energy Efficiency Program

Measure Status: Proposed
Responsible Department: Buildings, CCP Coordinator
CO₂ Savings: **7,314 tons**
Annual Financial Savings: **\$1,402,887**

This measure seeks to achieve a 10% reduction in home energy consumption with the implementation of a residential energy conservation program. The City of Keene could develop a residential energy efficiency program that supported programs already set in place by local utilities such as PSNH. PSNH has a variety of programs to promote energy efficiency that offer free energy audits and rebates for energy efficient retrofits and appliances. Keene could develop an energy education and outreach program for citizens and schoolchildren that advocate energy conservation and involvement in PSNH's residential programs. The program could involve the creation of informational material and workshops that outline available resources, contacts and strategies for energy conservation. The City would also work with resident's to reduce their oil and gas usage by 10%. If residential energy efficiency program resulted in a 10% decrease in energy consumption in Keene residences, 7,314 tons of CO₂ would be eliminated and an annual financial savings of \$1,402,887 could be achieved.

- Implementation of program cost: \$2,500 for educational materials and coordination of workshops. Accounted for in Municipal Sector.
- Payback: 0 years

Co-Benefits

- Creates market for renewable energy
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Promotes local and independent sources of electricity
- Decreases dependency on foreign fossil fuel resources
- Saves on utility bills, reduces vulnerability to fuel price spikes

Success Stories

- The City of Ashland, OR has a wide variety of residential conservation programs that include: Free home energy analysis, zero – interest loan programs for energy retrofits and rebate programs for water heaters and energy efficient appliances.

Future Measures in the Residential Energy Sector

3. Residential Use of Solar Hot Water Heating

Measure Status: Proposed

Responsible Department: Buildings, CCP Coordinator

CO₂ Savings: **134 tons**

Annual Financial Savings: **\$60,589**

In New Hampshire, solar water heating systems can cut the average family's water heating electricity use by 40-60%. Water heating accounts for about 14% of the average family's home energy consumption. A solar hot water heating system collects thermal energy from the sun to heat the water used to take showers, wash dishes and clean laundry. After a heat transfer fluid runs through pipes in the rooftop panels and is heated by the sun's rays, the fluid is pumped down to a heat exchanger where it warms household water. If 10% of residences in Keene installed solar hot water heating systems, 134 tons of CO₂ could be eliminated and \$60,589 could be saved due to reduced electricity consumption.

Methodology used to calculate this measure assumes electric hot water heating system.

- Average installation cost of solar hot water heating system \$5,000
- Installation cost for 977 solar hot water heating systems: \$4,884,500
- Before solar 932,136.4882 kwh used to heat water
- After solar, 50% of this generated by solar: 466,068.2441 kwh
- Therefore, 466,068 kwh are being displaced
- Financial savings from reduced electricity consumption \$60,589
- Payback: Immediate

Co-Benefits

- Creates market for renewable energy
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Promotes local and independent sources of electricity
- Decreases dependency on foreign fossil fuel resources
- Saves on utility bills, reduces vulnerability to fuel price spikes

Success Stories

- The installation of a 150-galolon solar hot water heating system installed on a house in Natick, MA resulted in an annual emissions offset of 1.5 tons of CO₂

Future Measures in the Residential Energy Sector

4. Lobby for Increased Renewable Portfolio Standard (RPS)

Measure Status: Proposed
Responsible Department: CCP Coordinator
CO₂ Savings: 1,907 tons

Another option that New Hampshire consumers have is to lobby for a Renewable Portfolio Standard (RPS). An RPS is a regulation that requires states to mandate that a percentage of any utility's total electricity production come from renewable sources. An RPS is desirable because it means that all citizens would start receiving some of their electricity from clean energy sources, not just those who are willing or able to pay more for renewable energy. The city of Keene will lobby for an RPS to be established in New Hampshire starting at 1% in 2004 and rising to 5% in 2010. After 2010 the RPS will increase annually by 1%. Therefore, in 2015 the RPS will be at 10%. The calculations used to determine the impact of this measure take 10% of the amount of the electricity forecast to be used in each sector in 2015 and replace it with green electricity. The extra \$133,162 spent on green electricity is clearly justified by the large amounts of money saved in other energy conservation measures. This measure would receive the support of Keene homeowners and illustrates the reductions in CO₂ that would occur in the residential sector only.

Co-Benefits

- Continued diversification of services provided by utility provider stimulates market for renewable energy in New Hampshire
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Promotes local and independent sources of electricity
- Decreases dependency on foreign fossil fuel resources
- The development of domestic renewable energy will keep energy dollars in the United States and create jobs

Success Stories

- The State of Maine became the first state to adopt a renewable portfolio standard when the state enacted restructuring legislation in 1997. The 30% RPS, the highest in the nation, reflects the state's plentiful renewable resource base and state policies to utilize that resource base.

Existing Measures in the Residential Waste Sector

1. Recycling Outreach Program

Measure Status: Existing

Responsible Department: Public Works

CO₂ Savings in 2015: **12,927 tons**

Financial Savings: **\$1,292,700**

In 1993, the City of Keene opened a transfer station in order to recycle a percentage of its solid waste in response to the closure of the Keene Landfill. Recycling rates were minimal in the beginning so the City adopted a Solid Waste Plan, which encouraged the recycling of all products the transfer station could process. This expansion began in 1995. Paper, tin, aluminum, plastics, cardboards and glass were expanded in this recycling program. It costs \$117 per ton to throw away trash. It costs about \$17 per ton to recycle. This results in a savings of approximately \$100 per ton. This results in a savings of \$1,292,700.

- **Tin expansion:** In 1995, 100,000 pounds of Tin was recycled. The rate of recycling in 2001 was 374,120 pounds. This is a difference of 137.06 tons of tin.
- **Aluminum expansion:** In 1995, 29,068 pounds of aluminum was recycled. The rate of recycling in 2001 was 61,400 pounds. This is a difference of 16 tons of aluminum.
- **Glass expansion:** In 1995, 634,460 pounds of glass was recycled. The rate of recycling in 2001 was 1,632,860 pounds. This is a difference of 499 tons of glass.
- **Cardboard expansion:** In 1995, 1,796,392 pounds of Cardboard was recycled. The rate of recycling in 2001 was 6,411,810 pounds of cardboard. This is a difference of 2,308 tons of cardboard.
- **Plastic expansion:** In 1995, 127,160 pounds of plastic were recycled. In 2001 the rate of recycling was 366,270 pounds. This is a difference of 119 tons of plastic.
- **Paper expansion:** In 1995 875,258 pounds of mixed paper was recycled. The rate of recycling in 2001 was 3,863, 240 pounds. This is a difference of 1,494 tons of mixed general paper.

Existing & Future Measures in the Residential Waste Sector
2. Solid Waste Ordinance Update
Multi-Unit Outreach Program

Measure Status: Proposed
Responsible Department: Public Works
CO₂ Savings in 2015: **148 tons**
Financial Savings: **\$14,800**

The City Council passed Ordinance 0-99-14-A effective March 1, 2000, which amended several procedures for solid waste and recycling collection in the City of Keene. The amendments and impacts are as follows:

Amendment #1- Amend- Section 3201.0, Definitions

The new definitions of Commercial and Residential Refuse are as follows:

Commercial Refuse: Discarded waste materials in a solid state from any commercial or industrial source, including multi-unit dwellings such as multi-family dwellings and condominium dwellings, with more than five (5) physically attached dwelling units.

Residential Refuse: Discarded non-recyclable waste materials in a solid state from any residential dwelling including single-family dwellings and multi-unit dwellings (apartment and condominium dwellings with five (5) or fewer physically attached dwelling units and mobile home subdivisions) whether or not under common ownership or configured on a common site in accordance with a condominium declaration.

Impact of Amendment #1-

Requires permitted haulers to extend recycling services to apartment complexes with five or fewer physically attached units, condominium complexes and mobile home parks. Participation in the recycling program by the occupant of the dwelling is not mandatory, but the permitted hauler is required to provide access to recycling collection services.

Amendment #2- Amend- Section 3208.1 Permits for Residential Private Contractors

The following permit terms are now in effect:

3208.1 PERMITS FOR RESIDENTIAL PRIVATE CONTRACTORS.
Effective July 1, 1999, any individual, firm, partnership, joint venture, corporation or association performing refuse/recycling collection and disposal for more than 1 family for a collection service fee within the City limits must obtain a permit to

operate from the Public Works Department. The cost of the permit shall be \$15 annually (non pro-rated beginning July 1 of each year). The terms of the permit include:

Term 1: Provide customers with a fixed rate to provide collection services. The fixed rate to provide collection services will include the cost of recycling collection. Provide a unit based pricing rate schedule for refuse disposal measured by volume or weight. Customers must be offered a unit price rate for refuse disposal set in volume increments of 33 gallons or weight increments of 20 pounds. Such rate shall be for disposal of residential refuse collected in the City of Keene. The schedule may show other rates charged for special pickups such as bulky waste.

Term 2: *The permittee is required to provide collection services for Recyclables including, but not limited to glass food and beverage containers, steel cans, aluminum cans, aluminum foil, HDPE #2 (High Density Polyethylene) and PETE #1 (Polyethylene Terephthalate) plastics, newspapers, mixed paper (including magazines, catalogs, junk mail, envelopes, stationary, computer paper, office paper and boxboard), paper bags, corrugated cardboard, and used clothing.*

The rate schedule for a Residential Private Contractor shall be filed with the Public Works Director not later than December 1 of each year and shall be effective January 1 to December 31 of each year.

Impact of Amendment #2-

Requires permitted haulers to bill for solid waste disposal on a per unit basis measured in increments of 20 pounds or 33 gallons. Costs for waste disposal cannot be included in the base fee. The base fee should be the cost to provide the service without any disposal cost. For example, the following price structure would comply with the terms of the ordinance (this example is for illustration purposes only, it has no basis in actual costs you might incur):

<u>Service</u>	<u>Cost per Month</u>
Collection of refuse and recycling (base fee)	\$25
Disposal of refuse (per 20 pounds or 33 gallon bag)	\$ 2
Disposal of recycling	\$ 0

The cost of collection remains constant; however, the cost of disposal is variable. The more waste generated, the more the cost of disposal.

The changes in the ordinance will increase the availability of recycling to Keene

residents as well as charge residents for waste disposal based on the amount of waste generated. Access to recycling in addition to economic incentives to reduce waste, will help the City achieve its goal of 50% waste diversion.

Follow-Up Measure: Expand recycling by 100 units per year for multi-unit dwellings, such as multi-family dwellings and condominium dwellings, with more than five (5) physically attached dwelling units.

The City of Keene, in cooperation with Waste Management of New Hampshire, is conducting a recycling pilot project at a 50-unit apartment complex in Keene. If successful, multi-family dwelling recycling could be expanded to include a greater number of the approximately 1,865 units not currently covered by the Solid Waste Ordinance. . It costs \$117 per ton to throw away trash. It costs about \$17 per ton to recycle. This results in a savings of approximately \$100 per ton. This results in a savings of \$1,292,700.

100 units x 2.5 persons/unit x 1,022 lbs. waste generated per year x 35% estimated diversion rate = 44.7 tons waste diversion per year for each 100 units added.

Co-Benefits

- Saves tax payer dollars
- Reduces methane emissions
- Encourages lower markets to reduce packaging on consumer products

Success Stories

From 1990 to 1995, Mount Vernon, Iowa's Pay As You Throw program cut the amount of trash sent to the landfill by 40 percent almost doubled the recycling rate and virtually eliminated disposal of yard waste.

Existing & Future Achievements in the Residential Waste Sector

3. Backyard Composting Program

Measure Status: Existing
Responsible Department: MSW
CO₂ Savings in 2015: **359**
Financial Savings: **\$42,003**

Since 1993 the City of Keene Department of Public Works- Solid Waste Division has been selling compost bins to residents as a reduced rate. Approximately 1,350 bins have been purchased since program inception. Of the 1,350 bins purchased, it is estimated that 60%, or 810 bins, have been purchased by City of Keene residents. The City had been burying its biosolids in the landfill as late as 1999.

The City of Keene has a population of approximately 23,000. There are approximately 5,300 single-family dwellings and 3,760 multi-family units (average 2.5 persons per dwelling). The average resident produces 1,022 lbs. of solid waste per year (source: City of Keene Solid Waste Plan 1997), which includes 184 lbs. of yard trimmings and 72 lbs. of food waste (2,116 tons yard waste, 828 tons food waste per year).

It is estimated that 80% of the 810 backyard compost bins sold to Keene residents are from single-family dwellings. It is further estimated that the diversion rate for yard trimmings and food waste in single-family dwellings that have purchased compost bins is 50%, and the diversion rate for yard trimmings and food waste in multi-family dwellings is 25%. **Therefore, the current diversion of yard waste and food waste is approximately 117 tons per year** through the backyard composting program (648 bins sold to single-family dwellings x 2.5 persons/dwelling x 128 lbs. organics diverted/person/year = 104 tons per year, 162 bins sold to multi-family units x 2.5 person/unit x 64 lbs. organics diverted/person/year = 13 tons per year).

Follow-Up Measure: Sell 100 bins/year to Keene residents for the next 10 years

At the end of 10 years the diversion rate would be as follows:

1,810 backyard compost bins sold (1993-2012). Assuming no population growth, and no increase in waste generation, the diversion rate of yard waste and food waste would be approximately 261 tons per year.

It costs \$117 per ton to throw away trash. This cost is avoided with composting.

Future Measures in Community Transportation Sector

1. Lobby for Increased CAFÉ Standards

Measure Status: Proposed

Responsible Department: CCP Coordinator

CO₂ Savings in 2015: **19,632 tons**

This measure evaluates the impact of lobbying for increased CAFÉ (Corporate Average Fuel Economy) standards. The fuel economy of the average new passenger vehicle peaked in 1988 and is now less than it was 10 years ago. The stagnation of CAFÉ standards since 1985, doubling of the annual vehicle miles traveled in the last 25 years and the recent explosion of SUV and light truck sales have eaten away at the nation's fuel efficiency. To reverse these trends and provide benefits to consumers and the environment, fuel economy standards need to be increased to over 40 mpg by 2010 and 55 mpg by 2020.

A fleet of cars and light trucks that reach 40 mpg will cost consumers only about \$1,00 to \$2,000 extra per vehicle. However the \$2,500 to \$5,300 saved on fuel over the life of the vehicle will more than compensate the consumer.

Co-Benefits

- Cost Savings to Citizens
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Decreases dependency on foreign fossil fuel resources
- Encourages innovation and energy efficient technology from automakers, creates new jobs in the automotive industry.

Success Stories

- Raising the CAFÉ standards to 45 mpg for cars and 35 mpg for light trucks would save the United States over \$200 billion in petroleum costs over the next ten years, and would save American families about \$590 annually, for a net savings of \$60 billion per year, according to a 1998 Surface Transportation Policy Project.

Future Measures in Residential Transportation Sector
2. 10% Challenge
Residential Transportation Program

Measure Status: Proposed
Responsible Department: CCP Coordinator
CO₂ Savings: **6,511 tons**
Annual Financial Savings: **\$7,756**

This measure seeks to achieve a 10% reduction in residential transportation emissions with the implementation of a residential transportation conservation program. The City of Keene could develop a residential transportation efficiency program in conjunction with the residential energy efficiency program listed earlier. Keene could develop a transportation education and outreach program for citizens and schoolchildren that advocate public transit, ride sharing, multiple trips, biking, walking and the importance of buying or leasing vehicles that achieve good gas mileage. The program could involve the creation of informational material and workshops that outline available resources, contacts and strategies for gasoline conservation. If the residential transportation efficiency program resulted in a 10% decrease in carbon dioxide emissions for Keene residences, 6,511 tons of CO₂ would be eliminated and an annual financial savings of \$7,756 could be achieved after payback period.

- Implementation of program cost: \$2,500 for educational materials and coordination of workshops. This is accounted for in Municipal sector.
- Payback: Immediate

CHAPTER 5

Commercial & Industrial Opportunities

A. ENERGY OPPORTUNITIES FOR BUSINESSES

1. Reduced annual operating and maintenance costs
2. Improved productivity
3. Tax Benefits
4. Reduced risk
5. Increased customer/client comfort
6. Marketing benefits

1. Climate Protection and Profits

Businesses today can choose among an extensive set of resource and energy efficiency strategies that simultaneously improve profitability, reduce risk and create significant environmental benefits. Climate protection measures can increase profits by these means:

- **Reduced annual operating costs.** Example: For a business with a 5 percent pre-tax profit margin, an annual savings of \$600 on energy costs has the same impact on the bottom line as increasing sales by \$12,000 annually.
- **Improved productivity.** Many energy efficiency projects result in enhanced comfort and improved lighting quality. Given the relatively high cost of labor, even small increases in worker productivity and comfort can translate into large returns.
- **Reductions in operations and maintenance.** Many of today's energy efficient technologies reduce maintenance and non-energy operating expenses—savings that are directly apparent in the bottom-line.
- **Reduced risk.** Strategic investments in energy efficiency and renewable energy systems can significantly reduce or even eliminate certain aspects of business risk. These include escalation and volatility of energy costs, loss of power and associated revenues through utility power interruptions, improved building performance, and work stoppage due to unexpected equipment failures.
- **Increased customer/client comfort.** For retail and other direct client service industries, investments that improve customer comfort and lighting quality can improve ambience and may encourage customers to stop by more often and stay longer.
- **New marketing power.** Reviews of market research and literature have shown that support for environmentally friendly products is broad, and that consumer support for environmental improvements cuts across demographic profiles. Making a creditable and sustained commitment to reducing the environmental impacts of your business can generate positive publicity, and increase the appeal of your products to the "green" consumer.

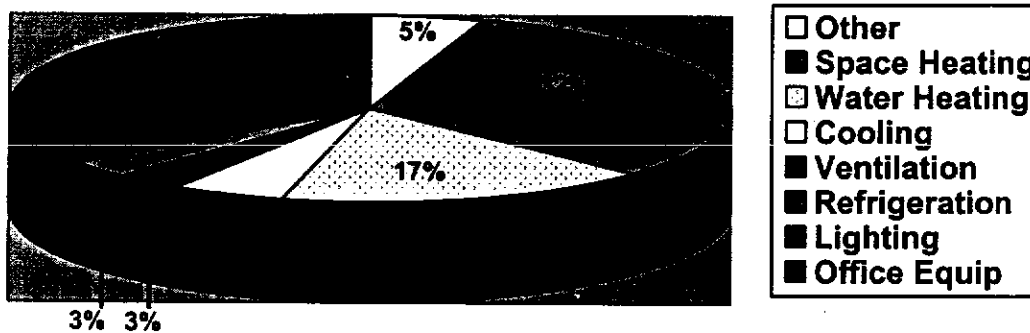
- **Tax benefits.** Investments in energy efficiency and renewable energy systems may be deductible as current-year expenses, rather than amortized and expensed over a period of several years. Check with your accountant about this and other tax benefits from climate protection investments that can improve your cash flow and reduce tax bills.

2. Commercial Energy Demands

In 2015, energy use by private and public businesses in Keene will account for approximately 33 percent of the city's projected emissions of greenhouse gases. Major commercial uses of energy include space heating, lighting, cooling and refrigeration. For an individual business, the type and amount of energy used, and the resulting emissions, vary widely depending upon the primary business activity, the vintages of equipment and the size of the facility. The chart below shows an example of the greenhouse gas emissions by a small office space in Keene. There are many technologies, services and resources on the market Today that can help businesses identify investments and operational changes that will reduce energy consumption and greenhouse gas emissions while improving competitiveness and profitability. The next section will help your business get started

Figure 7

Sample Office CO2 Emissions Annual Total 77,357 lbs.



3. TAKING ACTION

a. The Initial Assessment

During the early stages of developing a climate protection strategy, it can help to get an approximate idea of how your business's annual energy usage patterns compare to similar businesses. In most cases, small businesses can expect to save 10-50 percent on energy costs by implementing cost-effective efficiency measures. Even businesses that have already instituted energy saving measures are likely to identify additional climate protection opportunities that can bring new cost savings. A number of other service providers and resources are available to help you identify and implement cost-effective measures. Commercial customers

are eligible to receive assistance from the Public Service of New Hampshire. Initial energy audits and incentives are also available for some efficiency measures. Lighting and HVAC contractors, as well as equipment dealers and manufacturer representatives, can recommend efficiency upgrades and can estimate project costs and savings. The EPA maintains a directory of commercial Energy Star allies and products, and provides free technical telephone assistance (1-888-STAR-YES). Energy service companies (ESCO's) can provide comprehensive "turnkey" proposals for energy efficiency and equipment upgrades. They often use the realized energy savings to finance some or all of the efficiency upgrades.

b. Implementation

The fundamental components of most energy efficiency projects are management, financing and installation. It is possible to hire subcontractors for some or all of these responsibilities. The best strategy usually depends upon factors such as the size of the project, time availability and in-house expertise.

A rule of thumb cited in the EPA's Energy Star Small Business Guide is to expect that project management require three to ten percent of a project's total capital budget. This will include time spent on soliciting and evaluating project bids, preparing and/or approving installation contracts, and monitoring installation activities. Most projects should also develop a plan to monitor and verify savings. Project financing decisions will be based on the size of the investment required, cash flow and the firm's cost of capital. In addition to conventional loan sources, small businesses can also qualify to take advantage of loan enhancement products (such as loan guarantees) available from the Small Business Administration. Equipment suppliers are another potential source of project financing. Purchasing office equipment that has received the Energy Star designation is an easy way to lower your bills and reduce greenhouse gas emissions. Energy Star office equipment listed in the following table includes power-down features that allow a device to "sleep" during extended periods of inactivity, thereby reducing energy consumption by 25 to 60 percent. If a typical office, including 10 computers, one fax machine, two printers and one medium-sized copier, were to replace its office equipment with Energy Star models, it would reduce its CO₂ emissions by 5,000 pounds per year. If 50 Keene offices this size were to upgrade their equipment to Energy Star models, the total annual CO₂ reductions would equal 125 tons.

Energy Star Office Equipment Energy Savings and CO₂ Reductions

	Typical Annual kWh Savings per Device	Annual CO ₂ Emissions Reduced (lbs.) per Device
Computer	190	280
Fax Machine	130	190
Printer	390	580
Large Copier	1,300	1,900
Medium Copier	570	840

4. Renewable Energy Supplies

Renewable energy systems are a great way to demonstrate your commitment to environmental protection, help to educate the public about solar technologies, reduce your emissions of greenhouse gases, and cut your spending on conventional fuels. Systems can also be designed to provide you with backup power—and can provide an important degree of risk management for critical loads in case of temporary grid power outages. Investing in a renewable energy system can provide your business with clean, reliable, affordable energy for years to come. Solar hot water heaters for commercial applications can often provide better customer economics than residential-sized systems, due to economies of scale. Depending upon your type of business, water heating may represent a significant share of your annual energy bills. Solar collectors use the sun's free energy to heat your water, reduce your energy bills and reduce greenhouse gas emissions. Most systems use a conventional fuel for backup, to guarantee your hot water supply. Photovoltaic systems produce electricity directly from sunlight. They can be tied directly to the existing utility grid, and can power regular electronic loads. They can also be used to charge battery banks, or to feed your business directly in case of a utility power outage. By reducing consumption of conventionally produced electric power, each kilowatt of PV power installed in Keene prevents roughly 20 tons of greenhouse gas emissions over 20 years.

B. TRANSPORTATION OPPORTUNITIES FOR BUSINESSES

Significant opportunities exist for businesses to reduce greenhouse gas emissions caused by transportation. Virtually every aspect of a business operation can use strategies that will positively impact the bottom-line and the environment. In a recent publication the International Council For Local Environmental Initiatives (ICLEI), several business strategies for transportation efficiency were identified:

Managing the company fleet

- Increase the vehicle efficiency
- Modify vehicle procurement specifications
- Downsize vehicle fleet

Moving inventory

- Optimize routing
- Reduce truck idling
- Offer financial incentives for efficient fleet operation

Getting employees to the work place

- Subsidize employee transit passes
- Start a guaranteed ride home program
- Match up employees interested in ride-sharing

Providing employee parking

- Provide preferential parking for car-pools
- Provide financial incentives for car-pooling
- Initiate parking fees

Using information technologies

- Allow telecommuting options
- Establish satellite offices
- Conduct business by teleconferencing

Managing personnel

- Designate an employee transportation coordinator
- Stagger work hours
- Allow flex time

Planning facilities

- Build transit amenities
- Provide bicycle amenities (e.g., secured bike lockers and showers)
- Locate new business facilities in areas near housing and transit centers

C. SOLID WASTE OPPORTUNITIES FOR BUSINESSES

There are two main impacts on climate change from the generation of solid waste, one direct and one indirect. The direct impact is due to the anaerobic decomposition of organic waste, which produces the greenhouse gas methane. Businesses that produce significant amounts of organic waste, such as food and paper waste, can help reduce this by composting (in the case of food waste) and simple waste reduction measures such as printing double-sided copies. The indirect link to climate change has to do with embodied energy, which is the energy (and subsequent CO₂) needed to produce the raw materials required to manufacture a product. By recycling, and by purchasing products with high-recycled content, a business can cut down on this embodied energy. Recycled products can reduce by as much as 75 percent the amount of energy required to produce a product. One conservative estimate is that every ton of recycled waste prevents 1,000 pounds of CO₂. Adopting management policies that require green or climate friendly purchasing wherever possible, along with conscientious use of office supplies as well as waste reduction in the lunchroom (providing reusable dishware and coffee mugs as well as recycling bins), can also lead to significant reductions.

1. Climate Neutral Products

Some visionary companies are starting to take their climate protection efforts to a new level by working on "climate neutral" products. Climate neutral status comes from eliminating or offsetting all greenhouse gas emission associated with a product's life cycle. Businesses usually achieve this through a combination of on-site activities (energy efficiency, waste reduction) and off-site activities (such as

sponsoring reforestation projects). In New Hampshire, for example, Stonyfield Farm is developing "climate neutral" yogurt, and other examples. By supporting and promoting the sales of products like this, local businesses can encourage climate protection while increasing their customers' awareness and improving their image as environmentally responsible.

D. THE BUSINESS CHALLENGE

The City of Keene is challenging businesses to reduce their CO2 output by 10% in each sector: **Energy, Waste and Transportation**. The measures listed below are ways that the commercial sector can achieve this challenge. Commercial energy use in Keene is responsible for roughly 36 percent of current total emissions and energy use. The following measures in the Commercial sector will reduce CO2 in 2015 by **24,012 tons** and saves the commercial sector **\$5,334,795 annually**.

Future Measures in Commercial/Industrial Energy Sector

1. Lobby for Increased Renewable Portfolio Standard (RPS)

Measure Status: Proposed
Responsible Department: CCP Coordinator
CO₂ Savings: **5,819 tons**

Another option that New Hampshire consumers have is to lobby for a Renewable Portfolio Standard (RPS). An RPS is a regulation that requires states to mandate that a percentage of any utility's total electricity production come from renewable sources. An RPS is desirable because it means that all citizens would start receiving some of their electricity from clean energy sources, not just those who are willing or able to pay more for renewable energy. The city of Keene will lobby for an RPS to be established in New Hampshire starting at 1% in 2004 and rising to 5% in 2010. After 2010 the RPS will increase annually by 1%. Therefore, in 2015 the RPS will be at 10%. The calculations used to determine the impact of this measure take 10% of the amount of the electricity forecast to be used in each sector in 2015 and replace it with green electricity. The extra \$609,328 spent on green electricity is clearly justified by the large amounts of money saved in other energy conservation measures. This measure would receive the support of the Keene business owners and illustrates the reductions in CO₂ that would occur in the commercial sector only.

Co-Benefits

- Continued diversification of services provided by utility provider stimulates market for renewable energy in New Hampshire
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Promotes local and independent sources of electricity
- Decreases dependency on foreign fossil fuel resources
- The development of domestic renewable energy will keep energy dollars in the United States and create jobs

Success Stories

- The State of Maine became the first state to adopt a renewable portfolio standard when the state enacted restructuring legislation in 1997. The 30% RPS, the highest in the nation, reflects the state's plentiful renewable resource base and state policies to utilize that resource base.

Future Measures in the Commercial/Industrial Energy Sector

2. Use of Compact Fluorescent Light Bulbs in Businesses & Industry

Measure Status: Proposed

Responsible Department: PSNH & CCP Coordinator

CO₂ Savings in 2015: **6,692 tons**

Annual Financial Savings: **\$2,802,912**

This measure evaluates the impact of Keene business owners converting conventional incandescent light bulbs to compact fluorescents for their office lighting needs. Incandescent light bulbs waste a lot of electricity through the heat that the bulbs produce. A fluorescent bulb produces much less heat and as a result can be four to six times as efficient as incandescent bulbs. A 15-watt compact fluorescent provides the same amount of light as a 60-watt incandescent. In addition, compact fluorescents last at least nine to ten times longer than an incandescent. If Keene businesses converted their light bulbs to compact fluorescent, it could result in the elimination of 6,692 tons of CO₂ and \$2,802,912 in annual financial savings.

- Life-cycle cost comparison of incandescent vs. compact fluorescent: For 10,000-hour life, ten 60-watt incandescent bulbs cost \$5 to purchase and have an estimated energy cost of \$36 for a total cost of \$41. For a 10,000-hour life, one 15-watt compact fluorescent costs \$14 to purchase and has an energy cost of \$9 for a total cost of \$23. (Source <http://www.mge.com/business/saving/lighting.htm>)
- Payback: 1.1 year for purchase of compact fluorescent bulb.

Co-Benefits

- Financial savings for businesses
- Light bulbs last longer than conventional bulbs, saves time and money spent replacing burnt-out bulbs
- Compact fluorescents operate at a lower temperature than incandescent bulbs; can help to lower cooling costs.

Success Stories

- Harmony Library in Fort Collins, CO installed 26-watt Energy Star compact fluorescents in place of 75-watt incandescent bulbs. The project saves \$12,000 in annual operating costs.

Future Measures in the Commercial/Industrial Energy Sector

3. Sustainable Business Program

Measure Status: Proposed

Responsible Department: Buildings, CCP Coordinator

CO₂ Savings: 7,001 tons

Annual Financial Savings: \$2,071,883

This measure creates a 10% challenge program to businesses in the Keene community. With this measure, Keene could issue a certification or award to businesses that initiate emissions reduction activities with regard to energy conservation or waste prevention. The award would serve as public recognition of the efforts of local businesses and industry to lessen the impact of their activities on the environment. This program will not only help local businesses save money through reduced energy consumption, but award will serve as advertising that will help attract new customers. If all businesses in Keene committed to a 10% reduction in energy consumption through the program, it would result in the elimination of 7,001 tons of CO₂ and financial savings of \$1,189,012.

- Cost of awards recognition materials: \$2,000
- 14,612,179.8 kwh electricity= 4,186 CO₂ Reduction = \$1,753,462
202,723.5 gallons oil = 2,232 CO₂ Reduction by 2015= \$218,333
66,415.4 therms propane = 482 CO₂ Reduction by 2015 = \$100,088
Financial Savings from energy conservation: \$2,071,883
- Payback: 0 years

Co-Benefits

- Serves as a form of advertising for business & industry
- Reduces air pollution emissions that contribute to visibility degradation and health problems
- Improves comfort in buildings
- Financial savings for business & industry
- Businesses gain competitive advantage, attract new customers, enhance customer loyalty

Success Stories

- The EcoStar Business Awards Program administered by the Montana Pollution Prevention Program recognizes businesses that are taking environmentally friendly steps to reduce waste maximize efficiency and create a safer work environment. EcoStar Awards winners are featured in press releases, receive a certificate of recognition and other materials for company advertising and are automatically eligible for the prestigious Outstanding Achievement in Pollution Prevention Award sponsored by the U.S. Small Business Administration.

Future Measures in the Commercial/Industrial Waste Sector

1. Small Business Outreach Program Expanded Recycling Program

Measure Status: Proposed
 Responsible Department: MSW
 CO₂ Savings in 2015: **4,600 tons**
 Financial Savings: **\$460,000**

Since 1993 the Solid Waste Division has been actively seeking to divert increasing amounts of fiber products from the residential and commercial waste stream. As can be seen in the table below our efforts have paid off. However, there remains a significant portion of fiber that is not recycled for a variety of reasons. There is approximately 34,000 tons of total waste stream. 60% of this is considered Keene specific. Therefore 20,400 tons of waste is Keene specific.

	Mixed Paper	Cardboard	Totals	% Change from Prior Year
Total 1993	910,200	1,512,580	2,422,780	
Total 1994	712,573	846,605	1,559,178	-36%
Total 1995	875,258	1,796,392	2,671,650	71%
Total 1996	1,582,410	2,838,840	4,421,250	65%
Total 1997	2,356,480	3,389,460	5,745,940	30%
Total 1998	2,802,420	4,518,660	7,321,080	27%
Total 1999	3,594,220	6,049,360	9,643,580	32%
Total 2000	3,261,220	5,571,970	8,833,190	-8%
Total 2001	3,863,240	6,411,810	10,275,050	16%
All Total (pounds)	19,958,021	32,935,677		

Follow-Up Measure: Expand paper recycling to 12,000,000 pounds per year.
 This equates to $12000000/2000 = 6,000$ tons

The Solid Waste Division, in cooperation with Waste Management of New Hampshire will target small businesses for fiber recycling. Within the next two years the goal is to solicit 50 small businesses to participate in a fiber collection route. That along with expanded education geared towards the residential sector should allow the City of Keene to achieve the 12,000,000-pound per year total by the year 2004. Versus virgin production each ton of paper recycled realizes approximately 60% energy savings, generates 95% less air pollution (each ton saves 60 lbs. of air pollution), and saves 17 trees and 7,000 gallons of water (sources Center for Ecological Technology and EPA). It costs \$117 per ton to throw away trash. It costs about \$17 per ton to recycle. This results in a savings of approximately \$100 per ton. This results in a savings of \$460,000.

Appendix A: Measures Quantification Notes

Municipal Sector

LED Traffic Signals

Page Number in Action Plan: 15

The Keene Police Department installed LED (light emitting diode) lights for the red and green signals at most of the traffic signals in Keene. LED lights use 80 to 90% less energy than conventional incandescent bulbs. In addition, LED lights require 1/6 the maintenance of conventional bulbs, only needing replacement every eight to ten years. The street light conversion will eliminate 15 tons of CO₂ by 2015.

The CCP Software was used to convert electricity reduced into CO₂ saved. See attached excel spreadsheet for streetlights.

Cost of converting traffic signs= 19,000 after rebate PSNH
Financial Savings in software is= \$57,810- cost of conversion=\$38,810.

Municipal Use of Solar Electricity

Page Number in Action Plan: 16

New construction and renovations in Town buildings present opportunities to incorporate solar electricity production into design. Future possibilities that have been identified are the Recreation Center and City Hall.

Total Energy Consumption forecasted for these buildings in 2015: 639,780 kwh
Calculations assume that each building installs a 2 kw PV system that generates 3,600 kwh/year.

$2 \text{ buildings} = 2 \times 3,600 = 7,200 \text{ kWh}$

Cost of installation on average \$10 to \$12.50 per watt. Therefore, installation cost for 2kw photovoltaic system: $\$11.25 \times 2,000 = \$22,500$. Total installation costs for 4 buildings: $\$22,500 \times 2 = \$45,000$

7,200 kwh would be replaced saving \$640.8 a year on electricity costs. This would create a payback period of 70 years.

Energy Audits on All City Buildings

Page Number in Action Plan: 17

The City will implement a program of regular energy audits for all municipal buildings with the authority given to the building manager. Simple awareness of

energy use and subsequent adjustments will possibly result in 10-15% energy use reductions. (Heidelberg, Germany)

A 10% reduction in all city buildings would result in:

City Buildings use currently:

1,600,366 kWh of electricity at a cost of= \$216,670

124,915 gals oil at a cost of= \$84,446

50,090 therms of propane at a cost of= \$92,023

10% reduction

Electricity reduced= 160,036.6 kWh for a savings of= \$21,670

Oil reduced= 12,491.5 gals for a savings of= \$8,444.6

Propane reduced= 5,009 therms for a savings of= \$9,202.3

The software indicates a Co2 Reduction of 219 tons annually.

So from 2003 to 2015 we will reduce 2,847 tons

Promoting Voluntary Programs & Incentives for City Employees to Reduce Emissions

Page Number in Action Plan: 17

This is the way to achieve savings listed in the above measure.

Energy Star Procurement and Bulk Purchase

Page Number in Action Plan: 20

ENERGY STAR labeled copiers are equipped with a feature that allows them to automatically turn off after a period of inactivity, reducing a copier's annual electricity costs by over 60%. High-speed copiers that include a duplexing unit that is set to automatically make double-sided copies can reduce paper costs by \$60 a month and help to save trees.*

ENERGY STAR labeled fax machines are equipped with a power-management feature that can reduce energy costs associated with the use of the machines by almost 50%.

A medium-speed ENERGY STAR labeled fax machine uses 25% less energy in sleep mode than in standby mode when it is immediately ready to send or receive faxes. ENERGY STAR labeled fax machines can also scan double-sided pages. This will reduce both your copying and your paper costs.

Expanding & Maintaining Trees & City Owned Nurseries & Gardens

Page Number in Action Plan: 21

Trees play an important role in our community that goes well beyond aesthetics. Their shade helps to offset air conditioning use in the summer, and they can reduce heating costs by blocking cold winds in the winter. Storm-water absorbed by city trees can lock up pollutants that would otherwise end up in the Ashuelot River. And because of their ability to absorb carbon dioxide and produce oxygen, trees have aptly been called the "lungs of the planet." For these reasons, it is important that the city and the community support the parks and recreation department in its development of a comprehensive urban forestry master plan.

The California Energy Commission has estimated that on average, mature urban trees reduce the amount of Co₂ in the air by approximately 115 pounds per year. In 2003, ESRI donated 100 Liberty Elm Trees for the City of Keene to plant, leading to the sequestration of approximately 6 tons of equivalent Co₂ annually.

The city should explore the possibility of operating a community garden in order to encourage local agriculture and the possibility of green roofs on city owned buildings where appropriate.

Green Power

Page Number in Action Plan: 22

Cities such as Santa Monica have passed ordinances that mandate the purchase of 100% renewable energy to power all city facilities. Keene is not considering purchasing 100% of its electricity as renewable. Calculations therefore assume that the City will opt to purchase 20% of its total electricity needs from green sources in 2015. According to the GHG Inventory, electricity use in Municipal buildings, facilities, operations and streetlights is forecasted to be 9346 kwh at a cost of \$1,642.37. 20% of 9346 is 1869.2 kwh.

Municipal average = \$0.1757297

Electricity rates in 2015 estimated to be 10% less than 2002 rates dues to increased competition. Municipal average 2015 = \$0.15815673. Green electricity estimated to be 2/10 of a cent higher than conventional rates. Municipal average for green electricity in 2015 = \$0.16015673

Implementation costs: 1869.2 kwh at green electricity rates = .16015673 *
1869.2 = 299 versus 1869.2 * .15815673 = 296
\$3.00 difference

Existing Waste Landfill Gas Management

Page Number in Action Plan: 23

The City of installed a landfill gas-to-energy generator at the Keene Municipal Landfill in late 1994 in part to provide three-phase power for the adjacent Materials Recovery Facility. The decision to install the landfill gas-to-energy generator was made because of the cost savings of self-generated power versus utility supplied power as well as the environmental benefits of reduced air

emissions. The City of Keene operated Caterpillar G-3412-SINA, 250 kW electric generator powered by landfill gas through five interconnected wells combusts more than 98% of the volatile constituents of the inlet gas and eliminates approximately 140 tons of hydrocarbons per year that would otherwise be released by the landfill. In addition, the landfill gas-to-energy generator burns methane as its primary fuel. Methane is known to be 20-30 times worse than carbon dioxide as a greenhouse gas. The size of the Keene landfill required only a passive gas venting system, however the City of Keene installed an active gas collection system to reduce the effects of landfill gas.

In 1999 the well field was expanded to seventeen interconnected wells and a transformer was installed to supply single phase power needs. The materials recovery facility operates "off" grid approximately 95% of the time. The estimated the gas collection rate is 372,600 standard cubic feet per day or 260 standard cubic feet per minute. The landfill gas composition by volume is approximately 35% carbon dioxide, 1% oxygen, 58% methane and 6% nitrogen.

Existing Internal Recycling Program

Page Number in Action Plan: 24

In July of 2002, the City started an internal recycling program. The program involved education and blue bins for all paper recycling. It is anticipated to divert 20 tons of paper per year through this formal program.

- The EPA has found that making paper from recycled materials results in 74% less air pollution and 35% less water pollution. This means that every ton of recycled paper keeps almost 60 pounds of pollutants out of the atmosphere that would have been produced if the paper had been manufactured from virgin resources.
- One ton of recycled paper uses 64% less energy and 50% less water, saves 17 trees, and creates five times more jobs than one ton of paper products from virgin wood pulp.
- Every ton of recycled paper saves approximately 4 barrels of oil, 4,200 kilowatt hours of energy and enough energy to heat and air-condition the average North American home for almost 6 months.

The City of Keene will realize a savings of approximately \$2,340 in avoided disposal cost by recycling paper. In addition, the City of Keene will receive approximately \$800 in revenue from selling the paper in the recycling commodities markets.

Purchases of Environmentally Preferable Products

Page Number in Action Plan: 25

Purchasing policies can greatly affect the environmental impact of operations from government entities. State and local governments purchase more than \$1 trillion in goods and services each year, according to Governing Magazine. The EPA has developed an Energy Star labeling program for energy efficient equipment and appliances. Each Energy Star computer and monitor eliminates nearly 1 ton of CO2 per year and saves \$15 to \$25 per year in energy costs.

Products made from recycled materials should be preferred over those made from virgin materials when considerations of quality and cost are not in great excess.

The City of Keene should include in their Environmentally Preferred Products: janitorial and cleaning products, environmentally friendly vehicle products and building products (recycled lumber, plastic)

Municipal department should practice bulk purchasing of energy efficient and recycled content products.

Police Units on Bicycles

Page Number in Action Plan: 26

Ordinarily, the police have approximately five to nine cars on patrol at any given time. An average police cruiser, the Crown Victoria's, achieve 11.24 mpg. One cruiser will travel approximately 12,388.56 miles on an annual basis. The two police units on bicycles have displaced two cruisers 25% of the time.

Therefore: $2 \times 12,388.56 = 24,777.13 \times .25 = 6,194.28$ total displaced miles

$6194.28 \times \$0.13$ (cost per mile) = \$805.25 saved from fuel and maintenance

Cost of bike = \$1

Cost of Training = n/a

24 ton CO2 Reduction According to Software.

Hybrid Gas/Electric Vehicles in the Town Fleet

Page Number in Action Plan: 27

The City currently owns no AFV's out of 14 fleet vehicles. Approximately 9 vehicles from the following departments (Public Works, Accessing, Police, Fire, Codes and Health) are classified as passenger vehicles/light trucks that could easily be replaced by hybrid vehicles similar to the Prius.

In 2000, these vehicles used 3,347 gallons of gasoline at a cost of \$4,134.

Of the 9 cars: 1 Crown Victoria, 3 Ford Taurus, 3 Ford Contours and 2 Luminas would be displaced by the Prius.

A Ford Contour has an average fuel economy of 18.71 mpg and costs the city:
 $\$14,000 * 3 = \$42,000$

The Crown Vic has an average fuel economy of 14.11 mpg and costs the city
 $\$22,000 * 1 = \$22,000$

A Ford Taurus has an average fuel economy of 19.06 mpg and costs the city:
 $\$16,000 * 3 = \$48,000$

A Chevrolet Lumina has an average fuel economy of 20.12 mpg and costs the city:
 $\$16,000 * 2 = \$32,000$

For a total cost of **\$144,000**

Cost of a new Prius: $\$20,450 * 9 = \$184,050$

Difference in car cost = \$40,050

Thus in 2000 this vehicle fleet of 9 passenger cars drove mpg x gallons of gas = VMT or VMT/car.

This needs to be done four times since the mpg is different for each type of vehicle:

Ford Contour = $18.71 \times$ gallons of gas = 13,026

Ford Taurus = $19.06 \times$ gallons of gas = 13,927

Lumina = $20.12 \times$ gallons of gas = 27,412

Crown Vic = $14.11 \times$ gallons of gas = 7,864

62,229 Total VMT

3,347 gallons of gas

The average fuel economy for a Prius is 48 mpg.

A Prius driving 62,229 miles would use **1,296** gallons of gas.

If fuel costs an average of \$1.235 then

$3,347 * 1.235 = \$4,134$

$1,296 * 1.235 = \$1,600$

Annual Savings of **\$2,534.**

40,050/2534 = 15 year payback

Co2 Reduction – 23 tons

Conversion of Fleet Vehicles to CNG

Page Number in Action Plan: 28

In 2000, the DPW 36 light vans or trucks (excluding ambulances & trucks with plows) used 10,994 gallons of gasoline. According to the CCP software, light trucks/vans have an average fuel economy of 14 mpg (gasoline).

In 2000, DPW light vans or trucks had a VMT of $(10,994 \times 14) = 153,916$ miles or an average VMT/vehicle of 5,919.846 miles.

According to <http://www.fuel:economy.gov>, CNG light trucks have an average fuel economy of 13 mpg. To go 153,916 miles at 13 mpg would require 11,839.69 gallons of CNG.

Cost of CNG conversion kit estimated at \$3,250/vehicle (Alternative Fuels Data Center). $26 \times \$3,250 = \$84,500$ (implementation cost).

Cost of CNG per gasoline gallon equivalent: \$0.89/gallon (Alternative Fuels Data Center). $11,839.69 \times \$0.89 = \$10,537.33$.

Cost of conventional gasoline: \$1.235/gallon (Source). $10,994 \text{ gallons} \times 1.235 = \$13,577.59$.

Avoided fuel cost savings from CNG conversion: $\$13,577.59 - \$10,537.33 = \$3,040.26$

Payback: $84,500/3040.26 = 28$ years or $10 \times 3250 = 32500/3040.26 = 10$ year payback

97 ton reduction a year according to CCP software in Measures Sector

Conversion of Fleet Vehicles to Biodiesel Page Number in Action Plan: 29

This measure would convert Keene's fleet of heavy trucks and equipment vehicles to %100 biodiesel for one year.

In 2001 57 trucks and equipment used 40,202.40 gallons of diesel. According to CCP software, heavy trucks run on diesel have an average fuel economy of 8 mpg. Therefore in 2000 this section of the fleet generated a VMT of $(40,202.40 \times 8) = 321,619.2$ miles or an average of 705.3 miles per vehicle.

Pure 100% biodiesel reduces fuel economy by 10% (US DOE), thus the average economy of heavy trucks running on biodiesel would be $8 - (10\% \text{ of } 8) = 7.2$ mpg. To travel 321,619.2 miles would require $(321,619.2/7.2) = 44,669.3$ gallons of biodiesel.

According to the US DOE, biodiesel produces 2,661 grams of carbon dioxide per gallon compared to 12,360 grams per gallon for conventional diesel fuel. Therefore, 44669.3 gallons of biodiesel produces $(44669.3 \times 2,661) = 118,865,007.3$ grams of CO₂. 40202.40 gallons of diesel produces $(40202.4 \times 12,360) = 496,901,664$ grams of CO₂.

For the 57 vehicles and equipment, biodiesel produces 118,865,007.3 grams of CO₂ compared to the 496,901,664 grams produced by conventional diesel. As

there are no biodiesel options in the CCP software, this measure has been calculated as 'other' under corporate measures.

496901664-118865007.3 = 378036656.7 grams CO2 reduction =
416.70707308201053 Short tons

Price of petroleum diesel per gallon for the City of Keene = \$0.85 per gallon.
(Boston Spot Market for July 22, 2002)

40,202.4 gallons x 0.85 = \$34,172.04.

Price of biodiesel is approximately \$1.05. (20 cents more than conventional diesel on average)

44669.3 gallons x 1.05 = \$46,902.77

Difference is \$46,902.77 - \$34,172.04 = 12,730.73

\$2,500 grant money

12,730.73 - 2,500 = \$10,230.73

In July Biodiesel program started. Actual numbers will be forthcoming. Program will last one year.

Conversion of School Buses to Biodiesel

Page Number in Action Plan: 30

As heralded in the media and detailed in the Action Plan, Keene has made great strides in embracing the benefits of alternative fuels at the municipal level through Fleet Service's continued use of biodiesel (B20) in city vehicles. Building upon this important and popular success, the city must now work to promote the use of cleaner fuels in the community in areas where it will have the greatest impact in reducing greenhouse gases, and where such outreach has the best chance of being positively influential. By working with those commercial and public entities that utilize a diesel fleet, the city will be in a position to affect an issue perhaps even more compelling than curtailing greenhouse gases-that of public health.

The proposed measure requests the City to adopt the position that it is in the best interest of the entire community for the school district and their private carrier to consider switching from standard diesel to either (B20), or (ULSD). In passing the proposed measure the city would in effect, be making a statement of support and encouragement for voluntary action. The city would further offer its assistance to both parties, which could come in the form of pursuing grant money for the project, which has been successfully accomplished elsewhere. There is also the possibility that the City could partner with both parties to create a pilot project whereby a certain number of school buses that operate in or near the city, could refuel at the City's Fleet Services (B20) tank, which according to Steve Russell, the department's manager, "Has more than enough capacity to launch such a great idea."

In addition to encouraging a switch to a cleaner fuel, the city would also recommend that both parties explore the possibility of retrofitting the school bus

fleet with pollution control devices, like interior air filters, particle traps, and catalytic converters. The two types of devices currently recommended by the U.S. EPA, are Diesel Oxidation Catalysts and Diesel Particulate Matter Filters. The first device functions to break down pollutants in the exhaust stream into less harmful components. The device targets particulate matter (20%), hydrocarbons (HC) (50%), and carbon monoxide (CO) (40%). Diesel Particulate Matter Filters are ceramic devices that collect particulate matter (PM) in the exhaust stream. They can only be used in conjunction with buses that use ULSD. Their combined effect can reduce emissions of PM, HC, and CO by 60 to 90 percent. Emissions from diesel buses can also be reduced through a combination of engine improvements, changes to fuel and oil formulation, and exhaust control equipment.

While the City understands that cleaner fuels and retrofits cost more, whether per gallon, or for the installation cost of the pollution control devices, it hopes that in offering its support and assistance that a process of exploration can begin that may one day soon result in cleaner air for Keene's children and the community at large. The City understands that in all likelihood, any changes will be incremental and will not happen over night. It also appreciates the fact the associated costs are real and could easily erode into the private carrier's bottom line, and the communities' desire to see their school tax slightly raised to subsidize a cleaner fuel, and (or) retrofit. It is why any initiative must begin with open and ongoing dialogue between all relevant stakeholders, as well as a commitment from the City to staff someone, perhaps a qualified intern, who can actively pursue potential grant money. It is important to remember that without a commitment from all parties to begin the process of dialogue, that the necessary groundwork needed to successfully see such a grant awarded, will not be realized, and some other town will be the beneficiary of an immense asset that would do so much for Keene's community and commitment to advancing clean technologies. It should also be noted that the recently passed Energy Bill for 2004, includes sizeable grants for state and local entities that are eager to advance the cause of cleaner fuels for school buses.

Although most states rely on diesel school buses to transport children, there is a rapidly growing list of communities that are making the switch to cleaner fuels. Already in 131 school districts across 17 states, children ride cleaner buses to school. There are approximately 2,675 alternative fuel school buses operated by nearly 130 school districts across the country. Many of these fleets actively participate in the Clean Cities program. As Keene's Fleet Services and Keene State have already proven, biodiesel can be used successfully in existing diesel engines with few or no modifications.

For Appendix (Clean School Bus Initiative)

In recent months, various scientific studies have raised public concern over the harmful effects of diesel exposure to children who ride school buses. According to the Union of Concerned Scientists (UCS 2002), school children in every state

are being exposed to dangerously high levels of toxic air pollutants from school buses. School buses routinely expose children and communities to a mixture of smog-forming pollutants, soot particles, and other toxic constituents, which add to the global burden of greenhouse gas emissions.

Numerous scientific studies have shown diesel exhaust to cause or exacerbate a host of health problems and diseases, including asthma, cancer, heart disease, and premature death.

Diesel exhaust is known to be a major source of fine particulate matter (PM), or soot that can lodge deep in the lungs where, according to the EPA, it exacerbates such respiratory diseases as asthma, emphysema, bronchitis and allergies. Soot from exhaust significantly increases the risk of death from heart and lung disease, causing at least 70,000 deaths a year in the U.S.

A recent Yale University study found that children riding buses are exposed to 5-15 times more particulate matter than that found at nearby monitoring sites (Wargo Study, Yale University 2003). In addition, a study conducted by the Natural Resources Defense Council and the Coalition for Clean Air, children who ride in school buses may be exposed to up to four times more toxic diesel exhaust than someone traveling in a car directly in front of it.

Children are especially sensitive to environmental hazards. Diesel exhaust poses an especially significant risk to them because their respiratory systems are still developing and exposure increases the likelihood that they will develop a respiratory disease. According to the UCS (2002, there is no known safe level of exposure to diesel exhaust for children.

Asthma is a growing health problem now afflicting some 4.5 million American children

Asthma is the most chronic disease of childhood, and the leading cause of disability among children (UCS 2002). Although children comprise only 25% of the population, they represent 40% of the asthma cases-and asthma is the leading cause of school absenteeism related to chronic conditions (NRDC 2003).

In addition, diesel exhaust contains 40 compounds that are classified as "hazardous air pollutants" under the Clean Air Act, and are believed to cause cancer (UCS 2002). A study by federal pollution control regulators estimated that diesel exhaust may be responsible for over 125,000 cancer cases nationwide over the lifetime of exposure (STAPPA/ALAPCO, 2000).

Over a normal, twelve-year period that U.S. children are enrolled in school, each child will typically spend 90 full 24-hour days riding on a school bus (UCS 2002). Every year, the nation's fleet of school buses releases 3 thousand tons of soot, 95 thousand tons of smog-forming pollutants, and 11 million tons of greenhouse gas emissions (UCS 2002). Yearly emissions from one diesel

vehicle amount to 30 tons of discharge. In a single year, America's average school bus emits as much as 125 cars (UCS).

Using biodiesel is one of the easiest ways to protect the health of our kids. Biodiesel reduces the compounds linked to cancer by 80-90%. A recent EPA study in 2002 showed that biodiesel use provides significant reductions in most EPA-targeted emissions. The report showed the following results when pure B100 and B20 was used to power unmodified engines, when compared to petroleum diesel.

Pollutant	B100	B20
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-47%	-12%
Particulate Matter	-48%	-12%
Nox	+10%	+2%

In May 2000, biodiesel became the only alternative fuel in the country to have successfully completed the EPA's Tier I and II.

This measure would convert KSD fleet of 21 buses to b20 blend of biodiesel for one year.

Average school bus travels 15,000 miles per year (10 month period)

Average fuel economy is 7.5 mpg.

21 buses = 87,500 gallons of diesel.

A b20 biodiesel blend produces 7,516.709 grams of carbon dioxide per gallon compared to 12,360 grams per gallon for conventional diesel fuel. Therefore, 87,500 gallons of biodiesel produces $(87,500 \times 7,516.709 = 657,712,037.5$ grams of CO₂. 87,500 gallons of diesel produces $(87,500 \times 12,360) = 1,081,500,000$ grams of CO₂.

For the 21 buses, biodiesel produces 657,712,037.5 grams of CO₂ compared to the 1,081,500,000 grams produced by conventional diesel. As there are no biodiesel options in the CCP software, this measure has been calculated as 'other' under corporate measures.

$1,081,500,000 - 657,712,037.5 = 423,787,962.5$ grams CO₂ reduction = 467.1462645 Short tons

Price of petroleum diesel per gallon for the City of Keene = \$0.85 per gallon.
(Boston Spot Market for July 22, 2002)

87,500 gallons x 0.85 = \$74,375

Price of biodiesel is approximately \$1.05. (20 cents more than conventional diesel on average)

42,000 gallons x 1.05 = \$91,875

Difference is $\$91,875 - \$74,375 = \$17,500$

Conversion to Electric Cars for Parking Police

Page Number in Action Plan: 31

This measure will replace two of the three Parking Police Vans with electric vehicles. The 1989 van has accumulated 30,985 miles and gets 10.81 MPG

The 1991 van has accumulated 33,831 miles and gets 10.80 MPG.

Therefore this measure will displace 2,942 per year (1991) and 2,295 per year (1989) for a total of approximately: 5,237 miles per year

- The EV Ford Think! cities get 32 kwh / 100 miles (in the city highway=41 kwh / 100 miles).
- 32 kwh / 100 miles = 3.13 miles / kwh and 1 kwh = 0.021594 equivalent gallons gasoline
- $(3.13 \text{ miles / kwh}) * (1 \text{ kwh / } 0.021594 \text{ equivalent gallons gasoline}) = 144.72 \text{ miles per equivalent gallons gasoline}$

Parking Cash-Out Program for Town Employees

Page Number in Action Plan: 32

The methodology is based on the number of employees who have parking passes for the Elm, Winter and Wells parking lots. A 25% participation goal is assumed (19 participants). It is also difficult to characterize the transportation choices of people who give up their parking passes – they could switch to car-pooling, walking, bicycle or bus. For the purpose of quantifying the measure however, it is assumed that participants walk or bicycle after cashing in their passes.

Number of parking permits issued:

77 permits x 2 trips per day = 154 trips per day

Approximately 264 working days per year (22 days per month x 12). $264 \times 154 = 43,296$ annual number of trips.

Estimate average commute length for Keene: 8 miles.

Therefore $43,296 \text{ trips} \times 8 \text{ miles} = 346,368$ passenger miles traveled (PMT)

Goal of measure: Get 25% of City employees who currently drive to work to switch to an alternative. 25% of 77 people = approximately 19 people or 38 trips per day. $38 \text{ trips} \times 264 = 8,448$ of trips reduction = 8,448 trips or $(8,448 \times 8) = 67,584$ reduced PMT

Implementation cost: Value of parking spaces estimated at \$40/month. 19 spaces are worth \$760 per month or 9,120 per year. Keene could easily regain this cost by renting these municipal parking spaces to businesses or individuals.

Telecommuting for Town Employees

Page Number in Action Plan: 33

Number of employees who commute to work:

237×2 trips per day = 474 trips per day

(2 days per month which is 24 days per year). $24 \times 474 = 11,376$ annual number of trips.

Estimate average commute length for Keene: 8 miles.

Therefore $11,376$ trips \times 8 miles = 91,008 passenger miles traveled (PMT)

Goal of measure: Get 10% of City employees who currently drive to work to switch to telecommuting two days a month. 10% of 237 people = approximately 24 people or 48 trips per day. 48 trips \times 24 days = 1,152 of trips reduction = 1,152 trips or $(1,152 \times 8) = 9,216$ reduced PMT

Implementation cost: cost of setting up networking and software:

Bicycling Outreach Program

Page Number in Action Plan: 34

The four greatest impediments for commuters choosing cycling or walking to work for errands are safety, weather, distance and inadequate facilities for storage or changing at destinations. While Keene cannot control weather or people's commuting distance, the City benefits from the walk-ability of its downtown and bike-ability along the many bike lanes, paths and trails. In locations such as downtown Keene where the infrastructure is in place, bicycling and walking trips can take the place of certain auto trips.

Improvements such as new and expanded bike paths, bicycle storage facilities and safe sidewalks and crossings can encourage more bicycling and walking in and around the City. An outreach program could be developed with the City's Bike/Ped committee and other interested organizations in town to promote increased bicycling and walking.

Shifting an additional 10 trips from single occupant automobiles to bicycles through implementation of the bicycle outreach program and new bike paths

could reduce up to 9,234 pounds of CO2 a year and could save Keene commuters up to \$563 a year in fuel savings.

Calculations:

- 10 reduced round trips per day – or 20 total auto trips reduced per day
- Trips would average 2 miles each (distance from Central Square to most residential locations)
- Each day 40 vehicle miles (20 total trips x 2 miles each) would be removed from the network.
- The 40 vehicle miles equate to roughly 1.9 fewer gallons of fuel burned each day (40 miles / 21 mpg)
- The 1.9 fewer gallons of fuel burned each day equates to 38.5 pounds of CO2 each day, or approximately 9,234 pounds of CO2 over eight months.
- The 1.9 fewer gallons of fuel burned each day equates to \$2.35 saved each day, or approximately \$563 per year.

Traffic Calming

Page Number in Action Plan: 35

This has been calculated in the CCP Software as an Absolute Emissions Reduction because: It should be in the Corporate Measures since it is spearheaded by the City and there are no other options for this type of land-use measure in the Corporate Sector.

Traffic calming uses a variety of techniques (speed tables, islands, chicanes, humps, etc.) to promote a uniform traffic flow at a speed appropriate with the development context. By reducing the acceleration and deceleration typically found along arterials and local streets and encouraging a more uniform traffic flow, traffic calming can reduce fuel consumption and CO2 emissions. CO2 emissions are dependent upon fuel consumption. As fuel consumption is highest during vehicle acceleration, it would make sense that reducing the intensity and occurrences of vehicle acceleration through traffic calming would decrease overall CO2 emissions. Assuming, on average, a 10% increase in fuel economy by promoting more uniform speeds, adding traffic calming treatments to one city block has the potential to decrease 0.05 pounds of CO2 per vehicle per trip. Assuming an average street has 3,000 vehicles per day yields 146 fewer pounds of CO2 per year. Reductions on Main Street, due to existing traffic calming measures (with a daily traffic volume of 22,000) would equal approximately 160,600 lbs of CO2 reduced per year or 80.3 tons of CO2 per year.

Follow-up: Assuming that, by 2015, Keene has added traffic calming elements to 10 city blocks, total CO2 reductions total 1,463 pounds per year.

Calculations for one city block:

	Heavy Acceleration	Uniform Speeds
Average Fuel Economy	8.2 miles/gallon	9.02 miles/gallon
Distance	0.1 mile	0.1 mile
Fuel Burned	0.0122 gallons	0.0111 gallons

CO2 Emissions	0.244 lbs of CO2	0.224 lbs of CO2
Emissions reduced per car		0.020 lbs of CO2
Emissions reduced per year (assumes 3,000 cars/day)		21,900 lbs of CO2
For 10 City Blocks		219,000 lbs of CO2 or, 110 tons of CO2

Promote Mixed Use and Transit Oriented Development

Page Number in Action Plan: 36

Keene is characteristic of the network of compact, walkable, mixed-use centers and neighborhoods in older cities and towns scattered throughout New England. Many of these centers were historically connected by rail transit and still reflect land use patterns that were enabled by these strong connections. Keene's overall land use pattern contributes to the goals of a sustainable community and region by supporting a variety of transportation choices; creating walkable, close knit mixed neighborhoods; and intertwining the built environment with open space, farmland and natural beauty.

There are many connections that can be made between land use patterns and climate change. Mixed-use development and zoning is designed to permit a variety of community activities, locales and services to co-exist in close proximity, thereby reducing the need for extensive automobile travel. Transit oriented development brings potential riders closer to transit facilities rather than building away from population centers and making people more dependent on roads and automobiles. Put simply, if people live in close proximity to employment, retail, services, and entertainment, they won't need to drive as much. Fewer miles mean less greenhouse gas emissions.

Another beneficial impact of mixed use and transit-oriented development is to reduce the need for excess parking. Excess parking has costs for all of us. For an individual housing development, excess-parking requirements drive up costs and reduce the potential for amenities such as open space. Open space in Keene provides a variety of environmental and aesthetic benefits including more opportunity for landscaping with woody plants to promote the absorption of CO2. Paved land tends to reduce adjacent property values, increases water pollution and storm water flooding, reduces visual and acoustic privacy and causes urban heat islands (increased local temperature).

On a larger scale, excess parking contributes to traffic congestion and ironically even encourages more car ownership. Numerous studies have shown that higher land use densities are essential to reduce rates of car ownership and miles driven. Generous parking requirements encourage automobile dependency and urban sprawl by increasing the amount of land needed per unit, thus making

lower priced urban periphery land relatively more attractive than higher priced but more accessible urban locations.

The City of Keene and the Planning Department should promote mixed use and transit oriented development. A commitment should be made to incorporate climate change concerns into the Planning process so that future policy does not contradict the goals of sustainability and emissions reductions.

Climate Change Outreach & Education

Page Number in Action Plan: 37

Accounted for in other sectors such as the 10% challenges to businesses and residents.

Climate Change the Musical

Page Number in Action Plan: 38

Accounted for in other sectors such as the 10% challenges to businesses and residents.

Energy Efficiency Coordinator Position

Page Number in Action Plan: 39

Keene should implement measures to ensure that the emissions reduction measures outlined in this Plan actually become reality. Too many plans of this nature end up collecting dust on bookshelves. The City has already invested approximately \$10,000 in staff time in the preparation of this Action Plan. One way to ensure the completion of the five milestones of the CCP Campaign, incorporate energy efficiency throughout all municipal operations would be to hire a full-time Energy Efficiency/Environmental Coordinator. This person could be charged with maintaining the emissions inventory on CCP software so that the town can measure its progress towards the emissions reduction target. The individual could also assume responsibilities not directly related to the CCP Campaign, such as assisting with? In general, the role of the Energy Efficiency/Environmental Coordinator would be to protect and improve environmental quality in Keene through programs and projects that prevent pollution, encourage environmentally friendly alternatives and promote energy conservation.

- Implementation costs: \$???? salary for EEC x 1.6 (to account for hiring, administrative and support costs) = \$?????
- Implementation cost of four measures mentioned above for which EEC could assume responsibility: \$26,000
- Financial savings to Keene from four measures for which EEC could assume responsibility: \$

Amount that Keene would save by hiring an EEC: \$

Use of Compact Fluorescent Light Bulbs in Residences and Commercial

Page Number in Action Plan: 45 & 61

Residential Electricity usage in 2015: 66,581,226 kwh
Number of households in 2015: 9,769. Therefore electricity usage/household:

$66,581,226 / 9769 = 6,815.562$ kwh

Lighting accounts for approximately 9% of a household's energy budget
(http://www.iclei.org/efacts/home_eff.htm)

9% of $6,815.562 = 613.4005876$ kwh

Compact fluorescents produce about 4 times more illumination/watt that traditional incandescent bulbs, therefore replacing conventional bulbs with CF's can reduce electricity usage attributed to lighting by 75%.

613.4005876 kwh x $9,769$ households = $5,992,310.34$ kwh

75% of $5,992,310.34 = 4,494,232.755$ kwh

Difference = **1,498,078** kwh

Implementation Cost:

Assume that typical Keene residence has 20 light fixtures, which are in use for an average of 5 hours per day, or 1,865 hours per year.

For a 10,000-hour life, ten 60-watt incandescent bulbs cost \$5 to purchase and have an estimate energy cost of \$36 for a total cost of \$41. For a 10,000-hour life, one 15-watt compact fluorescent costs \$5 to purchase through PSNH's Smart living Catalogue and has an energy cost of \$9 for a total cost of \$14.
(Source <http://www.mge.com/business/saving/lighting.htm>)

10,000 hours = 5.5 years of use

Retail bulb costs for 10 60 watt: 5×20 fixtures/ 5.5 years = $\$18.18/\text{year} \times 9,769$ households = $\$177,600$

Retail bulb costs for one CF: 5×20 fixtures/ 5.5 years = $\$18.18/\text{year} \times 9,769$ households = $\$177,600$

Implementation cost is difference between two: \$0 if bought through PSNH!

\$0.13 kwh average Residential Rate from

<http://www.psnh.com/SharePDFs/ratecomparehome.pdf>

Savings = $1,498,078 \times \$0.13 = \$194,750$

CO2 Savings = 429 tons

Commercial Electricity usage in 2015: 203,109,299 kwh

Number of establishments in 2015: 575. Therefore electricity usage/establishment:

$203,109,299 / 575 = 353,234$ kwh

Lighting accounts for approximately 46% of a commercial establishments energy budget

(<http://www.eia.doe.gov/emeu/cbecs/cbec-eu3.html>) Look at Table 3.

46% of $353,234 = 162,487.64$ kwh

Compact fluorescents produce about 4 times more illumination/watt that traditional incandescent bulbs, therefore replacing conventional bulbs with CF's can reduce electricity usage attributed to lighting by 75%.

162,487.64 kwh x 575 = 93,430,393 kwh

75% of 93,430,393 = 70,072,794.75 kwh

Difference = 93,430,393 - 70,072,794.75 = **23,357,598.25 kwh**

Replace standard 4-foot or 8-foot fluorescent lamps with energy-efficient lamps and electronic ballasts that save even more energy

Average Cost per kwh = \$0.12

<http://www.psnh.com/SharePDFs/ratecomparebusiness.pdf>

Savings = 23,357,598 X .12 = 2,802,912

CO2 Savings = 6,692

10% Challenge

Residential Energy Efficiency Program

Page Number in Action Plan: 46

This measure seeks to achieve a 10% reduction in home energy consumption with the implementation of a residential energy conservation program. To calculate the impact of this measure on emissions, the following methodology was used.

From 2015 GHG Inventory residential energy forecast:

Electricity: 66,581,226 kwh

Oil: 4,459,909 gallons

Gas: 410,949 therms

10% reduction in energy use would be:

Electricity: 6,658,122.6

Gas: 41,094.9

Oil: 445,990.9

CO2 Reduction 7,314 tons

\$1,402,887 savings

\$0.13 average kwh cost

These figures were entered into the CCP Software as Potential Energy Reductions. Implementation cost estimated as \$2,500 for educational materials and coordination of workshops. \$?????? for one full-time Environmental Coordinator to administer program (cost accounted for in Environmental Coordinator Position Measure

Residential Use of Solar Hot Water

Page Number in Action Plan: 47

In New Hampshire, solar water heating systems can cut the average family's water heating electricity use by 40-60%. Water heating accounts for about 14% of the average family's home energy consumption. Methodology used to calculate this measure assumes electric hot water heating system.

2015 residential energy use forecasted at 66,581,226 kwh for 9,769 households = 6815.562/households/year. 14% of 6,815.562 kwh = 954.178 kwh used to heat hot water. Measure assumes that by 2015, 10% of residences replace electric hot water heating system with solar. 10% of residences = 976.9

Before solar, using 976.9 X 954.178 = 932,136.4882 kwh
After solar, 50% of this generated by solar: 976.9 X 477.089 = 466,068.2441 kwh

Solar hot water systems generally cost from \$4,000 - \$6,000 but vary depending on size and difficulty of installation. Installation costs for 977 solar hot water heating systems: \$5,000 X 976.9 = \$4,884,500

\$.013 Average Cost per KWH
Financial Savings: \$60,589

Lobby for RPS Standards

Page Number in Action Plan: 48 & 60

An RPS regulation requires states to derive a percentage of any utilities' total electricity production from renewable sources. An RPS has not been established in New Hampshire. The city of Keene will lobby for an RPS to be established in New Hampshire starting at 1% in 2004 and rising to 5% in 2010. After 2010 the RPS will increase annually by 1%. Therefore, in 2015 the RPS will be at 10%. The calculations used to determine the impact of this measure take 10% of the amount of the electricity forecast to be used in each sector in 2015 and replace it with green electricity.

Residential: 66,581,226kwh, 10% = 6,658,122.6
Commercial/Industrial: 203,109,299 kwh, 10% = 20,310,929.9
Total Municipal: 9,346 kwh, 10% = 934.6

Electricity rates in 2015 estimated to be 10% less than 2001 rates due to increased competition.

Residential Average: \$0.13

Commercial Average: \$0.12

Green Electricity rates estimated to be \$0.02 higher than conventional rates.

Residential Average: \$0.15

Commercial Average: \$0.14

Expanded Recycling Program

Page Number in Action Plan: 49

In 1993, the City of Keene opened a transfer station in order to recycle a percentage of its solid waste in response to the closure of the Keene Landfill. Recycling rates were minimal in the beginning so the City adopted a Solid Waste Plan, which encouraged the recycling of all products the transfer station could process. This expansion began in 1995. Paper, tin, aluminum, plastics, cardboards and glass were expanded in this recycling program. . It costs \$117 per ton to throw away trash. It costs about \$17 per ton to recycle. This results in a savings of approximately \$100 per ton. This results in a savings of \$1,292,700.

- Tin expansion: In 1995, 100,000 pounds of Tin was recycled. The rate of recycling in 2001 was 374,120 pounds. This is a difference of 137.06 tons of tin.
- Aluminum expansion: In 1995, 29,068 pounds of aluminum was recycled. The rate of recycling in 2001 was 61,400 pounds. This is a difference of 16 tons of aluminum.
- Glass expansion: In 1995, 634,460 pounds of glass was recycled. The rate of recycling in 2001 was 1,632,860 pounds. This is a difference of 499 tons of glass.
- Cardboard expansion: In 1995, 1,796,392 pounds of Cardboard was recycled. The rate of recycling in 2001 was 6,411,810 pounds of cardboard. This is a difference of 2,308 tons of cardboard.
- Plastic expansion: In 1995, 127,160 pounds of plastic were recycled. In 2001 the rate of recycling was 366,270 pounds. This is a difference of 119 tons of plastic.
- Paper expansion: In 1995 875,258 pounds of mixed paper was recycled. The rate of recycling in 2001 was 3,863, 240 pounds. This is a difference of 1,494 tons of mixed general paper.

Existing Waste Solid Waste Ordinance Update

Page Number in Action Plan: 50

The City Council passed Ordinance 0-99-14-A effective March 1, 2000, which amended several procedures for solid waste and recycling collection in the City of Keene. The amendments and impacts are as follows:

Amendment #1- Amend- Section 3201.0, Definitions

The new definitions of Commercial and Residential Refuse are as follows:

Commercial Refuse: Discarded waste materials in a solid state from any commercial or industrial source, including multi-unit dwellings such as multi-family dwellings and condominium dwellings, with more than five (5) physically attached dwelling units.

Residential Refuse: Discarded non-recyclable waste materials in a solid state from any residential dwelling including single-family dwellings and multi-unit dwellings (apartment and condominium dwellings with five (5) or fewer physically attached dwelling units and mobile home subdivisions) whether or not under common ownership or configured on a common site in accordance with a condominium declaration.

Impact of Amendment #1-

Requires permitted haulers to extend recycling services to apartment complexes with five or fewer physically attached units, condominium complexes and mobile home parks. Participation in the recycling program by the occupant of the dwelling is not mandatory, but the permitted hauler is required to provide access to recycling collection services.

Amendment #2- Amend- Section 3208.1 Permits for Residential Private Contractors

The following permit terms are now in effect:

3208.1 PERMITS FOR RESIDENTIAL PRIVATE CONTRACTORS. Effective July 1, 1999, any individual, firm, partnership, joint venture, corporation or association performing refuse/recycling collection and disposal for more than 1 family for a collection service fee within the City limits must obtain a permit to operate from the Public Works Department. The cost of the permit shall be \$15 annually (non pro-rated beginning July 1 of each year). The terms of the permit include:

Term 1: Provide customers with a fixed rate to provide collection services. The fixed rate to provide collection services will include the cost of recycling collection. Provide a unit based pricing rate schedule for refuse disposal measured by volume or weight. Customers must be offered a unit price rate for refuse disposal set in volume increments of 33 gallons or weight increments of 20 pounds. Such rate shall be for disposal of residential refuse collected in the City of Keene. The schedule may show other rates charged for special pickups such as bulky waste.

Term 2: *The permittee is required to provide collection services for Recyclables including, but not limited to glass food and beverage containers, steel cans, aluminum cans, aluminum foil, HDPE #2 (High Density Polyethylene) and PETE #1 (Polyethylene Terephthalate) plastics, newspapers, mixed paper (including magazines, catalogs, junk mail, envelopes, stationary, computer paper, office paper and boxboard), paper bags, corrugated cardboard, and used clothing.*

The rate schedule for a Residential Private Contractor shall be filed with the

Public Works Director not later than December 1 or each year and shall be effective January 1 to December 31 of each year.

Impact of Amendment #2-

Requires permitted haulers to bill for solid waste disposal on a per unit basis measured in increments of 20 pounds or 33 gallons. Costs for waste disposal cannot be included in the base fee. The base fee should be the cost to provide the service without any disposal cost. For example, the following price structure would comply with the terms of the ordinance (this example is for illustration purposes only, it has no basis in actual costs you might incur):

<u>Service</u>	<u>Cost per Month</u>
Collection of refuse and recycling (base fee)	\$25
Disposal of refuse (per 20 pounds or 33 gallon bag)	\$ 2
Disposal of recycling	\$ 0

The cost of collection remains constant, however the cost of disposal is variable. The more waste generated, the more the cost of disposal.

The changes in the ordinance will increase the availability of recycling to Keene residents as well as charge residents for waste disposal based on the amount of waste generated. Access to recycling in addition to economic incentives to reduce waste will help the City achieve its goal of 50% waste diversion.

Follow-Up Measure: Expand recycling by 100 units per year for multi-unit dwellings such as multi-family dwellings and condominium dwellings, with more than five (5) physically attached dwelling units.

The City of Keene, in cooperation with Waste Management of New Hampshire is conducting a recycling pilot project at a 50 unit apartment complex in Keene. If successful, multi-family dwelling recycling could be expanded to include a greater number of the approximately 1,865 units not currently covered by the Solid Waste Ordinance.

100 units x 2.5 persons/unit x 1,022 lbs. waste generated per year x 35% estimated diversion rate = 44.7 tons waste diversion per year for each 100 units added.

**Existing Waste Backyard Composting Program
Page Number in Action Plan: 53**

Since 1993 the City of Keene Department of Public Works- Solid Waste Division has been selling compost bins to residents as a reduced rate. Approximately 1,350 bins have been purchased since program inception. Of the 1,350 bins purchased it is estimated that 60%, or 810 bins have been purchased by City of Keene residents.

The City of Keene has a population of approximately 23,000. There are approximately 5,300 single-family dwellings, and 3,760 multi-family units (average 2.5 persons per dwelling). The average resident produces 1,022 lbs. of solid waste per year (source: City of Keene Solid Waste Plan 1997), which includes 184 lbs. of yard trimmings, and 72 lbs. of food waste (2,116 tons yard waste, 828 tons food waste per year).

It is estimated that 80% of the 810 backyard compost bins sold to Keene residents are from single-family dwellings. It is further estimated that the diversion rate for yard trimmings and food waste in single-family dwellings that have purchased compost bins is 50%, and the diversion rate for yard trimmings and food waste in multi-family dwellings is 25%. **Therefore the current diversion of yard waste and food waste is approximately 117 tons per year** through the backyard composting program (648 bins sold to single-family dwellings x 2.5 persons/dwelling x 128 lbs. organics diverted/person/year = 104 tons per year, 162 bins sold to multi-family units x 2.5 person/unit x 64 lbs. organics diverted/person/year = 13 tons per year).

Follow-Up Measure: Sell 100 bins/year to Keene residents for the next 10 years

At the end of 10 years the diversion rate would be as follows:

1,810 backyard compost bins sold (1993-2012). Assuming no population growth, and no increase in waste generation, the diversion rate of yard waste and food waste would be approximately 261 tons per year.

Lobby for Increased CAFÉ Standards

Page Number in Action Plan: 54

With this measure, Keene and community groups could lobby the Federal Government to increase CAFÉ (Corporate Average Fuel Economy) Standards. The methodology used to calculate the impact of this measure is as follows:

Number of passenger cars registered in Keene: (85%)

Current average MPG figures:

Passenger cars: 21.4 mpg

Light Trucks: 19.6 mpg

(Source: CTPS)

Total VMT from 1995: 97.46 million miles (gasoline powered personal vehicle from GHG Inventory)

85% = 82.841 million miles

So, passenger cars going 82.841 million miles at 21.4 mpg use gallons of gas. Million miles use 3,871,074.76 gallons of gas.

If fuel efficiency levels were increased to over 40 mpg, then the cars going 82.841 million miles would use 2,071,025 gallons of gas. Thus the potential fuel savings would be 3,871,074.76 – 2,071,025 = 1,800,049.76 gallons.

This equals approximately **\$2,223,061**

And **19,632** tons of CO₂

Future Measures in Residential Transportation Sector

10% Challenge Residential Transportation Program

Page Number in Action Plan: 55

This measure seeks to achieve a 10% reduction in residential transportation emissions with the implementation of a residential transportation conservation program. The City of Keene could develop a residential transportation efficiency program in conjunction with the residential energy efficiency program listed earlier. Keene could develop a transportation education and outreach program for citizens and schoolchildren that advocate public transit, ride sharing, multiple trips, biking, walking and the importance of buying or leasing vehicles that achieve good gas mileage. The program could involve the creation of informational material and workshops that outline available resources, contacts and strategies for gasoline conservation. If the residential transportation efficiency program resulted in a 10% decrease in carbon dioxide emissions for Keene residences, 6,511 tons of CO₂ would be eliminated and an annual financial savings of \$775.3 could be achieved after payback period.

10% of 4,602.402 gal gas = 460

10% of 1,399.83 gal diesel = 140

1.235 price per gas average = 460 * 1.235 = \$568.1

1.48 price per diesel average = 140 * 1.48 \$207.2

568.1 + 207.2 = \$775.3

- Implementation of program cost: \$2,500 for educational materials and coordination of workshops.
- Financial Savings for Keene Residents (775.30) - \$(2,500) =
- Payback: 3 years

Sustainable Business Awards Program

Page Number in Action Plan: 62

The base level of energy is taken from the 1995 Inventory on Commercial and Industrial energy use. It is assumed that the project would be started in 2005, but that the goal of Keene's businesses committing to a 10% reduction in energy usage would not be achieved until 2015. According to information in the 1995 Inventory, there are 575 Commercial properties in Keene. The energy usage in 1995 for these properties was:

146,121,798 kwh electricity
2,027,235 gallons of light fuel oil
664,154 therms of propane

Thus, on average per property basis, (These numbers are total energy usage divided by 575 – number of businesses)

254,125 average kwh/property
3,526 average gallons/property
1,155 average therms/property

Therefore, a 10% reduction in energy use per property would mean a reduction of:

25,412.5 kwh reduction in electricity
352.6 gallons reduction in oil
115.5 therms reduction in propane

If all of these businesses reduced their energy by 10% that would mean:

14,612,179.8 kwh electricity
202,723.5 gallons of light fuel oil
66,415.4 therms of propane

Average Price of :

Electricity: \$0.12 per kwh

Oil: \$1.077 per gallon

Gas: \$1.507 per therm

Therefore, the potential energy reductions for the Commercial/Industrial properties:

14,612,179.8 kwh electricity = 4,186 CO2 Reduction = \$1,753,462 Savings
202,723.5 gallons oil = 2,232 CO2 Reduction by 2015 = \$218,333 Savings
66,415.4 therms propane = 482 CO2 Reduction by 2015 = \$100,088 Savings

Implementation cost: Salary of Environmental Coordinator to administer program (cost accounted for in separate measure); \$2,000 for recognition and awards

Existing Waste Expanded Paper Recycling

Page Number in Action Plan: 63

Since 1993 the Solid Waste Division has been actively seeking to divert increasing amounts of fiber products from the residential and commercial waste stream. As can be seen in the table below our efforts have paid off. However, there remains a significant portion of fiber that is not recycled for a variety of reasons. There is approximately 34,000 tons of total wastestream. 60% of this is considered Keene specific. Therefore 20,400 tons of waste is Keene specific.

	Mixed Paper	Cardboard	Totals	% Change from Prior Year
Total 1993	910,200	1,512,580	2,422,780	
Total 1994	712,573	846,605	1,559,178	-36%
Total 1995	875,258	1,796,392	2,671,650	71%
Total 1996	1,582,410	2,838,840	4,421,250	65%
Total 1997	2,356,480	3,389,460	5,745,940	30%
Total 1998	2,802,420	4,518,660	7,321,080	27%
Total 1999	3,594,220	6,049,360	9,643,580	32%
Total 2000	3,261,220	5,571,970	8,833,190	-8%
Total 2001	3,863,240	6,411,810	10,275,050	16%
All Total (pounds)	19,958,021	32,935,677		

Follow-Up Measure: Expand paper recycling to 12,000,000 pounds per year.
This equates to $12000000/2000 = 6,000$ tons

The Solid Waste Division, in cooperation with Waste Management of New Hampshire will target small businesses for fiber recycling. Within the next two years the goal is to solicit 50 small businesses to participate in a fiber collection route. That along with expanded education geared towards the residential sector should allow the City of Keene to achieve the 12,000,000 pound per year total by the year 2004. Versus virgin production each ton of paper recycled realizes approximately 60% energy savings, generates 95% less air pollution (each ton saves 60 lbs. of air pollution), and saves 17 trees and 7,000 gallons of water (sources Center for Ecological Technology and EPA).

Keene

Corporate Greenhouse Gas Emissions Reductions in 2015 Target Year Measures Summary by Sector

<i>Measures Summary</i>	Equiv CO ₂ (tons)	Equiv CO ₂ (%)	Energy (million Btu)	Energy Cos Savings (\$)
Buildings Sector	229	12.4	2,813	39,957
Vehicle Fleet Sector	1,141	62.1	346	4,747
Employee Commute Sector	42	2.3	483	4,747
Streetlights Sector	14	0.8	170	3,857
Water/Sewage Sector	182	9.9	2,165	27,917
Waste Sector	223	12.1		
Other Sector	6	0.3		
Total	1,837	100.0	5,977	81,217

<i>Climate Action Plan</i>	(tons eCO ₂)
Base Year 1995 Emissions	7,097
Target Year 2015 Emissions Forecast	6,894
Target Emissions Level	5,677
Emissions Reductions Required to Meet Target	1,217
Emissions Reductions in Climate Action Plan as of 2015	1,837

Keene

Corporate Greenhouse Gas Emissions Reductions in 2015 Target Year Measures Detailed Report

	Equiv CO ₂ (tons)	Equiv CO ₂ (%)	Energy (million Btu)	Energy Cost Savings (\$)
Buildings Sector				
<i>Change in Energy Source</i>				
Solar Panels on 2 Buildings	2	0.1	25	641
Purchase Green Power	1	0.0	0	0
<i>Energy Efficiency: Buildings</i>				
Education-Elec-10%	46	2.5	546	21,670
Education-Gas-10%	36	2.0	501	9,202
Education-Oil-10%	144	7.8	1,741	8,445
Subtotal Buildings	229	12.4	2,813	39,957
Vehicle Fleet Sector				
<i>Absolute Emissions Reduction</i>				
Biodiesel Project	417	22.7		
School Bus Program	467	25.4		
	190	10.3		
<i>Change in Fuel Type</i>				
CNG Project	28	1.5	-106	0
Electric Vehicles	5	0.3	56	599
<i>Increase in Fuel Efficiency</i>				
Hybrid Car Replacements	4	0.2	49	486
Hybrid Car Replacements	5	0.3	53	525
Hybrid Car Replacements	5	0.3	55	544
Hybrid Car Replacements	9	0.5	99	977
<i>Walking/Biking</i>				
Police Units on Bikes	6	0.3	69	805
Expand Police on Bikes	6	0.3	69	805
Subtotal Vehicle Fleet	1,141	62.1	346	4,741

Keene

Corporate Greenhouse Gas Emissions Reductions in 2015 Target Year Measures Detailed Report

	Equiv CO ₂ (tons)	Equiv CO ₂ (%)	Energy (million Btu)	Energy Cost Savings (\$)
Employee Commute Sector				
<i>Car/Van Pooling</i>				
Parking Reimbursement	37	2.0	425	4,173
<i>Other VMT Reduction</i>				
Telecommuting	5	0.3	58	569
Subtotal Employee Commute	42	2.3	483	4,742
Streetlights Sector				
<i>Energy Efficiency: Lamp and Ballast</i>				
Streetlights Replacements	1	0.1	12	247
Streetlights Replacements	2	0.1	27	629
Streetlights Replacements	2	0.1	30	754
Streetlights Replacements	2	0.1	20	414
Streetlights Replacements	0	0.0	2	33
Streetlights Replacements	0	0.0	2	30
Streetlights Replacements	3	0.2	38	900
Streetlights Replacements	1	0.1	14	314
Streetlights Replacements	1	0.1	15	313
Streetlights Replacements	1	0.0	11	220
Subtotal Streetlights	14	0.8	170	3,854
Water/Sewage Sector				
<i>Energy Efficiency: Equipment and Lighting</i>				
Aeration Mixers	114	6.2	1,357	17,499
Sludge pumps	4	0.2	46	595
Septage Aeration	48	2.6	568	7,323
VFD	16	0.9	194	2,498
Subtotal Water/Sewage	182	9.9	2,165	27,915

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	Equiv CO ₂ (tons)	Equiv CO ₂ (%)	Energy (million Btu)	Energy Cost Savings (\$)
Waste Sector				
<i>Methane Recovery</i>				
Methane Recovery	140	7.6		0
<i>Waste Recycling</i>				
Internal Recycling Program	83	4.5		0
Subtotal Waste	223	12.1		0
Other Sector				
<i>Absolute Emissions Reduction</i>				
Tree Planting	6	0.3		
Subtotal Other	6	0.3		
Total	1,837	100.0	5,977	81,210