Sustainability in Hanover

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EXECUTIVE SUMMARY

The manifestations of global warming and climate change can be seen in cities, towns, and villages all over the world, although their specific effects depend on a number of local geographical, political, social, and economic factors. Local governments are in a unique position to address the main contributors of greenhouse gas emissions that drive global climate change: energy use, transportation, waste, and land use. Land use, zoning, building codes, waste disposal, service delivery, and management of schools, parks, and recreational areas all affect a municipality's energy inputs and outputs. Local governments can also influence the culture of sustainability in a municipality through education and outreach that influence citizen energy use, consumption patterns, and consumer choices.[1]

This project has two main goals. The first is to raise awareness about actions that governments, businesses, and individuals can take to reduce the threat of global warming through reductions in greenhouse gas emissions and to guide decision makers, business owners, and homeowners in Hanover toward policies, strategies, and actions that can make Hanover more sustainable. The second is to create a resource manual that improves the town's sustainability, helps manage current sustainability practices, and provides feedback on policies not currently pursued. This resource manual will have three main focuses: 1) assessing Hanover's current practices, 2) assessing outside practices that could be implemented in Hanover, and 3) providing policy recommendations based on the assessments.

The development of community-specific policies and programs that seek to reduce greenhouse gas emissions and foster sustainability tend to involve one or more of the following elements: an emissions inventory to identify the major sources of greenhouse gas production and establish a baseline to measure future progress; a solutions plan that is community specific and meets the specified target for greenhouse gas reduction and other sustainability goals; a commitment from the local government to create a reduction target in greenhouse gas emissions; and the formation of citizen activist groups focused on educating and working with citizens, the local government, businesses, schools, and other municipalities on issues related to sustainability. Lastly, a method to implement and monitor progress toward reaching the set goals is necessary.[1]

Small towns and big cities alike have started to incorporate sustainability initiatives into local policies. Some of these initiatives are specific to the community, and others have been put into place in many communities across the United States and abroad. Sustainability measures that we consider to be "smart practices" not only benefit the environment, but are cost-effective and enforceable, encourage citizen involvement, and have proven successful in their communities. Communities that currently implement smart practices include Burlington, Vermont; the Chequamegon Bay Region, Wisconsin; the Duluth Superior Area, Minnesota; Lawrence Township, New Jersey; Keene, New Hampshire; and Cambridge, Massachusetts.

Hanover is making strides with regard to sustainability, but more can be done. Hanover can learn from smart practices in similar communities, encourage more community participation and education, and strengthen the relationship between the Town and Dartmouth College.

1. PURPOSE AND BACKGROUND

1.1 Purpose and Definition

This project has two main goals. The first is to raise awareness about actions that governments, businesses, and individuals can take to reduce the threat of global warming and climate change and guide decision makers, business owners, and homeowners in Hanover toward policies, strategies, and actions that can make Hanover more sustainable. The second is to create a resource manual that improves the town's sustainability, helps manage current sustainability practices, and provides feedback on policies not currently pursued. This resource manual will have three main focuses: 1) assessing Hanover's current practices, 2) assessing outside practices that could be implemented in Hanover, and 3) providing policy recommendations based on the assessments.

At the 1987 World Commission on Sustainable Development, the United Nations General Assembly agreed upon a broad definition of sustainability as "the ability to meet the needs of the present generation without compromising the ability of future generations to meet their own needs."[2] In their Climate Action Plan, the city of Burlington, Vermont defined a sustainable city as "a city where environmental, economic, and social conditions contribute to the well-being of all."[3] Based on these definitions, an evaluation of Hanover's current practices, and research identifying sustainability practices in other communities, we find that further steps could be taken to increase sustainability within the community through reductions in greenhouse gas emissions.

1.2 Background

The manifestations of global warming and climate change can be seen in cities, towns, and villages all over the world, although their specific effects depend upon a number of local geographical, political, social, and economic factors. New England is already experiencing the consequences of rising sea levels, unpredictable weather patterns, and rising temperatures.[4] Models indicate that New Hampshire winters could become as much as 60 percent wetter than they are today, and summers could be as much as 60 percent drier.[4] The average temperature in Hanover has risen 1.8 degrees Fahrenheit over the past 120 years.[4] According to the New England Environmental Protection Agency (EPA), such changes would affect forests and coastal areas through the population dynamics of insects, disease vectors, windthrow (trees uprooted by strong winds), fire, coastal erosion, and the increasing intensity of hurricanes. Timber and recreation values could decrease, and wildlife habitat, fisheries, water and air quality, and local economies may be adversely impacted.[4]

Local governments are in a unique position to address the main contributors of greenhouse gas emissions that drive climate change: energy use, transportation, waste, and land use. Land use, zoning, building codes, waste disposal, service delivery, and management of schools, parks, and recreational areas all affect a municipality's energy inputs and outputs. Local governments can also influence the culture of sustainability in a municipality through education and outreach on issues like citizen energy use, consumption patterns, and consumer choices.

2. HOW DO COMMUNITIES BECOME MORE SUSTAINABLE?

2.1 Introduction

Cities across the United States have worked to create sustainable communities in ways that are often more effective and more aggressive than actions taken so far at the national level. For example, on February 16, 2005, Mayor Greg Nickels of Seattle launched the U.S. Mayors' Climate Protection Agreement. The Agreement brings the Kyoto Protocol to a municipal level by enacting policies and programs that strive to meet or beat the greenhouse gas reduction target identified for the United States: a seven percent reduction below 1990 levels by 2012. The U.S. Conference of Mayors recently created the Mayors' Climate Protection Center to monitor the Agreement's progress, and to date, more than 200 mayors representing more than 42 million Americans in 38 states have signed the Agreement.[5] This section addresses how local governments, businesses, and citizens have been incorporating sustainability into their communities and how effective such policies have been in reducing greenhouse gas emissions and promoting citizen involvement.

2.2 Development of a Community Sustainability Plan

The development of community-specific policies and programs that seek to reduce greenhouse gas emissions and foster sustainability tend to involve one or more of the following elements:

- A global warming emissions inventory to identify the major sources of greenhouse gas production and establish a baseline to measure future progress;
- A solutions plan that is community-specific and meets the specified target for greenhouse gas reduction and other sustainability goals;
- A commitment from the local government to create a reduction target in greenhouse gas emissions;
- The formation of citizen activist groups focused on educating and working with citizens, the local government, businesses, schools, and other municipalities on energy, transportation, waste, and other issues related to sustainability;
- A method to implement and monitor progress toward reaching set goals.

Small towns and big cities alike have started to incorporate sustainability initiatives into local policies. Some of these initiatives are specific to the community and others have been put into place in many communities across the United States and abroad. Sustainability measures that we consider to be "smart practices" not only benefit the

environment, but are cost-effective, encourage citizen involvement, and are enforceable and successful in their communities.

2.3 General Sustainability Practices: Global Warming Emissions Inventory

A global warming emissions inventory identifies and quantifies the global warming pollution produced by the community in a particular year. An inventory is established by collecting data about energy purchases and use from residential and municipal buildings and operations, recycling and waste reduction, transportation, and land use.[6] The city of Somerville, Massachusetts measured energy purchases and use from municipal buildings, transportation, water, and waste disposal using data from local, state, and federal agencies, local utilities, and non-profit organizations. Specialized software designed by the International Council of Local Environmental Initiatives (ICLEI) and Torrie Smith Associates analyzed the data to calculate equivalent carbon dioxide emissions.[7] This inventory provides a benchmark against which the city can measure the effectiveness of policies designed to reduce greenhouse gas emissions and set a target for future reductions. Additionally, an emissions inventory identifies the activities that contribute to global warming pollution, the quantity of pollution generated, and the energy costs of each of these activities. This information helps streamline and target policies where they will be the most effective in reducing greenhouse gas emissions in a cost-effective manner.

The challenge to conducting an inventory is primarily the cost and expertise required; however, groups such as the International Council of Local Environmental Initiatives (ICLEI) are ameliorating this challenge by providing free software and training for local governments to track and quantify emissions outputs and help develop future emissions scenarios.[8] Another challenge is collecting emissions data on waste disposal, construction, and other activities where the energy costs do not come directly from a utility and require combining data from a number of different sources.

2.4 General Sustainability Practices: Climate Agreements

One way local governments incorporate sustainability into their communities is through regional or national agreements to reduce greenhouse gas emissions and waste, promote energy efficiency, encourage the use of alternative and renewable technologies, and recycle. Climate agreements are not sustainable outcomes themselves; rather, they are outputs that require actions and changes in behavior that lead to sustainable outcomes. These agreements are beneficial because they establish targets or goals for greenhouse gas emissions reductions to which local governments can be held accountable. The challenges to such commitments are similar to those seen at the international level: a reliance on individual communities to develop and implement plans that meet the targets or goals without addressing existing community resources or lack of compliance.

New Hampshire is part of the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort by nine Northeast and Mid-Atlantic states to design a regional cap-and-trade program initially covering carbon dioxide emissions from power plants in the region,

with the hope of eventually including other greenhouse gases and their sources.[9] Cities can also join the International Council for Local Environmental Initiatives (ICLEI), which "provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level."[10]

3. SPECIFIC SUSTAINABILITY PRACTICES

3.1 Energy

Policy solutions to improve sustainability within a community have focused on reducing greenhouse gas emissions in four broad areas: energy, transportation, waste, and land use. Sustainable policies focused on energy include:

- Green power purchases from solar, wind, biomass, hydroelectric, and geothermal sources;
- Energy audits and energy retrofits;
- Installation of Energy Star and other energy-efficient appliances and technologies;
- Implementation of programs to provide low-income weatherization services;
- Construction of LEED (Leadership in Energy Efficient Design) and Energy Star certified homes and buildings;
- Citizen education through campaigns targeted at energy conservation.

3.1.1 Specific Energy Solutions: Burlington, Vermont

Policies. In 1996, Burlington's City Council voted in favor of joining the "Cities for Climate Protection (CCP)" campaign, which is run by the International Council for Local Environmental Initiatives (ICLEI).[11] The foundation of the CCP is to help towns and cities adopt and implement sustainable policies that will help to reduce greenhouse gas emissions, improve the community's air quality, and create a more livable community.

In 1998, Burlington's City Council passed a resolution to reduce greenhouse gas emissions in the city to 10 percent below the 1990 levels by 2005.[12] The campaign challenges all parts of the community (individuals, the city government, businesses, others) to reduce their emissions by at least ten percent. The campaign tracks the community's progress and educates the public on the best practices to live a more sustainable life.

Once Burlington joined the CCP and passed this resolution, the Mayor formed a committee named the Climate Protection Task Force. This committee was in charge of developing an action plan so the city could discover the best ways to meet their target by 2005. One initiative is the Lawn Mower Exchange Program, which encourages citizens in Vermont to trade in their gas mowers in exchange for a substantial discount on an efficient electric mower called the Neuton Cordless Electric Lawn Mower.[13] The exchange program also educates the public with tips for keeping a more environmentally safe lawn. One other initiative under the 10 Percent Challenge is the 55 mph Slows Down

Global Warming campaign. Driving 55 mph in a 65 mph zone in Vermont would save motorists 25,000 gallons of fuel per day and 700,000 pounds of global warming pollutants per day.[14]

Results. The 10 Percent Challenge campaign model has proven successful in New Hampshire and Vermont. Six other towns and cities are now using this model to improve sustainability in their communities. These cities are Keene, NH; Brattleboro, VT; Middlebury, VT; Charlotte, VT; Underhill, VT; and Williston, VT.[15]

3.1.2 Specific Energy Solutions: Keene, New Hampshire

Policies. Keene has implemented sustainability programs that both reduce greenhouse gas emissions and saved the city money annually. These include:

- Replacing traditional red and green traffic signals with light emitting diode (LED) lights;[16]
- Adopting the Cities for Climate Protection campaign in 2004;[17]
- Signing a Memorandum of Understanding (MOU) with the Clean Air-Cool Planet campaign, its mission being to "solve global warming problems, develop economically efficient and innovative climate policies and to mobilize civic engagement to implement practical climate solutions;"[18]
- Installing a landfill gas-to-energy generator at the Keene Municipal Landfill;
- Investigating the possibility of using a wind turbine to generate power at the local landfill.[19]

Results. Replacing traditional traffic lights with LEDs uses 80-90 percent less energy and requires one-sixth of the maintenance.[20] Keene reduces its carbon emissions by 15 tons and saves $4,000 annually from LED lights.[21] The new landfill generator saves Keene $55,000 annually and eliminates 140 tons of hydrocarbons that would otherwise be released into the air.[22]

3.1.3 Specific Energy Solutions: Cambridge, Massachusetts

As a member of the Cities for Climate Protection campaign, Cambridge, Massachusetts set two main goals for the city. The first was to reduce greenhouse gas emissions to 20 percent below 1990 levels by 2010, and the second was to draw 20 percent of the municipal electricity load from renewable sources by 2010.[23] Specific energy solutions include:

- Formation of the Cambridge Energy Alliance to reduce greenhouse gas emissions in the fields of energy, green facilities, and transportation;
- Hired Engaged Think Energy, a consultant firm in Washington DC, to assess city facilities for possible renewable energy installations;[24]
- Incorporated U.S. Green Building Council's LEED standards for city projects on many buildings, including a portion of City Hall and a youth center;[25]

- Created bicycle lanes, bicycles racks, and the Cambridge Walk campaign to promote transportation alternatives.

Cambridge is home to two universities, Harvard and MIT, both of which have made great strides in sustainability. The Harvard Green Campus Initiative is focused on the use of renewable energy and green building design and has started dorm-based initiatives to promote sustainability.[26] MIT also started a sustainability initiative that dedicates research and campus education to concerns involving energy use.

Results. Cambridge's energy solutions have reduced carbon dioxide emissions by 1,230 tons and saved the city $284,000 annually.[27]

3.2 Transportation

Sustainable transportation initiatives include car-pooling, walking, biking, car-share programs, and mass transportation; utilizing energy-efficient and alternative fuel vehicles; establishing idle-free zones; improving the synchronization and energy-efficiency of traffic signals; and building alternative fuel and electric plug-in stations for hybrid and electric vehicles.

3.2.1 Specific Transportation Solutions: Philadelphia, Pennsylvania

Policies. PhillyCarShare is a nonprofit organization started by four Philadelphia residents that offers the use of environmentally-friendly vehicles for a fee to offset gas costs. One year after its conception, this grassroots program had 535 members who chose to give up 270 personal vehicles to share 13 environmentally-friendly vehicles.[28] In 2004, Philadelphia became the first government to join PhillyCarShare in a municipal fleet reduction effort.

Results. PhillyCarShare replaced 330 municipal vehicles and 1,200 citizen vehicles, saving residents $5.5 million in costs and reducing vehicle travel by 8.2 million miles per year.[29] Berkeley, California; Minneapolis, Minnesota; and Portland, Oregon have followed Philadelphia's lead.[30]

3.2.2 Specific Transportation Solutions: Keene, New Hampshire

Policies. In Keene, New Hampshire, all 77 of the city's fleet vehicles run on 20 percent biodiesel (B20) fuel.[31] B20 fuel tends to perform better in colder environments and prevents an estimated 12 tons of carbon dioxide from entering the atmosphere annually.[32] Another simple initiative Keene put into place is a program called "Police on Bikes," that takes police officers out of cars and onto bicycles.

Results. Keene saves $805 in fuel expenses annually by moving more police officers from cars to bicycles, and the city has reduced its annual fuel emissions by six tons.[33]

3.3 Waste

Sustainable practices that promote recycling and waste reduction have included: expanding recycling programs and targets; establishing programs for recycling solid waste and construction/demolition materials; implementing composting programs; and educating the community to promote compliance with penalties for non-compliance.

3.3.1 Specific Waste Solutions: San Francisco, California

Policy. San Francisco, California instituted residential curbside collection of organic material as part of its Fantastic Three program, which provides each household with a green cart for organic waste, a blue cart for mixed recyclables, and a black cart for all remaining trash.

Results. The Fantastic Three program enabled San Francisco to reach a reported overall garbage diversion rate of 67 percent in 2004.[34] Co-collecting compost with trash and other recyclables saves money by decreasing the number of collection trips. The Sunset Scavenger Company, which operates the program with San Francisco, predicts that the initial costs for new dual trucks and composting containers will balance out in ten years as older vehicles need replacements.[35] Recycling and composting are included in trash rates for residents, so the Fantastic Three program can save residents money through reductions in trash bin size and the addition of free compost bins.[36]

3.3.2 Specific Waste Solutions: Montgomery County, Maryland

Policy. Montgomery County, Maryland installed a methane collection system in the Rockville, Maryland landfill.

Results. The methane collection system has saved millions of dollars in capital.[37] Approximately 600 million cubic feet of 50 percent methane landfill gas is prevented from going into the atmosphere each year. This is equivalent to approximately 120,000 tons of prevented carbon dioxide and 20,000 megawatt hours of electricity generated per year – enough to serve an estimated 2,700 homes.[38] Montgomery County also generates revenue from the sale of landfill gas rights.

3.4 Land Use

Sustainable land use practices resemble Smart Growth principles such as preserving open space through high-density, multi-use, and fill-in development; establishing energy-efficient building and construction codes; zoning for growth boundaries and ordinances to reduce sprawl; and planting trees to produce shade and absorb carbon dioxide. With funding from a statewide urban forest energy efficiency initiative, Newark, New Jersey planted over 500 trees in strategic places to offset carbon emissions and promote energy savings through increased shading. It has been estimated that each tree, if planted strategically, could reduce heating and cooling costs for buildings by 12 percent.[39]

3.5 Citizen Involvement

Citizen involvement plays a large part in the success of local sustainability policies. Research revealed numerous case studies where citizens were the initiators, educators, implementers, and accountability-holders of sustainable policy solutions. Citizens can aid policy makers in identifying community needs, concerns, and potential with regard to current and best practices that promote sustainability. The Vermont Energy and Climate Action Network (VECAN) describes the benefits of grassroots energy and climate action committees as sources of information for decision makers and voters on "how to advance cost-effective strategies to save energy and reduce waste."[40]

3.5.1 Specific Citizen Involvement Solutions: Chequamegon Bay Region, Wisconsin

Policies. The Chequamegon Bay region of Wisconsin includes the towns of Ashland, Bayfield, and Washburn. In 2005, an organization called the Alliance for Sustainability started the Sustainable Chequamegon Initiative. In the same year, the Alliance for Sustainability hosted a workshop on eco-municipalities with the founder of Sweden's groundbreaking eco-municipality movement called The Natural Step.[41] The mission statement of The Natural Step is "to accelerate global sustainability by guiding companies, communities and governments onto an ecologically, socially, and economically sustainable path."[42] Residents of the Chequamegon Bay region were educated in the practices of The Natural Step in weekly discussion groups of 8-12 citizens called "Study Circles."[43] Citizens also formed the Green Team, a three-year program that seeks to reduce the energy consumption and negative environmental impact of participating organizations by providing training, networking, and technical support.[44]

Results. During the fall of 2005, Washburn and Ashland received national attention for their eco-municipality resolutions and officially became the first two communities in the United States to pass Natural Step resolutions.[45]

Each Green Team in the region created an action plan for their specific organization. Participating entities include towns, Native American tribes, colleges and universities, industries, and retailers throughout the Chequamegon Bay region.

In 2007, a sustainability office opened in Chequamegon with a full-time manager.[46] The initial funding for the center supports a DVD project addressing solar energy and a networking program to connect Green Teams throughout the region.[47]

3.5.2 Specific Citizen Involvement Solutions: Lawrence Township, New Jersey

Policies. In 2006, Sarah James from The Natural Step came to Lawrence Township for a one-day event.[48] Following this event, the Mayor of Lawrence created the Mayor's Task Force on Sustainability, with The Natural Step as its sustainability practice of choice.[49] These sustainability measures and one more sustainability workshop led by Sarah James led to the formation of Sustainable Lawrence. Sustainable Lawrence started an organization called Future Search, which gathers people throughout the community to

meet in small groups and ultimately adopt an action plan and create task forces focused on sustainability improvements.[50]

Sustainable Lawrence, unlike many sustainability measures that are backed by the city, is a non-profit organization with partnerships in the area. The rationale behind this model is that the program can have impact and influence outside the borders of Lawrence.

Results. The formation of Sustainable Lawrence has created partnerships between local corporations, town governments, the school and university systems, and local farmers. The community has a partnership with Rutgers University that will create sustainability indicators, effective ways to collect data, and track the progress of Lawrence statistically.[51] The Future Search brought together people throughout the community to meet in small groups and join forces to adopt an action plan for the city to implement.

3.5.3 Specific Citizen Involvement Solutions: Duluth-Superior Area, Minnesota

Policies. In 2006, the Duluth City Council took steps to support sustainable community development through funds to train city staff on the practices of The Natural Step.[52] In 2007, the Duluth-Superior Area Community Foundation funded an eight-week, door-to-door sustainability campaign.[53] The canvassing was done by four college student interns, who gave citizens CFL light bulbs in exchange for their incandescent bulbs. They also gave out free local public transportation tickets and sustainability literature.

Results. Due to the initial success of the program, it was repeated in 2008.

3.5.4 Challenges to Citizen Involvement

The challenges to citizen involvement include a reliance on consistent volunteer efforts and the organization, education, and mobilization of those volunteers. The effort it takes to network for support and resources among other citizen groups, businesses, and the local government can be very time and work-intensive. Also, one community member's environmental concerns are not necessarily equal to those of her or his neighbor. Sustainability is applicable to a wide range of local issues, including land use and zoning, business and economic development, environmental protection and recreation, and education; therefore, issue prioritization can determine the level of citizen involvement and the community commitment to groups promoting sustainability. Finally, maintaining motivation toward increased sustainability, the effects of which may not be immediately or directly apparent, requires a strong commitment to the perceived long-term benefits of implementing such practices.

4. SUSTAINABLE PRACTICES IN HANOVER

4.1 Hanover: Current Energy Practices

The Town of Hanover produced approximately 3,250 metric tons of carbon dioxide emissions between 2005 and 2006. This includes emissions from burning fuel for heat,

vehicles, and power plants providing electricity.[54] Town buildings account for the largest share of emissions at 36 percent, followed by the wastewater treatment plant at 25 percent, vehicles at 20 percent, streetlights at 13 percent, and water works at five percent.[55]

The Town of Hanover has conducted lighting audits of all municipal buildings, installed programmable thermostats to reduce fuel oil consumption, lowered office temperatures town-wide, and replaced many light fixtures to reduce electricity usage. The Hanover Climate Protection Campaign (CPC) contacted auditors and encouraged them to submit proposals to increase the energy efficiency of town buildings. Energy auditor Margaret Dillon was selected by Frank Austin, the Hanover Fleet and Facilities manager, to conduct more comprehensive energy audits on municipal buildings, including a blower test and use of infrared testing equipment to determine heat loss and remediation strategies.[56] Audits were scheduled for January of 2008, and the results have not yet been published.

In addition to the energy audits mentioned above, Hanover High School and Richmond Middle School have installed wood chip conversion technology. In 2006, the Richmond Middle School saved upwards of $45,000 by converting to wood chips. This amount exceeded the annualized cost of building the facility. Minimal technical or logistical problems have been encountered.[57] The Hanover CPC conducts community workshops to connect residents with groups such as the New Hampshire Electricity Coop and "Green-e.org," which provide free energy audits and rebates for residential homes seeking to install alternative and renewable energy technologies such as solar panels, wind turbines, and solar water heating systems.[58]

4.1.1 Assessment of Current Energy Practices

Buildings are the leading source of carbon dioxide emissions in Hanover, and energy audits provide the most cost-effective opportunities for energy efficiency improvements. Improving weatherization, especially on older homes, and conducting more extensive energy audits on both municipal and residential buildings can save both energy and money.

There are up-front costs for the energy audits, but the savings from the reduction in energy usage can result in a return on the initial investment. While no statistical data have yet been produced on the energy and cost savings of Hanover's current practices, encouraging citizens to turn down thermostats, to recycle and compost, and to carpool, walk, bike, and reduce driving are all energy-saving practices that cost nothing to implement and may actually save the town money.

4.2 Hanover: Current Transportation Practices

Street lights account for 13 percent of Hanover's carbon dioxide emissions. Hanover currently leases about 480 streetlights from the National Grid at a cost of approximately $80,000 per year.[59] The lights are a mixture of mercury vapor and high pressure sodium,

both of which are relatively inefficient. Changing to more efficient lighting, town ownership of lights, and elimination of some lights have been discussed as energy and money-saving options.[60]

Hanover's Public Works department currently uses 10 percent biodiesel (B10) fuel in its fleet vehicles and is seeking to upgrade to B20 biodiesel.[61] The Hanover CPC works with schools, businesses, media outlets and the Town to encourage people to turn off automotive engines rather than idling. Idling observed and analyzed at the Bank of America for nine days produced an estimated 30,000 pounds of annual carbon dioxide emissions and 1,500 gallons of wasted fuel at the drive-up area each year.[62]

4.2.1 Assessment of Current Transportation Practices

Switching from incandescent signal lights to LEDs improves the efficiency and lifespan of the signals, which results in energy savings and reduced maintenance costs. However, the National Grid does not offer more efficient lights, and with rapidly changing technology, the option of town ownership seems unlikely to be cost-effective at this time.[63] Hanover also works with the Streetlighting Committee and National Grid to remove any unnecessary lights.

Citizen and police involvement in the No Idling campaign is crucial to its success. "No Idling" signs have been posted in area schools, parking lots, the Howe Library, and Kendal. "No Idling" stickers and information cards are distributed to newly registered vehicles. A Hanover CPC member is also trying to organize a seminar series on sustainable, low carbon emitting transportation.

4.3 Hanover: Current Waste Practices

Hanover has a recycling program (Hanover Recycles!) that provides biweekly curbside collection services along with special days for Christmas tree, scrap metal, electronics, and household hazardous waste collection and recycling. During the 1990s, the Town and Dartmouth College collaborated in the construction of the Hanover-Dartmouth Composting facility, which accepts sludge, food waste, yard waste, paper waste, and sawdust from the town, Dartmouth College, and the Dartmouth-Hitchcock Medical Center. The high quality compost produced is used on construction projects and sold to local landscapers.[64]

All of the trash collected in the Town of Hanover and Dartmouth College ends up in the Lebanon landfill. Mike Lavalla, Director of Public Works in Lebanon, New Hampshire, reports that the next phase of development at the Lebanon landfill includes a more comprehensive gas management system. A preliminary study was conducted one year ago on the possibility of methane capture and storage for energy needs. A current study to determine the quantity and quality of methane is being analyzed. Several firms have expressed interest in working with the City of Lebanon if such a project comes to fruition.[65]

The wastewater treatment plant accounts for 25 percent of Hanover's carbon dioxide emissions. Each year, it produces 510 tons of carbon dioxide from electricity use and 300 tons from fuel oil use.[66] The facility uses some highly specialized equipment and would require special expertise for design improvements. According to the Hanover CPC, one of the best ways to reduce energy use from the facility is to educate residents that unnecessary water and sewer use incurs both energy and financial costs.[67]

4.3.1 Assessment of Hanover Current Waste Practices

The Hanover Recycling Committee has been monitoring recycling tonnage on a year-to-year basis since 1998. The total combined tonnage of all eight recycling categories has fallen from 1082 tons in 1998 to 818 tons in 2006.[68] (See Appendix A). Co-collecting trash, recycling, and compost, similar to the Fantastic Three program in San Francisco, CA, could increase the trash diversion rate and possibly save money through reducing the number of collecting trips.

According to Betsy Smith, a member of the Hanover Recycling Committee, citizen participation in the recycling program is difficult to determine since numbers exist only for how many new bins are picked up by residents who move in without subtracting those who move out. A comparison of tipping fees for trash with recycling rates could help determine whether recycling alone has decreased or overall waste disposal has decreased.

4.4 Hanover: Current Land Use Practices

Three years ago, Hanover began planting wildflowers in place of lawns in some public spaces to reduce the need to mow weekly.[69] This was the only practice that received some public opposition due to the weed-like appearance of the plants when not in bloom.

4.4.1 Assessment of Hanover Land Use Practices

Land use practices, in particular zoning, construction, and building codes, all have potential for incorporating sustainability through energy-efficiency and the use of recycled materials. Smart practices to consider include incorporating Smart Growth principles into Town planning and construction and planting trees in strategic areas that provide shade in the summer and wind barriers in the winter.

4.5 Hanover: Climate Change Agreements

Hanover is part of the U.S. Mayor's Climate Change Agreement, which designates it a Sierra Club Cool City. Hanover is also a member of the local Sustainable Energy Resource Group (SERG), whose mission is to "promote energy conservation, efficiency and renewables through the formation of town energy committees to help residents, businesses and the municipalities reduce energy consumption, save money, increase the sustainable use of renewables, strengthen the local economy and improve the environment."[70]

4.5.1 Assessment of Hanover's Climate Change Agreements

Climate change agreements are only effective if they are enforced. Enforcement of sustainability initiatives in Hanover comes primarily through citizen enforcement. For a number of programs, in particular recycling, composting, and the No Idling campaign, citizen enforcement through participation is a necessary component of success. Citizen enforcement through political pressure can initiate action on the part of government and business to make commitments to sustainability. Methods of citizen pressure in Hanover have included lobbying the local, state, and national government to sign on and commit to greenhouse gas reduction targets, writing letters and articles, and conducting community outreach and educational events.

4.6 Citizen Involvement in Hanover

Groups focused on promoting and implementing sustainability in Hanover include:

- Hanover Climate Protection Campaign, with members composed of area volunteers collaborating with the Sierra Club, Sustainable Energy Resource Group (SERG), Dartmouth College, Kendal at Hanover, Town Manager Julia Griffin, and other town officials;
- Upper Valley Sierra Club;
- Hanover High Green Bag program, which purchased and distributed reusable cloth bags to area businesses in order to reduce plastic bag waste;
- Hanover Recycling and Sustainability Committee;
- Local Energy Committee Working Group.

Hanover's Climate Protection Campaign has been the primary link among citizens, local government, Dartmouth College, local schools, and businesses in Hanover. Community and school outreach events have included:

- Neighborhood walks to inform residents about climate change,
- Earth-Friendly Halloween party at the Black Senior and Community Center,
- Display tables at the Hanover and Lebanon Co-ops;
- Step-It-Up: Take Action on Global Warming campaigns in Hanover and Lebanon;
- Student survey concerning thoughts, feelings, and actions about global warming (results to be published this spring).[71]

Educational initiatives have included:

- Publication of "Earth-friendly Tips for Kids" and "Conservation Tips for Adults;"
- Columns in the *Upper Valley Parents' Paper*, *Connecticut Valley Spectator*, and the *Valley News*,
- Regional television ads.

4.6.1 Assessment of Citizen Involvement in Hanover

Current sustainability practices in Hanover demonstrate a strong commitment to encouraging citizen involvement in the development and implementation of such practices. Many of the individual actions citizens take (e.g., in choosing to walk or bike instead of drive, to turn off lights and turn down thermostats, to turn off the car engine instead of idling, and to use cloth instead of plastic bags) are cost-effective choices because they lower greenhouse gas emissions and electricity use at no additional cost.

Financial incentives have not yet been utilized to promote business and citizen involvement. According to the American Council for an Energy-Efficient Economy (ACEEE), tax incentives have two advantages. First, tax incentives induce manufacturers to mass produce and market energy-efficient technologies, which lowers the initial costs for these technologies. Second, lowering initial costs makes these technologies more affordable for consumers.[72]

Federal tax incentives exist for a number of energy-efficiency improvements and investments.[73] (See Appendix B). The ACEEE recommends energy-efficiency tax incentives in the following areas: energy-efficient appliances, building equipment, combined heat and power (CHP) systems, commercial building improvements, hybrid electric, battery electric, and fuel cell vehicles, and new home construction.[74] The New Hampshire Public Utilities Commission Code 900 permits homeowners to receive credit for on-site electricity generation that exceeds household consumption so the homeowner is billed only for the net reading on the meter.[75] Local incentives include property tax exemptions for certain renewable energy installations, primarily solar thermal, solar voltaic, wind, and central wood-fired heating systems. As of 2007, 67 cities and towns, not including Hanover, have adopted one or more of these renewable energy property tax exemptions.[76]

The existence of opportunities for citizen involvement does not assume active participation of a large number of citizens. Ways in which Hanover can continue to encourage citizen involvement include:

- Conduct community meetings, discussion groups, and workshops that educate and encourage the public to incorporate sustainability into their daily lives, in particular, to perform energy audits and retrofits on residential units;
- Keep records of the number of attendees, frequency of meetings, and activities of the citizen groups to help measure the amount of active citizen participation in community sustainability;
- Conduct surveys that gauge citizen awareness and reaction to sustainability initiatives.

5. POLICY OPPORTUNITIES FOR IMPROVING SUSTAINABILITY IN HANOVER

Sustainability in Hanover can be improved through the implementation and promotion of the following policies. Included in the table are action steps, rough estimates of the costs, benefits, and speed of implementation of the recommended policies.

Table 1. Summary of policy opportunities for improving sustainability in Hanover.

POLICY	ACTION STEPS	COST/BENEFIT	TIMELINE
Greenhouse gas emissions inventory	• Continue energy monitoring • Energy audits • Make data publicly available • Establish reduction target	• Low-to-medium initial costs • Payback through energy savings	Immediate
Improve weatherization on public buildings	• Storm windows • Caulk holes • Air locks • Insulation	• Low-to-medium initial costs • Payback through energy savings	Immediate
New building and construction codes	• Minimum requirements for energy efficiency • Recycled building materials • Solar access	• Medium-to-high costs • Payback through energy savings • Alternative energy	Immediate to long-term
No Idling Campaign	• Informational fliers and signs • Seminars on low carbon transportation alternatives	• Low cost • Potential to reduce 30,000 pounds of CO_2 and 1,500 gallons of wasted fuel per year	Continual
Energy-efficient street lighting	• Continue replacement of traffic lights with LEDs • Eliminate unnecessary lights	• High initial costs • LEDs improve energy efficiency and lifespan of traffic lights • Payback through energy savings	Continual
Upgrade to B20 fuel in fleet vehicles	• Switch from B10 to B20 fuel in fleet vehicles	• Low-to-medium cost • Reduces fuel oil use	Immediate

Methane collection from Lebanon landfill	• Feasibility study of methane generators • Installation of methane capture and storage system	• High initial cost • Potential to save money and generate revenue through sale of landfill gas • Reduces CO_2 emissions and conserves electricity	Long-term
Reexamine recycling program	• Compare tipping fees with recycling rates • Co-collection of waste, recycling, and compost • Financial incentives	• Decreasing collection trips could save money • Increasing tipping fees could provide financial rewards for recycling	Immediate to long-term
Explore property tax incentives for energy retrofits	• Research existing federal, state, and local tax incentives for energy-efficient and alternative energy technologies	No initial costs	Immediate
Become a member of ICLEI	• Agree to become a member and register on-line	• No cost • Assist with global warming emissions inventory • Resource for other municipal sustainability practices	Immediate
Create a municipal Sustainability Office or Sustainability Officer	• Contact municipalities with similar programs to examine effectiveness	• Salary for Sustainability Officer • Expert focused on improving sustainability	Immediate to long-term
The Natural Step	• Contact Sarah James to conduct The Natural Step workshops and discussion groups	• Minimal cost • Resource for developing a municipal sustainability plan	Short-term
Dartmouth College-Hanover connection	• Make contacts with campus sustainability leaders • Share ideas and resources	No cost	Immediate to long-term

6. CONCLUSION

Hanover is making strides with respect to incorporating sustainability, but more can be done. Many of the initiatives involve community participation and motivation, which are reasonable expectations of an educated, involved community such as Hanover. Hanover is a small town and does not have the abundance of resources and finances as some bigger cities, but many of the policy options listed above are simple, cost-effective, and produce a return on the initial investment. Many of the towns and cities studied had sustainability initiatives that brought together community members, the city government, businesses, and the university system. The relationship between Hanover and Dartmouth College with regard to sustainability should continue to strengthen. Hanover's proximity to Dartmouth College and existing facilities such as the Hanover-Dartmouth Composting facility and the wastewater treatment plant make close collaboration a requirement for integrated sustainability. In conclusion, sustainability in Hanover can be improved by carefully integrating current Town resources with existing smart practices in similar towns.

APPENDIX A: WASTE TONNAGE BY YEAR

YEAR	MIXED PAPER	PET	HDPE	ALUM	TIN	CLEAR GLASS	GR/BR GLASS	OCC	Total Tons (combined)
1998	608	18	30	11	30	102	203	80	1,082
1999	643	18	30	12	30	102	203	81	1,119
2000	369	12	18	8	18	65	140	47	677
2001	357	10	18	7	19	58	119	43	631
2002	378	11	18	7	18	61	121	48	662
2003	470	13	22	9	22	75	151	60	822
2004	496	14	23	9	23	80	159	63	868
2005	497	14	23	9	23	80	159	63	869
2006	467	13	22	9	22	75	150	59	818
(Avg)	476	14	23	9	23	77	156	60	839

Source: Smith, Betsy. "Tonnage By Year." E-mail correspondence. May 7, 2008.

APPENDIX B: TAX INCENTIVES FOR ADVANCED ENERGY-EFFICIENT TECHNOLOGIES

Tax Credit	Total Energy Savings (Quads)	Federal Cost (2002–2006) ($million)	Energy Savings per Federal Dollar (mmBtu/$)	Net Overall Benefits ($billion)	Overall Benefit-Cost Ratio	Rank*
Combined heat & power (CHP)	29	1,000	29	62	3.1	1*
Commercial buildings	18	1,400	13	30	5.4	1*
New homes	6.3	940	6.8	4.7	1.6	3
Heat pump water heaters	2.2	250	8.9	4.5	2.5	4
Fuel cell cogeneration	4.2	100	42	2.1	1.2	5
Gas heat pumps	0.9	120	7.5	1.1	1.6	6*
Transformers	0.9	290	3.1	1.6	3.9	6*
Hybrid vehicles	3.1	760	4.1	3.9	1.3	8
Gas furnaces	2.3	750	3.1	2.0	1.4	9
Central air/heat pumps	1.5	1,000	1.5	2.0	1.4	10
Appliances	0.8	440	1.8	0.5	1.2	11
Electric & fuel-cell vehicles	0.4	290	1.3	(2.2)	0.5	12
TOTAL	70	7,300	9.6	110	2.3	

Source: ACEEE

APPENDIX C: CONTACTS AND RESOURCES

Individual/Program	Contact Info
Environment and Energy Study Institute	http://www.eesi.org
U.S. Mayors Climate Action Handbook	PDF available on-line: http://www.iclei-usa.org/action-center/planning/climate-action-handbook
The Natural Step Contact: Sarah James	http://www.thenaturalstep.org 617-576-1745 sjames@post.harvard.edu
The Climate Action Plan: A Plan to Save Energy and Reduce Greenhouse Gas Emissions for Burlington, Vermont	http://www.burlingtonelectric.com/SpecialTopics/Reportmain.htm
Sustainable Energy Resource Group (SERG)	http://www.serg-info.org
International Council of Local Environmental Initiatives (ICLEI)	http://www.iclei.org
Sustainable Lawrence Executive Director Ralph Copleman	http://www.sustainablelawrence.org rcopleman@sustainablelawrence.org
Cambridge—Harvard Green Campus Initiative, Cambridge Energy Alliance Program Manager Deborah Donovan	http://www.cambridgeenergyalliance.org info@CambridgeEnergyAlliance.org
Keene Climate Protection Committee James Duffy, Keene City Council member and Chair of the Climate Protection Committee	http://www.ci.keene.nh.us/planning/climateprotection.htm
10% Challenge Campaign	http://www.tenpercentchallenge.org
PhillyCarShare	http://www.phillycarshare.org Phone: 215-730-0988 E-mail: info@phillycarshare.org
"Toward Sustainable Growth for Montgomery Country: A Growth Policy for the 21st Century"	http://www.mdp.state.md.us/pdf/mont_0709GP.pdf
Alliance for Sustainability	Phone: 715-682-1189 http://www.allianceforsustainability.org
Duluth-Superior Eco-Industrial Development Initiative Tim Nolan	c/o Minnesota Pollution Control Agency 520 Lafayette Road North Saint Paul, Minnesota 55155-4194
New Hampshire Office of Energy and Planning Amy Ignatius, Director	http://www.nh.gov/oep/index.htm Phone: 603-271-2155 amy.ignatius@nh.gov
Vermont Energy and Climate Action Network (VECAN)	http://www.vnrc.org/article/view/9452/1/625
VECAN's "Town Energy and Climate Action Guide"	PDF:http://www.vnrc.org/filemanager/filedownload/phphU7TKi/VECANActionGuide-March2007.pdf
EPA	http://www.epa.gov/
Fantastic Three	http://www.sfrecycling.com/residential/composting.php?t=r
Clean Air Cool Planet Christa Koehler, Community Program Manager	http://www.cleanair-coolplanet.org/ Phone: 603.313.5182
Regional Greenhouse Gas Initiative (RGGI)	http://www.rggi.org/
American Council for an Energy Efficient Economy (ACEEE)	http://www.aceee.org/

Green.org	http://www.green.org/
Dartmouth Sustainability Office Kathy Lambert, Dartmouth Sustainability Coordinator	Sustainability Initiative 63 S. Main Street Room 316 Hanover, NH 03755 603-646-3532 Sustainable.Dartmouth@Dartmouth.edu kathy.lambert@dartmouth.edu
Dartmouth Sustainable Living Center	slc@dartmouth.edu
Hanover Recycling Committee Director, Betsy Smith	http://www.hanovernh.org/stories/storyReader$215 Phone: 603 643-3327 betsy.smith@hanovernh.org
Upper Valley Sierra Club Contacts: Denis Rydjeski and Betsy Eldridge	http://newhampshire.sierraclub.org/ Phone: 802-384-6847
Mike Lavalla, City of Lebanon Public Works Director	Phone: 603-371-0557
Larry Litten, Recycling Committee	Larry.H.Litten@valley.net Phone: 603-643-1859
Tom Wojciechowski, Program Director, Ashland County UW Extension	www.uwex.edu/ces/cty/ashland/cnred/index.html
Sustainable Chequamegon Initiative Strategic Plan 2006-2011	http://www.uwex.edu/CES/cty/ashland/cnred/documents/FinalDocumentSCIStrategicPlan4-11-06.pdf
Doug McKenzie-Mohr, Environmental Psychologist, author of *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing*	Phone: (506) 455-506 dmm@cbsm.com.

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