Dover Energy Action Plan

March, 2008

City of Dover, NH
Ad-Hoc Energy Advisory Committee

Eric Steltzer, Chair
Robin Estee
Eric Kelsey
Liz Goldman
Dona Layton
Randy Overby
Brett Pasinella

TABLE OF CONTENTS

LIST OF FIGURES

PURPOSE

This document reports on progress the city of Dover has made in its commitment to mapping and reducing energy consumption and carbon dioxide emissions. The ultimate goal is to establish actions the City of Dover and its residents can take to reduce their energy consumption, saving taxpayers money and reducing harmful pollutants. It is a living document, a necessarily incomplete first step toward reducing energy consumption. With it, Dover joins more than 90 other New Hampshire communities that have begun to take energy issues into their own hands. Since the establishment of the Dover Energy Advisory Committee (DEAC) in February 2007, the price of oil has risen from $57 a barrel to over $110 a barrel, representing a 92% increase in the price of oil. This makes the importance of DEAC and the Energy Action Plan all that more important for the city.

INTRODUCTION

Over the coming century, energy will play an increasingly important role in our communities. The decisions we make about how much and what types of energy we use will have powerful effects on the quality of life we and future citizens may enjoy.

Two severe problems have arisen out of our profound dependence on burning fossil fuels as our primary source of energy. First, burning fossil fuels is a primary contributor to global climate disruption ("global warming"). Burning moves carbon from underground and releases it into the atmosphere as carbon dioxide, trapping warmth in what is known as the "greenhouse effect." Long-term consequences may include severe climate aberrations and serious social disruptions. Second, the rate of production of fossil fuels has peaked and begun to decline (an event known as "peak oil"). Approximately half of all global oil reserves have been consumed. From now on, fossil fuels will only become rarer and more expensive. In the near term, energy costs will continue to rise; in the long term, extended social conflicts may occur. Detailed explanations of both climate change and peak oil appear in the appendices.

Whether or not you "believe" in global warming or peak oil, it is clear that injecting the atmosphere with carbon dioxide results in poor air quality. The environmental consequences of this alone should lead us to minimize the burning of fossil fuels. However, taking action to reduce our dependence on fossil fuels will require concerted action by many people.

HISTORY OF ENERGY PLANNING IN DOVER

Since the mid-1990s, Dover has implemented a variety of programs to reduce its energy use. These initiatives have decreased costs for heat and electricity for the municipality. An early step was to retain, in 1996, the Siemens Company, an energy consulting firm, through a performance contract. Evaluating the history of cooling and electrical needs in city and school buildings, Siemens identified opportunities for cogenerating heat and electricity by gas-fired motors; energy-efficient fixtures and occupancy sensors were installed and heating and cooling systems were reconfigured to increase efficiency in five school and eight city buildings. While some efforts were successful, those which were not were protected by the performance contract.

With savings realized from these initial upgrades, the city was able to invest in further improvements. Dover introduced Light Emitting Diodes (LED) technology for traffic lights and outdoor lighting and made energy-improving upgrades to the windows in the fire station, library, and city hall. Energy-efficiency technologies were used in renovations at the McConnell Center and Woodman Park School. These technologies include energy-saving windows, lighting and high efficiency gas-fired boilers. A computer-driven energy management system was installed at Woodman Park School to monitor use of heating, cooling, and lighting, initially for the school, but ultimately for all city buildings. This system tracks patterns of energy use in buildings and makes adjustments accordingly.

The city has also participated in several grant and rebate programs through the utility companies, purchasing and installing high efficiency gas boilers through a grant from Northern Utilities.

The Dover City Council recently approved a plan to trade or sell police cars for smaller, more energy-efficient vehicles to be used by city departments. Before this program, former police department vehicles were passed on to other city departments. The program will save money through fuel efficiencies and reduce emissions of greenhouse gases.

Along with more than 700 other cities in the US, Dover has signed on to the U.S. Mayor's Climate Agreement. In addition, the city has joined the EPA's Energy Star Challenge, a national campaign to improve energy efficiency by 10% or more in buildings across the United States.

In February 2007 after the city signed on to the U.S. Mayors' Climate Change Agreement and the Sierra Club's Cool Cities Program, the Dover Energy Advisory Committee (DEAC) was created and charged to identify ways to reduce the city's energy use, reductions which will in turn save the city money and reduce harmful effects related to global warming. The committee has met bimonthly since its inception, bringing together a strong mix of individuals with backgrounds in development, academia, municipal planning, renewable energy, land conservation, climate science, and technical writing. Since February 2007, the committee has:

1) Signed on to ICLEI - Local Governments for Sustainability, making Dover the first of many New Hampshire cities to sign on to the EPA Energy Star Challenge.
2) Worked with city planning staff to incorporate energy efficiency and sustainability into the land use chapter of the master plan.
3) Advocated for green development of the Cochecho Waterfront Development.
4) Held an educational workshop on Peak Oil, presented by Dr. John Carroll from UNH and attended by more than 50 people. (DVD copies of the workshop are available.)
5) Conducted educational outreach at Apple Harvest Fest and presented at regional energy workshop events throughout the Seacoast.
6) Worked with the city manager on the performance contract renewal process and the hiring of an energy consultant, set to begin this Spring.

The city's efforts to conserve energy and reduce its expenditures in energy costs are ongoing. Actions now and in the future will help Dover to exceed the initial goals for energy conservation and efficiency which were envisioned in the 1990s. The city is currently in the process of hiring an energy management consultant, who would be responsible for representing the city's interests as it enters into a new performance contract with an energy service company (ESCO). The purpose of retaining a dedicated individual or firm to perform these tasks is so that steps can be taken to conserve energy wherever possible.

THE BIGGER PICTURE: NEW HAMPSHIRE'S ENERGY USE

In 1990, total energy consumption in New Hampshire was 264.6 trillion British Thermal Units (BTU) and the state population was 1,109,117. Per capita, each resident consumed 239 million BTU. A mere 14 years later, per capita energy consumption rose to 262 million BTU: the average New Hampshire resident consumed 9% more energy in 2004 than he or she did in 1990.

During the same time period, the commercial sector saw the largest growth, a 74% increase, followed by the transportation sector, which saw a 50% increase. Residential sector use is also noteworthy. In 1994, it consumed 30% of the state's energy, making it the highest energy consumer by sector. Since then, the residential sector experienced a 26% increase, similar to the overall average of energy growth; by 2004 it was the second largest consumer, falling behind greater growth in transportation.

Across all sectors, petroleum products—gasoline, propane, No. 2 home heating oil, and diesel—were the primary fuel source, accounting for approximately 60% of the energy in 1990 and in 2004. Natural gas has expanded drastically, from 6% of total energy use in 1990 to 19% of total energy consumption, the third largest fuel source, in 2004. An increase in the use of natural gas to generate electricity explains this growth; by 2004 several natural gas plants were installed in New Hampshire, producing 23% of all the state's electricity. The Seabrook nuclear power plant, the largest nuclear reactor in New England, accounts for the largest source of electricity in New Hampshire (43%). Renewable energy has played a smaller role, accounting for only 4% of the state's energy in 2004.

Figure 1 compares energy consumption patterns in New Hampshire with those in New England and the United States in 2004. The energy consumption per capita is relatively similar—262 million BTU per capita in New Hampshire and 258 million BTU per capita in New England. Across the energy sectors, the results are also similar, with heavier energy consumption in the residential sector and lower levels in the industrial sector. This is vastly different compared with national patterns. Energy consumption per capita is substantially higher in the United States (341 million BTU per capita). Also within the sectors, the industrial sector in the United States makes up 33% of the energy consumed, versus approximately 16% in New England.

Figure 1: Regional Comparison of Energy Consumption, 2004

Category	NH		New England		US	
	#	% of category	#	% of category	#	% of category
Total (Sectors and Fuel Sources)						
Energy Consumption (trillion BTU)	340.7	n/a	3,683.5	n/a	100,279	n/a
Population	1,299,169	n/a	14,241,495	n/a	293,638,158	n/a
By Sector (trillion BTU)						
Residential	99.6	29.2%	1,125.3	30.5%	21,243	21.2%
Commercial	75.6	22.2%	854.9	23.2%	17,721	17.7%
Industrial	56.2	16.5%	596.2	16.2%	33,415	33.3%
Transportation	109.2	32.1%	1,107.1	30.1%	27,900	27.8%
Total	340.7	100.0%	3,683.5	100.0%	100,279	100.0%
Fuel Source (trillion BTU)						
Coal	43.4	12.7%	199.9	5.4%	22,466	22.4%
Natural Gas	64.5	18.9%	774.6	21.0%	22,902	22.8%
Petroleum (Total)	205.4	60.3%	1,879.9	51.0%	40,593	40.5%
LPG	10.4	3.1%	41.6	1.1%	2,824	2.8%
Gasoline	89	26.1%	853.0	23.2%	17,379	17.3%
Nuclear Electric Power	106.1	31.1%	380.7	10.3%	8,222	8.2%
Hydroelectric Power	13.2	3.9%	74.2	2.0%	2,690	2.7%
Biomass	23	6.8%	237.0	6.4%	2,683	2.7%
Other	1.5	0.4%	28.6	0.8%	586	0.6%
Net Interstate Flow Loss	-116.5	-34.2%	108.6	2.9%	n/a	n/a
Total	340.7	100.0%	3,683.4	100.0%	100,279	100.0%
Fuel Source (Electricity Production- million Mwh)						
Natural Gas	5.4	22.6%	100.6	37.2%	1,548.6	19.1%
Petroleum	2.0	8.2%	26.6	9.8%	245.0	3.0%
Coal	4.1	17.1%	40.9	15.1%	4,026.4	49.7%
Nuclear	10.2	42.6%	69.1	25.5%	1,564.0	19.3%
Hydroelectric	1.3	5.5%	14.9	5.5%	526.1	6.5%
Renewables	0.9	4.0%	18.7	6.9%	189.9	2.3%
Other	n/a	n/a	0.0	0.0%	9.5	0.1%
Total	23.9	100.0%	270.8	100.0%	8,109.4	100.0%

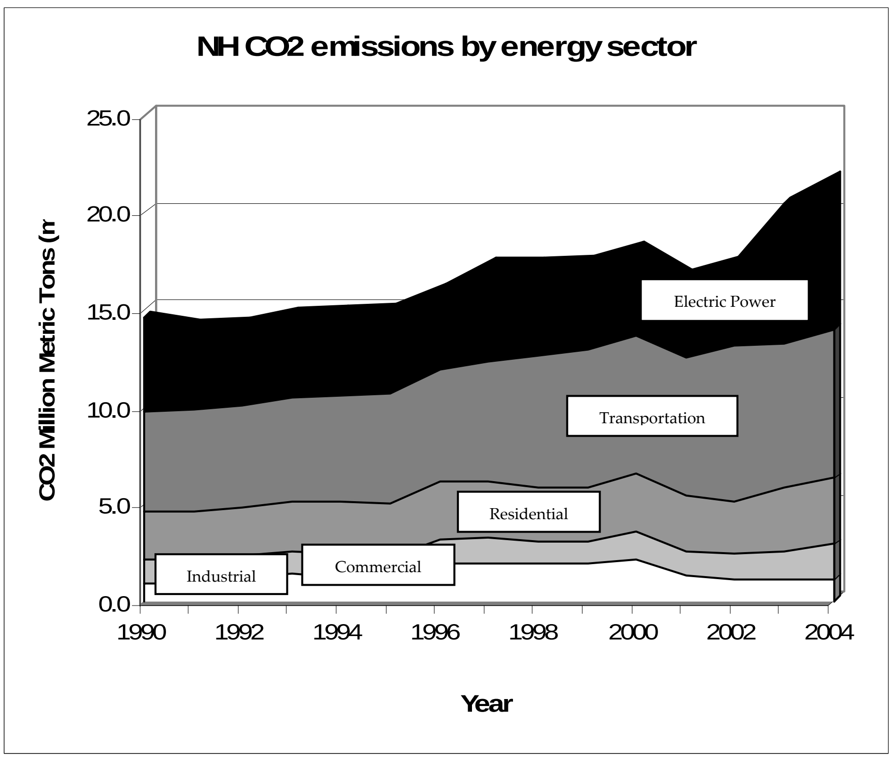
* Due to rounding, the data may not add up to the totals.

Source: Energy Data - EIA, 2007
Population Data - NH OEP, 2007; US Census Bureau, 2007

Fuel sources across the sectors and the region are largely similar to those shown in Figure 1. Like most of the country, the state and region rely heavily on petroleum products. Natural gas varies minimally as well across the total energy consumption. However, New England and New Hampshire both rely more than the rest of the country on natural gas as a fuel source for electricity. Coal, by contrast, is responsible for 22% of the nation's total energy use, but for only 5% of New England's and 13% of New Hampshire's. Regarding the electrical portion of this energy, coal is used to produce close to half of the country's electricity, but is only attributable for a mere 15% of the electricity in New England and 17% in New Hampshire. Substantially more nuclear power is produced in New Hampshire, which is due to the Seabrook nuclear power plant. This is less revealing because the electricity from the plant enters the New England power pool and the electricity from Seabrook isn't confined to New Hampshire. This is shown in New Hampshire's net interstate flow of energy: New Hampshire exports 34% of its energy.

With climate change concern centered on emissions, it is also important to look at emissions trends here in New Hampshire (Figure 2). Since 1990, CO_2 emissions have increased by 33% to 21.8 million metric tons (mmt). Historically, the transportation sector has been the largest producer of CO_2 emissions. However, between 2002 and 2004, CO_2 emissions from the electric power sector increased sizably while the remaining sectors stayed flat or in some cases decreased. By 2004, the electric power sector was responsible for 36% of the CO_2 emitted, edging itself past the transportation sector which stood at 35 %, followed by the residential (16%), commercial (8%) and the industrial (5%) sectors.

Figure 2: New Hampshire Carbon Dioxide Emissions by Energy Sector, 1990-2004



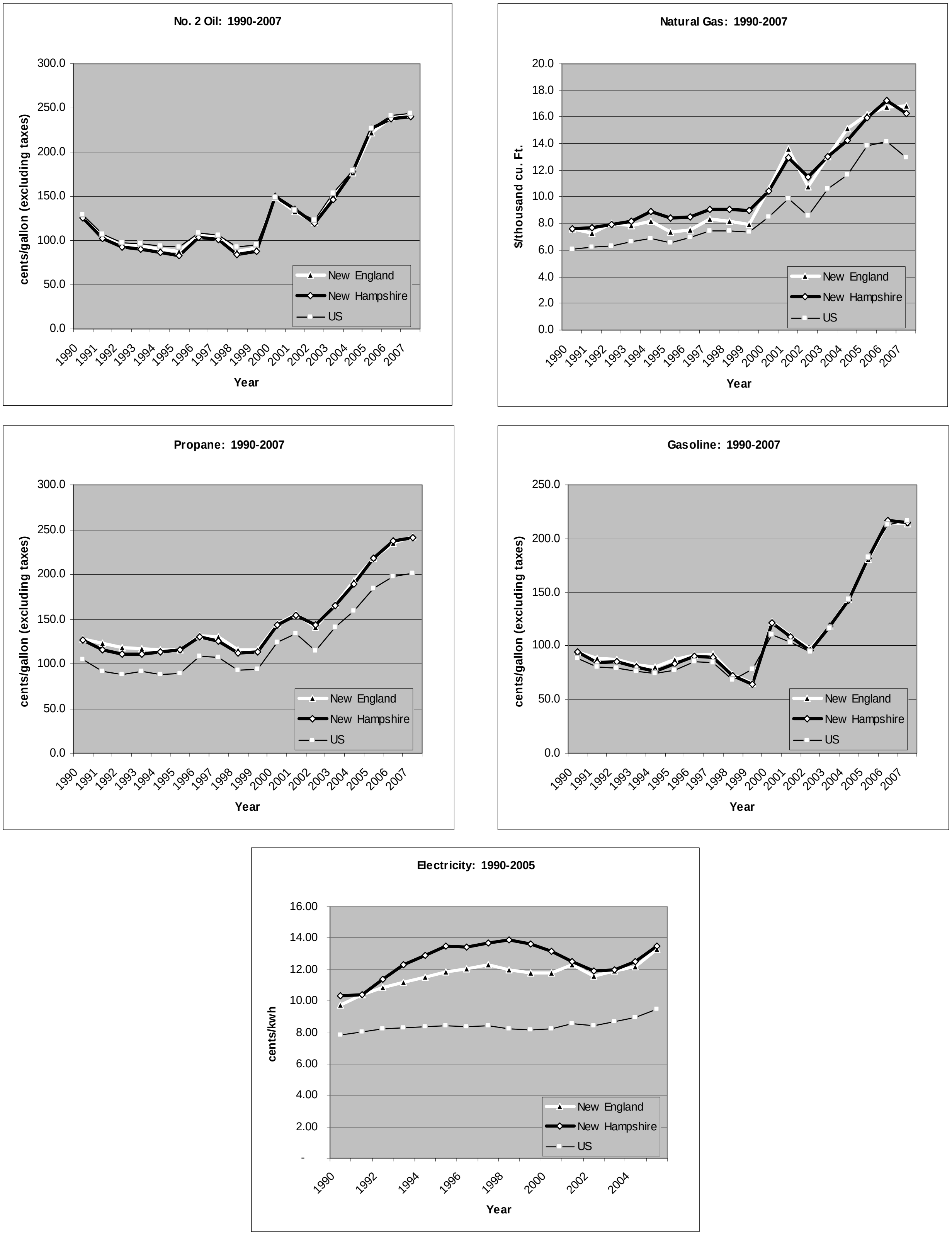
Data:

By Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Residential	2.4	2.4	2.5	2.5	2.6	2.7	2.9	2.9	2.8	2.8	2.9	2.8	2.6	3.2	3.4
Commercial	1.3	1.3	1.1	1.1	1.3	1.1	1.3	1.3	1.1	1.2	1.4	1.3	1.3	1.5	1.8
Industrial	0.9	0.9	1.2	1.5	1.2	1.1	1.9	2.0	1.9	1.9	2.2	1.3	1.2	1.1	1.2
Transportation	5.1	5.2	5.2	5.3	5.5	5.7	5.8	6.2	6.8	7.0	7.2	7.2	8.0	7.5	7.7
Electric Power	4.8	4.4	4.3	4.4	4.4	4.3	4.1	5.1	4.8	4.6	4.6	4.2	4.4	7.2	7.8
Total	14.6	14.2	14.3	14.9	15.0	15.0	16.0	17.4	17.4	17.5	18.3	16.8	17.5	20.5	21.8

Source: Lindstrom, 2007

Figure 3 shows the energy costs for the period between 1990 and 2007 for heating fuel No. 2, natural gas, propane, gasoline (all grades), and electricity for New Hampshire, New England and the United States. Costs of all petroleum forms of energy remained relatively level between 1990 and 2002; after 2002, each fuel source rose significantly. No. 2 heating oil and gasoline prices in New Hampshire and New England followed national trends closely. However, the price of propane and natural gas is significantly higher than the national average, and the region's electricity rates are substantially higher than national average. This is due to New England's limited access to coal (an affordable energy source for parts of the South, Midwest, and Rocky Mountains) resulting in a heavier reliance on natural gas and nuclear energy. Regionally, electricity prices in New Hampshire have historically exceeded those of surrounding states. Beginning in 2001, New Hampshire prices have become closer to the average price in New England, but are still slightly higher.

Figure 3: New Hampshire, New England, and U.S. Energy Costs, 1990-2007



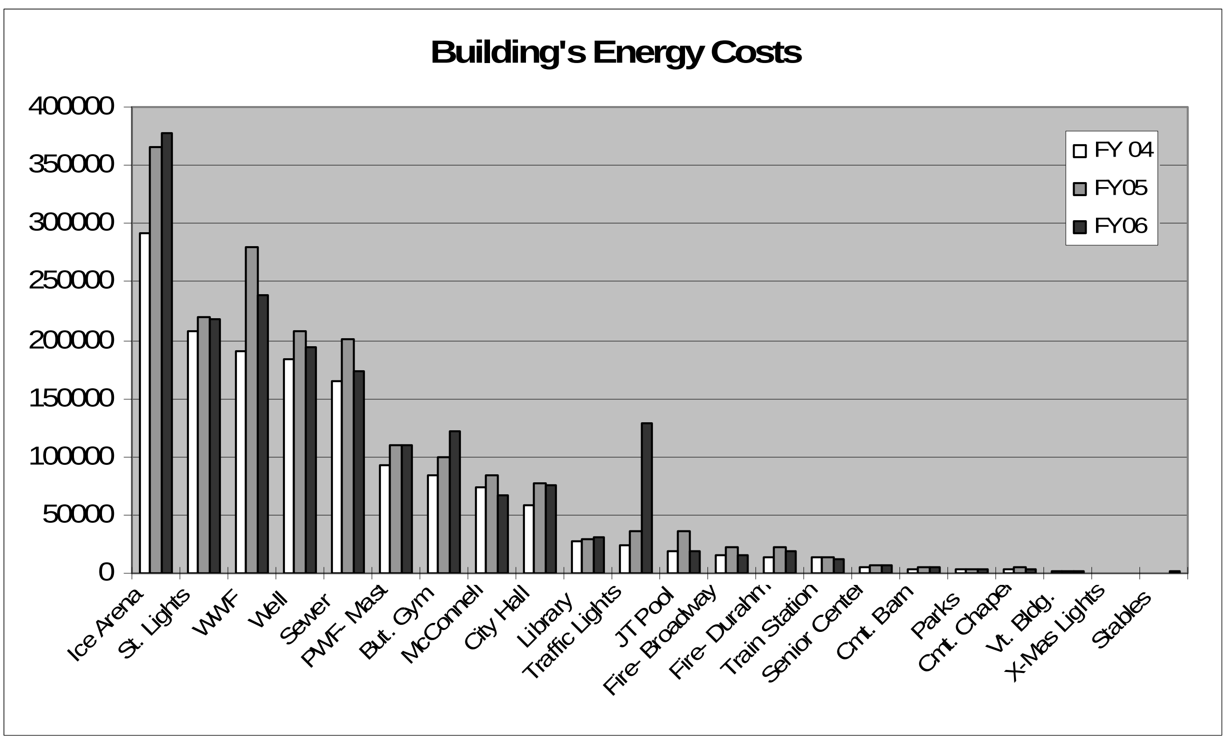
Source: EIA, 2007

CITY OF DOVER ENERGY USE

A key goal of the Dover Energy Advisory Committee, as outlined by the Council's resolution, was to create an Energy Action Plan. The first step in such a plan has been to get a baseline measure of current energy use. DEAC has tabulated City energy costs from 2004 to 2007, and coded energy use and expenses for all City buildings, a broad term which includes schools, sewage treatment facilities, and streetlights. In Figures 4 through 8, we show the city's energy use. Figure 4 shows energy use by municipal building from 2004 through 2006, with the greatest expenditures of energy by the Ice Arena, the Waste Water Facility, and streetlights. Overall municipal energy costs were $1.476 million in 2004; in 2005, costs rose to $1.826 million, but decreased slightly, to $1.823 million, in 2006. Figure 5 shows figures for electricity from 2004 through 2007, peaking in the quarter between January and March 2006. Figure 6 profiles natural gas use, which peaked in January, 2007. Figure 7 shows propane use peaked in successive Januaries, while Figure 8, profiling oil use, shows similar peaks in January of each year.

The city's greatest energy costs are for electricity, although its portion of overall energy use declined slightly, from 72% in 2005, to 70% in 2006, and 69% last year. Of interesting note is the large spike in Traffic Lights. This was accounted to a traffic light that was added on at 61 St. Thomas St. (account # 61-35-08894-0-0) which added approximately 60,000 KwH to 80,000 KwH of additional electricity. This is a large draw for a traffic light and it is possible that this account was classified to an incorrect classification. Propane and oil use remained relatively low, accounting for 10% of total energy use in 2005 and 2006, and declining to 9% in 2007. Natural gas is the only energy source that has grown as part of the overall mix, up from 18% in 2005, and 19% in 2006, to 23%, nearly a quarter of all energy use, in 2007. Table 1 translates the city's energy use into tons of carbon dioxide, the leading contributor to global warming.

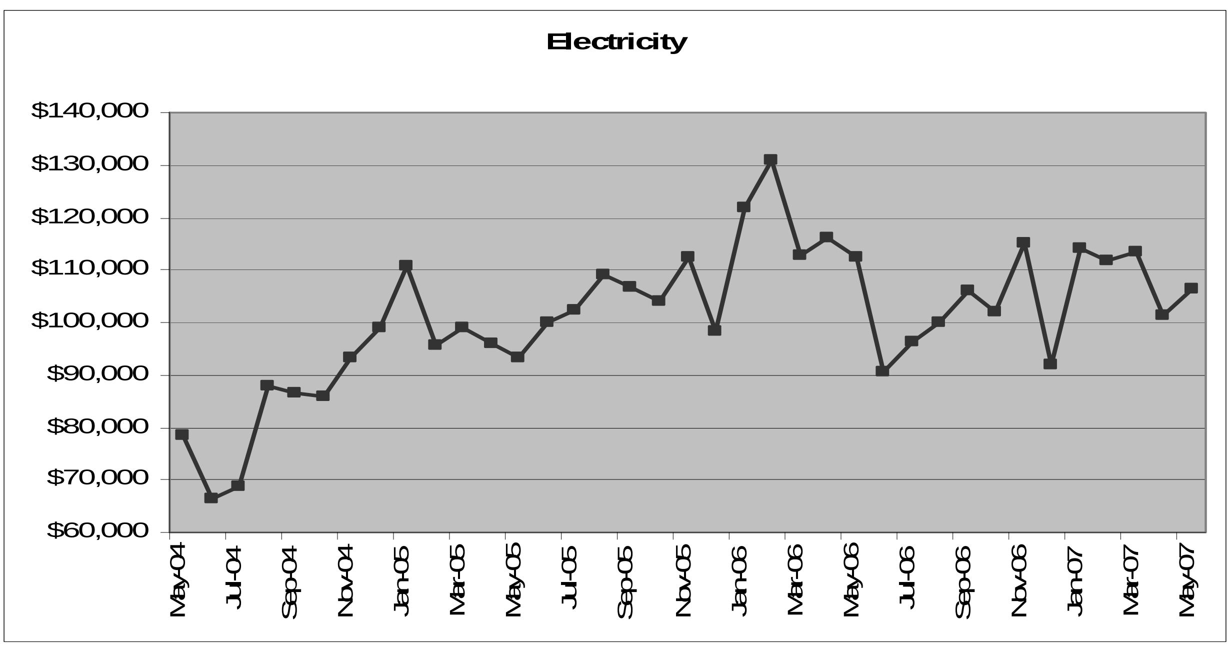
Figure 4: Dover Energy Costs by City Building



DATA FOR BUILDING ENERGY COSTS

FACILITY	FY 04	FY05	FY06
Ice Arena	$292,109	$366,294	$378,460
St. Lights	$208,306	$219,348	$218,216
WWF	$190,768	$279,477	$238,094
Well	$184,018	$207,799	$193,311
Sewer	$164,323	$201,170	$174,178
PWF- Mast	$92,445	$110,320	$109,187
But. Gym	$84,433	$99,035	$121,042
McConnell	$73,568	$83,869	$67,685
City Hall	$58,443	$77,137	$75,251
Library	$27,531	$29,227	$31,157
Traffic Lights	$23,386	$35,830	$129,361
JT Pool	$18,360	$36,051	$19,098
Fire- Broadway	$14,746	$22,564	$15,242
Fire- Durham	$13,597	$22,172	$18,102
Train Station	$13,222	$14,561	$12,488
Senior Center	$5,058	$6,353	$7,043
Cmt. Barn	$3,379	$4,980	$5,088
Parks	$3,256	$3,587	$2,995
Cmt. Chapel	$2,907	$4,560	$3,895
Vt. Bldg.	$1,369	$1,267	$1,299
X-Mas Lights	$396	$267	$346
Stables	$0	$5	$1,723

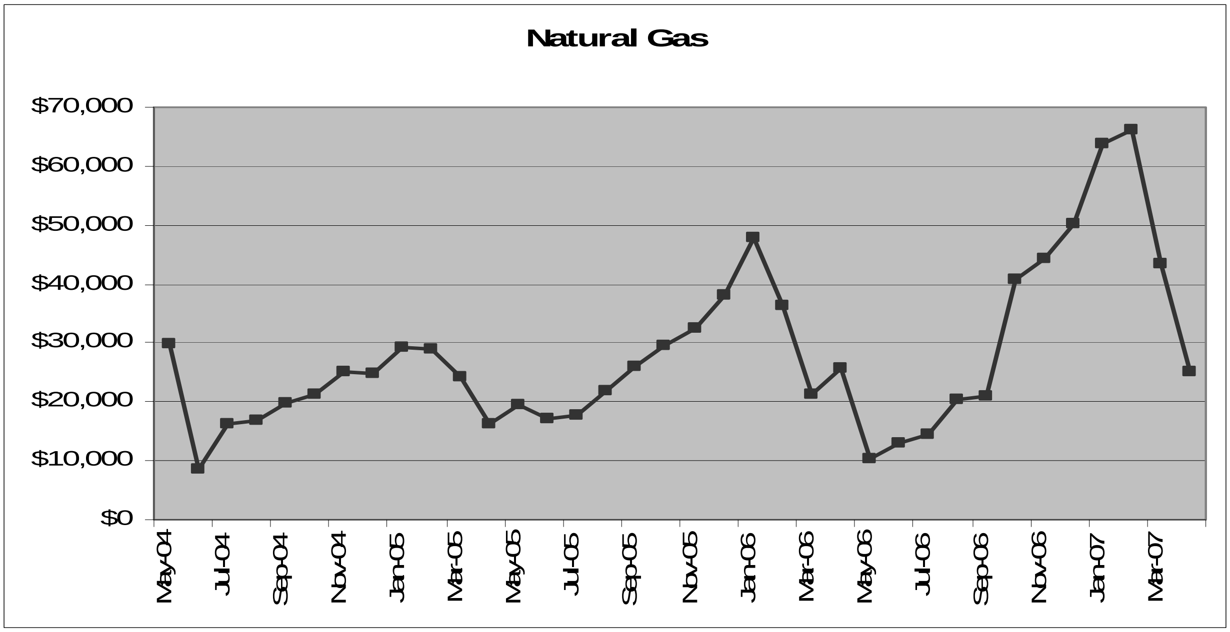
Figure 5: City Electricity Use, May 04-May 07



DATA FOR ELECTRICITY

Fiscal Year	kwh	Charge	$/ kwh	% change (kwh)	# change (kwh)
FY05	8,460,672	$1,067,183	$0.13	n/a	n/a
FY06	8,653,820	$1,307,905	$0.15	2%	193,148
FY07	8,968,867	$1,255,195	$0.14	4%	315,047

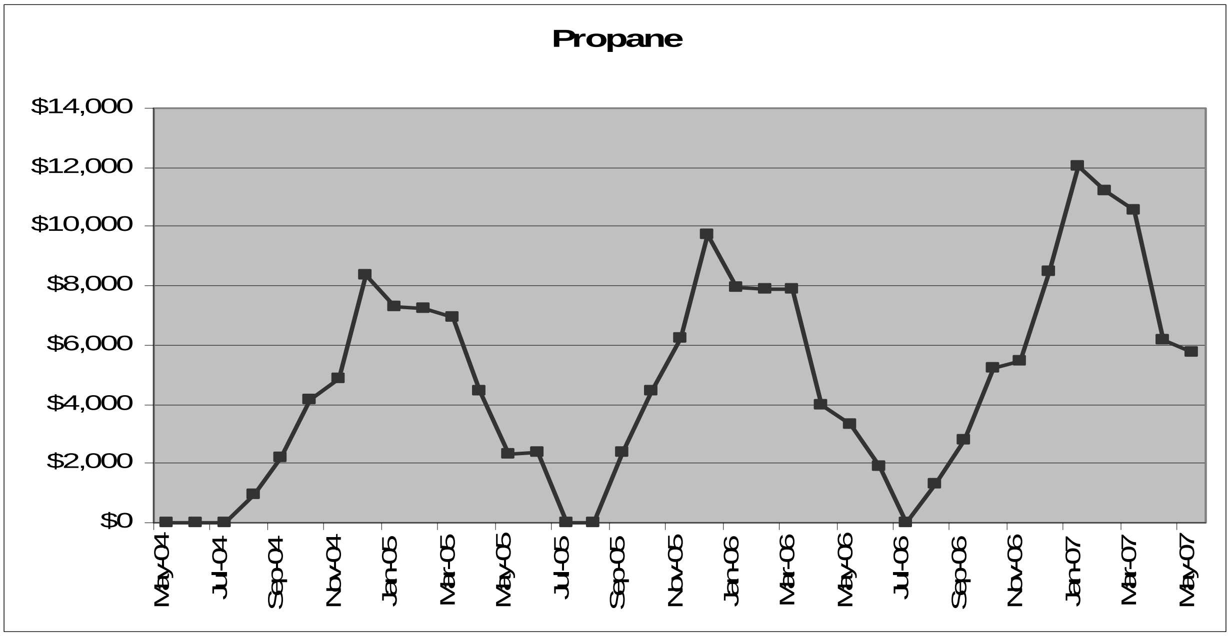
Figure 6: City Natural Gas Use, May 04-May 06



DATA FOR NATURAL GAS

Fiscal Year	Therms	Charge	$/Therm	% change (therm)	# change (therm)
FY05	250,349	$260,842	$1.04	n/a	n/a
FY06	307,989	$333,549	$1.08	23%	57,640
FY07	361,978	$412,958	$1.14	18%	53,989

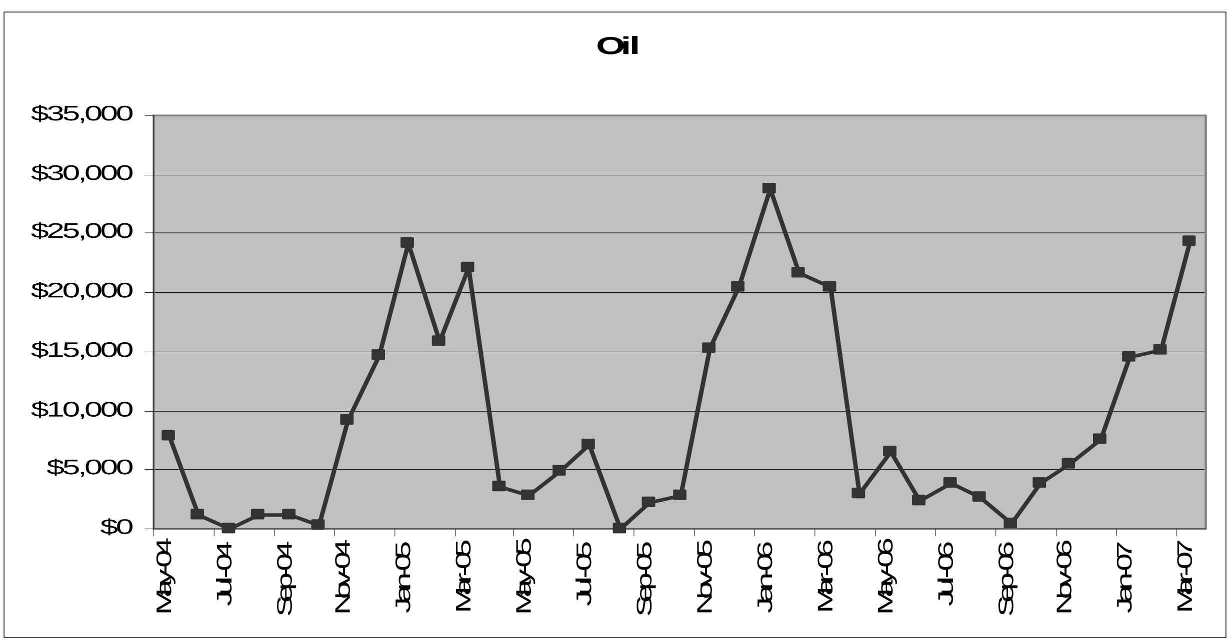
Figure 7: City Propane Use, May 04-May 07



DATA FOR PROPANE

Fiscal Year	Gallons	Charge	$/Gallon	% change (gallon)	# change (gallon)
FY05	45,505	$46,378	$1.02	n/a	n/a
FY06	45,299	$55,155	$1.24	0%	-206
FY07	43,972	$68,453	$1.59	-3%	-1,327

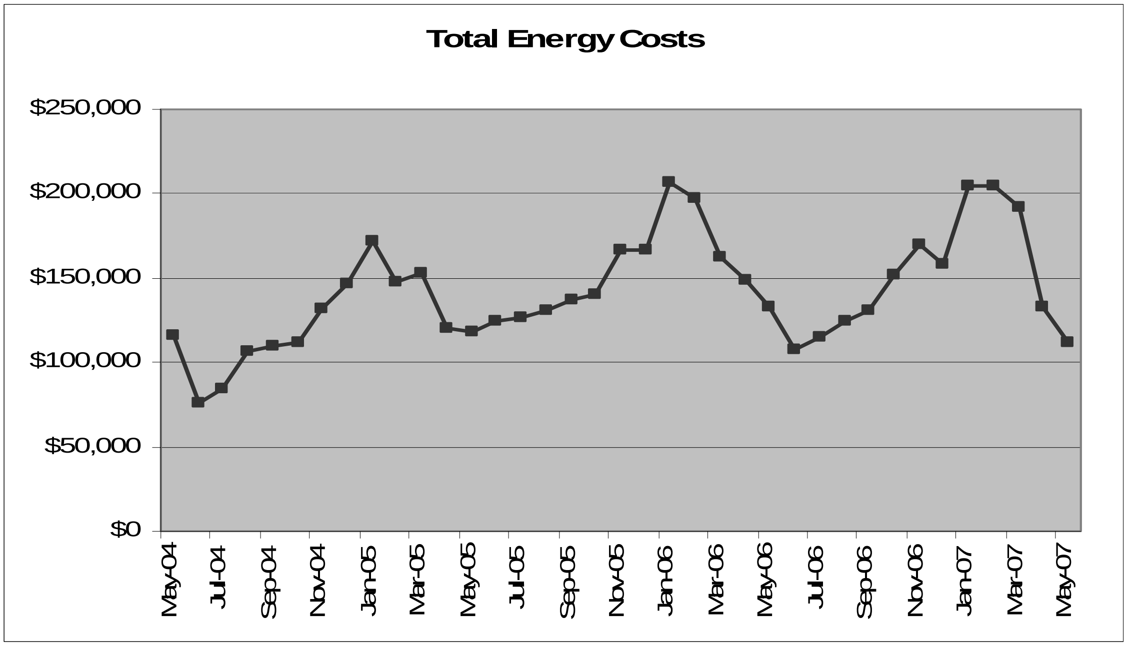
Figure 8: City Oil Use, May 04-May 07



DATA FOR OIL

Fiscal Year	Gallons	Charge	$/Gallon	% change (gallon)	# change (gallon)
FY05	88,666	$101,215	$1.14	n/a	n/a
FY06	79,387	$129,268	$1.24	-10%	-9,278
FY07	39,453	$86,655	$1.59	-50%	-39,935

Figure 9: Total City Energy Costs, May 04–May 07



DATA FOR TOTAL ENERGY

Fiscal Year	Charge	% change	# change
FY05	$1,475,619	n/a	n/a
FY06	$1,825,876	24%	350,257
FY07	$1,823,260	0%	-2,616

Table 1: City 2005 Greenhouse Gas Emissions—Detailed Report

		Equiv CO2	Equiv CO2	Energy	Cost
		(tons)	(%)	(MMBtu)	($)
BUILDINGS					
Butterfield Gym/Indoor Pool					
	Electricity	75	1.1	661	26281
	Natural Gas	392	5.9	6343	64019
Subtotal Butterfield Gym/Indoor Pool		467	7	7004	90299
Cemetery- Barn					
	Electricity	3	0	28	1451
	Light Fuel Oil	21	0.3	250	2361
	Propane	2	0	21	2318
Subtotal Cemetery- Barn		25	0.4	299	6130
Cemetery- Chapel/Office					
	Electricity	4	0.1	35	1695
	Light Fuel Oil	17	0.3	212	1902
Subtotal Cemetery- Chapel/Office		22	0.3	247	3597
City Hall/Police					
	Electricity	139	2.1	1229	44205
	Light Fuel Oil	171	2.6	2066	20332
	Natural Gas	10	0.2	165	2824
Subtotal City Hall/Police		320	4.8	3459	67361
Fire Department- Broadway					
	Electricity	31	0.5	270	9833
	Natural Gas	26	0.4	425	6348
Subtotal Fire Department- Broadway		57	0.9	695	16181
Fire Department- Durham Rd.					
	Electricity	26	0.4	226	8257
	Propane	45	0.7	620	5206
Subtotal Fire Department- Durham Rd.		70	1.1	845	13463
Guppey Pool/Jenny Thompson Pool					
	Electricity	28	0.4	248	9039
	Natural Gas	61	0.9	995	8934
Subtotal Guppey Pool/Jenny Thompson Pool		90	1.3	1243	17973
Ice Arena					
	Electricity	568	8.5	5016	180592
	Natural Gas	1008	15.1	16316	166007
Subtotal Ice Arena		1576	23.6	21331	346600
Library					
	Electricity	52	0.8	463	17827

	Natural Gas	58	0.9	941	12340
Subtotal Library		111	1.7	1404	30167
McConnell Center					
	Electricity	93	1.4	823	29633
	Light Fuel Oil	573	8.6	6934	60581
	Natural Gas	1	0	16	444
Subtotal McConnell Center		667	10	7773	90657
Parks					
	Electricity	5	0.1	42	2420
	Light Fuel Oil	5	0.1	60	652
Subtotal Parks		10	0.1	102	3072
Police Horse Stable					
	Propane	0	0	0	149
Subtotal Police Horse Stable		0	0	0	149
Public Works Facility/Recycling Center					
	Electricity	142	2.1	1253	47113
	Light Fuel Oil	321	4.8	3881	33824
	Natural Gas	132	2	2137	30204
	Propane	2	0	31	1953
Subtotal Public Works Facility/Recycling Center		597	8.9	7302	113094
Senior Center					
	Electricity	6	0.1	54	2407
	Light Fuel Oil	34	0.5	412	3794
Subtotal Senior Center		40	0.6	466	6201
Train Station					
	Electricity	43	0.6	376	13754
Subtotal Train Station		43	0.6	376	13754
Veteran's Building					
	Natural Gas	5	0.1	79	1385
Subtotal Veteran's Building		5	0.1	79	1385
SUBTOTAL BUILDINGS		**4099**	**61.4**	**52627**	**820083**
LIGHTING					
Street Lights					
	Electricity	332	5	2935	210136
Subtotal Street Lights		332	5	2935	210136
Traffic Lights					
	Electricity	60	0.9	528	27848
Subtotal Traffic Lights		60	0.9	528	27848
X-Mas Lights					
	Electricity	1	0	4	267
Subtotal X-Mas Lights		1	0	4	267
SUBTOTAL LIGHTING		**393**	**5.9**	**3467**	**238251**

WATER/SEWAGE					
Sewer					
	Electricity	513	7.7	4529	177498
	Light Fuel Oil	56	0.8	678	5971
	Natural Gas	9	0.1	139	2431
	Propane	40	0.6	547	13679
Subtotal Sewer		617	9.2	5893	199580
Wastewater Facility					
	Electricity	708	10.6	6254	235353
	Propane	169	2.5	2338	21909
Subtotal Wastewater Facility		878	13.1	8592	257262
Well					
	Electricity	584	8.7	5152	182077
	Natural Gas	37	0.6	597	5812
	Propane	69	1	950	8071
Subtotal Well		689	10.3	6699	195960
SUBTOTAL WATER/SEWAGE		**2184**	**32.7**	**21184**	**652802**
TOTAL		**6676**	**100**	**77278**	**1711136**

ACTION STEPS

Now that baseline figures have been established for Dover's municipal buildings, we will be able to measure reductions in energy use by both source and building. To begin the process of developing action items, DEAC took part in a visioning process to generate a collective sense of how energy use might be reduced in our city and prioritize the programs. There were a total of 61 ideas generated, several rated very high (5 out of 5 points) in later voting. Below are the categories and priorities underneath the categories.

1) Advocacy:
   a. Encourage the Cochecho Waterfront to be developed Green
   b. Develop a Green Building Ordinance
   c. Renewable Energy Tax Exemption
   d. Energy Issues in Master Plan (completed!)

2) Municipal:
   a. Update website
   b. Create an Energy Savings Checklist for Employees
   c. Alternative Fuels for Vehicles
   d. Inventory Public Buildings (2 buildings per year)

3) Residential:
   a. Presence at Apple Harvestfest
   b. Speaker Series

4) Renewable Generation
   a. Solar Panels at School
   b. Methane Digester at WWF
   c. Micro Hydro on River
   d. Wind Turbine

5) Schools:
   a. Teacher Involvement
   b. School Kids Involvement

Under the heading of Advocacy, highly rated ideas include advocating for green design in prominent developments within the city, creating a green building ordinance and inputting energy issues into the updates of the Land Use Chapter of the Master Plan. This final goal has been achieved. Municipal programs that garnered high ratings were updating the website, distributing an energy savings checklist to city employees, using alternative fuels for the vehicle fleet and conducting a public inventory of 2 buildings per year. Having a presence at Apple Harvest Fest was the single highest rated item under Residential Programs. Second to that was conducting a public speaker series. Highly rated ideas for Renewable Energy Generation were pursuing a micro hydro turbine on the Cochecho, installing wind turbines and solar panels at schools and determining the feasibility of a methane digester at the Wasterwater Treatment Facility. Under School

Programs, highly rated ideas were involving schools, using energy toolkits as a school fundraiser, and creating school energy committees. Finally, under the category of Big Ideas, three highly rated ideas emerged: changing the registration structure for cars, hosting an energy summit in the city of Dover, and entering energy-related partnerships with other communities. A brief discussion of some of these ideas follows.

Green Building Design and Ordinances

Many components of Smart Growth, now a planning industry buzzword, address energy conservation. Ideas such as mixed use development and compact village centers help reduce energy by reducing distances and transportation needs between shopping areas and where residents live. Similarly, alternative transportation reduces vehicular traffic and subsequently carbon dioxide emissions.

The American Planning Association (APA) has adopted the *Guide on Planning for Sustainability* (APA, 2000), largely based on working models in Sweden through the organization Sveriges Ekokommuner. At the core of the *Guide* are four objectives for achieving sustainability, commonly referred to as "Natural Steps":

1) Reduce dependence on fossil fuels, extracted underground metals and minerals;
2) Reduce dependence on chemicals and other manufactured substances that can accumulate in Nature;
3) Reduce dependence on activities that harm life-sustaining ecosystems; and
4) Meet the hierarchy of present and future human needs fairly and efficiently.

The US Green Building Council takes the APA steps outlined above to a more detailed level, looking specifically at the built environment to reduce energy use during and post construction. The Council developed the Leadership in Energy and Environmental Design (LEED) criteria, the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. The LEED rating system ranks indicators in six areas: Sustainable Site, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design Process. Many cities have used the LEED criteria in Green Building Ordinances, which vary in their regulatory authority. The most basic level is to create a system of incentives, such as expedited reviews, reduced fees, increases in density, and lower taxes. The most intensive level would require all development, including additions and home improvement, to meet a certain standard, based on the square footage of the development or improvement. Epping was the first community in New Hampshire to adopt a green building ordinance.

Land conservation, a related aspect of green planning, continues to be an important part of the city's program for sustainability. Since 2000, the Open Lands Committee has presented conservation projects to the City Council for approval that have protected hundreds of acres of open space in Dover. The city is also developing a city-wide Community Trail from downtown Dover to the Strafford County Farm, which will provide an alternative transportation route through some of Dover's conserved land. Local farms and agricultural land in Dover have also been protected under conservation easements.

Partnerships with Other Communities

One way Dover can achieve the 10% or more reduction in energy use is by participating in energy-reducing projects with nearby communities. These could involve sharing services such as public transportation, large fire-fighting vehicles, and a regional water treatment plant. Communities could use their joint-purchasing power to leverage prices for energy. There are also opportunities for the Dover city government and school department to collaborate on similar energy-reduction programs.

Local Agriculture

In light of the issues of peak oil and climate change, increasing local agriculture is vitally important. The Dover City Council has demonstrated support for local agriculture over the years by voting to protect farms and agricultural land. It is important that support for local agriculture continues through land conservation and other means. To achieve a secure, local supply of food, one *conservative* study states residents must grow at least 30% of the food their community needs, with the remainder grown by neighboring farms (Pfieffer, 2006). Fortunately, Dover retains large amounts of open, arable land, much of which has been placed under conservation easement by the Conservation Commission and Open Lands Committee. The Open Lands Committee took an important step in encouraging more local agriculture by granting the use of conserved land for the new Cassily Community Garden.

Dover can achieve stronger food security by continuing to provide incentives to preserve land for agriculture, and to pass policies that make it easier for potential farmers to acquire land, provided the land is used strictly for agricultural purposes. We can further facilitate local agricultural ventures in and around Dover by providing more opportunities and expanding existing venues for Seacoast farmers to sell their produce (e.g., the indoor "Farmers Market" held at the Atlantic Culinary Institute in December 2007).

Residential Energy Reductions

Along with reducing the energy use of the city government and school department, another goal of Dover's emerging energy policy is to extend energy saving programs to Dover residents and businesses. The programs will provide information and resources that will help people who live and work in Dover to reduce both the amount they pay for energy and the impact they have on the environment.

Transportation Solutions

With Dover as a multimodal transportation hub, the Seacoast area has the opportunity to mitigate the effects of peak oil on the transportation sector throughout the region. A strong foundation of public transportation is already in place: the Amtrak Downeaster, COAST bus, Wildcat Transit, C & J Trailways, and the intracity bus service in Dover coming in 2008. Plus, the Cochecho River links downtown Dover to the Piscataqua River, offering boaters virtually unrestricted access to the Atlantic Ocean.

Despite recent sprawl, much of Dover's population and family-owned retail businesses remain within 1.5 miles of downtown, making Dover a walkable community for these residents. Many more can get to downtown by bicycle. Dover and our citizens have a great opportunity to increase accessibility to and from downtown through a strengthened public transportation system. This will reduce oil dependence relatively quickly in the transportation sector and increase economic activity to downtown businesses.

A key recommendation of Dover's 2008 City Master Plan is to reduce sprawl by focusing new building in already developed areas near downtown. We can attract businesses and residents to live and work in and around downtown Dover by promoting a walkable community and providing easy access to multiple modes of transportation. A strong public transportation system will encourage more commuters and visitors to leave their cars at home, thus reducing the need for parking space that is already in short supply.

Planning for Fuel Shortages

To best respond to sudden fuel shortages, any city or town should have emergency procedures and local officials should be familiar with these procedures. Here in New Hampshire, state officials have emergency procedures should a fuel emergency arise. However, the Dover Police Department does not have any information about these procedures. In the event of fuel shortages, valuable time would be wasted in the communication of such plans to city and emergency officials before action could begin. Before such fuel emergencies occur, city officials should review the state procedures and inform all essential employees of them. Dover should supplement the state procedures where necessary to ensure fuel security to Dover's vital public and social services in the event of fuel shortages.

Other Issues

These recommendations are preliminary and should serve as a starting point for community-based discu ssions about solutions to mitigate the effects of peak oil in Dover and surrounding communities. Some questions that bear discussion include:

- How will demand for other basic products and services be affected?
- How will upstream supplies of raw goods and materials be affected?
- What alternatives or substitutes are available to mitigate shortages of vulnerable goods?
- What types of jobs are most vulnerable?
- What new jobs will be needed and how can Dover prepare to provide these jobs?

Appendix C distills the Committee's thinking into a set of goals and action items.

REFERENCES

American Planning Association (APA), 2000, Policy Guide on Planning for Sustainability, Washington D.C., www.planning.org/policyguides/sustainability.htm, accessed 10/1/07.

City of Portland Peak Oil Task Force (2007, March). *Descending the Oil Peak: Navigating the Transition from Oil and Natural Gas.*

Commodity Flow Survey, Economic Census, US Census Bureau. 2002, www.census.gov/prod/www/abs/02cf-pdf.html

Energy Information Agency, United States Federal Government. http://www.eia.doe.gov/

Energy Information Administration (EIA), 2007, http://www.eia.doe.gov/, accessed 8/16/07.

EIA, 2007(b), http://www.eia.doe.gov/emeu/states/_seds.html, accessed 8/21/07.

Lindstrom, Perry, Project Coordinator, U.S. Greenhouse Gas Inventory, Energy Information Administration, Washington D.C., personal communication, 8/27/07.

Harvard University, Center for Health and the Global Environment, 2007, http://chge.med.harvard.edu, accessed 8/23/07.

Houghton, J. T., et al. (Eds). 2001. *Climate Change 2001: The Scientific Basis.* Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). UK: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC), 2001, Third Assessment Report: Synthesis Report, Figures 2-4.

IPCC, 2007a, Fourth Assessment Report: Synthesis Report.

IPCC, 2007b, Climate Change 2007: The Physical Science.

Keeling, C. D., & Whorf, T. P. (2005) Atmospheric CO_2 records from sites in the SIO air sampling network. In *Trends: A Compendium of Data on Global Change*, Oak Ridge, TN: Oak Ridge National Laboratory, U.S. Department of Energy, Carbon Dioxide Information Analysis Center.

National Oceanic and Atmospheric Administration (NOAA). (2007). Mauna Loa Observatory, HI: U.S. Department of Commerce.

New Hampshire Office of Energy and Planning, 2007, http://www.nh.gov/oep/programs/DataCenter/Population/PopulationEstimates.htm, accessed on 8/21/07.

NHOEP, 2002, New Hampshire State Energy Plan, http://www.nh.gov/oep/programs/energy/StateEnergyPlan.htm, accessed on 8/29/07.

Perkins, Timothy, PhD, University of Vermont, Proctor Maple Research Center, Burlington, VT, personal communication, 8/23/07.

Petit, J.R., Jouzel, J., et al., 1999, Climate and Atmospheric History of the past 420,000 years from the Vostok Ice Core in Antarctica, Nature 399 (3 June), 429-436.

Pfeiffer, D. A. (2006). *Eating Fossil Fuels: Oil, Food and the Coming Crisis in Agriculture*, New Society Publishers.

http://www.theoildrum.com - An online scientific discussion about energy and our future.

U.S. Census Bureau. (2007), http://www.census.gov/popest/estimates.php, accessed 8/21/07.

Wake, C. P. (2005). *Indicators of Climate Change in the Northeast*. Durham, NH: University of New Hampshire Climate Change Research Center.

U.S. Department of Energy. (2005). *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management*. Washington, DC: Department of Energy, United States Federal Government.

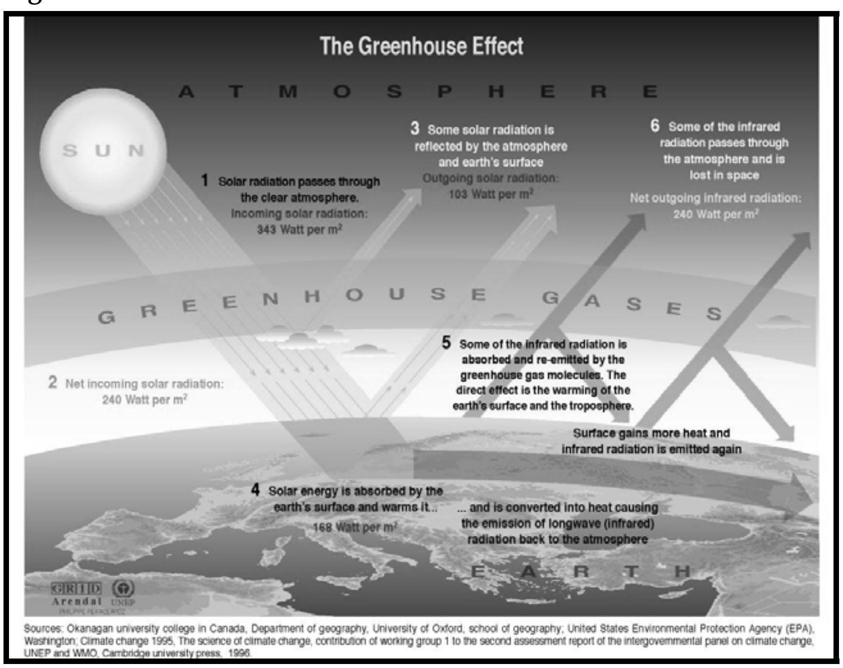
APPENDIX A: CLIMATE CHANGE

Much of the following information is based on the Intergovernmental Panel on Climate Change (IPCC) reports. Formed in 1988 under the United Nations Environmental Programme and the World Meteorological Organization, the IPCC released its fourth report in early 2007 (IPCC, 2007a). It gathers three years of research by hundreds of scientists and policy makers across the globe, as reported in peer-reviewed journals which entailed several rounds of review and more than 30,000 comments that were addressed. ***It is regarded as the single most comprehensive and unbiased report on climate change.***

Causes of Climate Change

Understanding climate change begins with the “greenhouse” effect. This is the process, shown in Figure 11, whereby heat from the sun is trapped within the global ecosystem by gases in the atmosphere.

Figure 10: The Greenhouse Effect



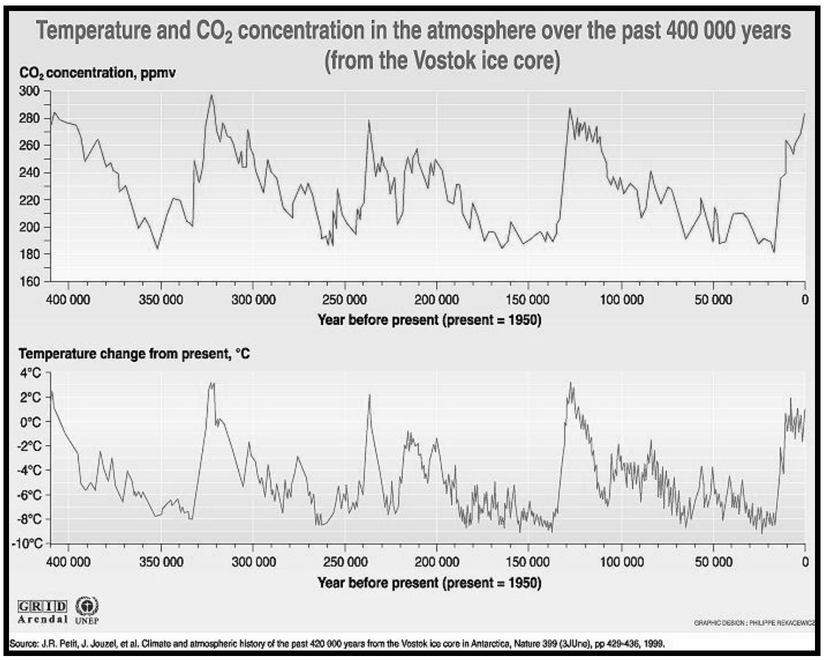
Source: EPA, 1995

As the figure shows, most of the sun’s radiation passes through Earth’s atmosphere. While some of this radiation is reflected back out through the atmosphere, the larger amount is absorbed by the earth’s surface. Once absorbed by Earth, solar radiation is converted to heat and returned as such back into the atmosphere. The so-called “greenhouse” gases such as carbon dioxide (CO_2), methane (CH_4), Chlorofluorocarbons (CFC), nitrous oxide (N_2O), ozone (O_3) and water vapor (H_2O) absorb some of this reflected radiation. This prevents solar radiation from escaping Earth’s atmosphere, increasing temperatures in the atmosphere and ultimately on Earth’s land and sea masses. This process of warming Earth is vital to life’s existence on the planet but the amount of heat retained by Earth in recent years has heightened concerns over its effect on environmental ecosystems.

Of the greenhouse gases, water vapor has the highest concentrations, but of gases attributed to human influence, carbon dioxide is the primary concern. The problem lies in CO_2's concentration in the atmosphere: is estimated to cause some 60% of the enhancement to the greenhouse effect (Hougton et al, 2001).

The following figure shows the relationship between CO_2 and global temperatures over the past 400,000 years (to 1950) as determined from the Vostok Ice Core in Antarctica.

Figure 11: Global Temperature and CO_2 Concentrations Over Time

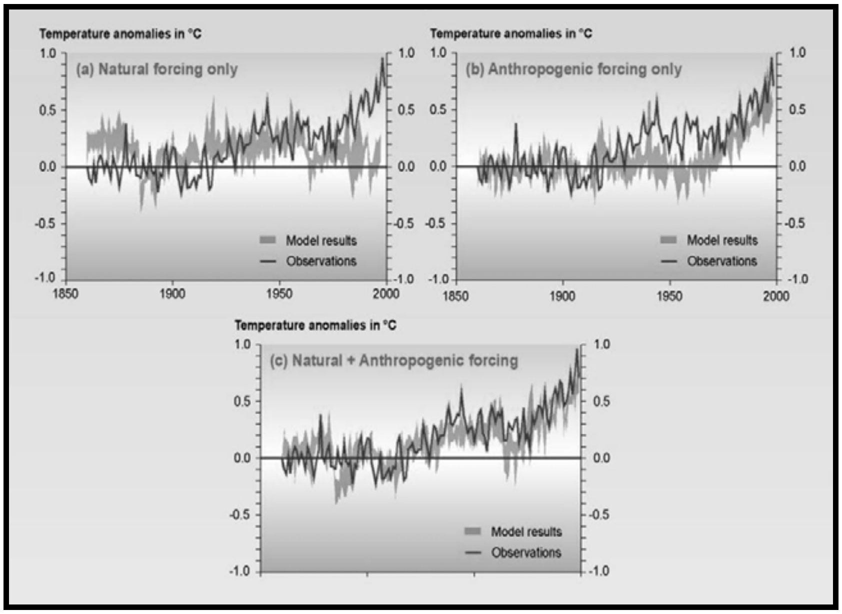


Source: Pettit, et al. 1999

Carbon dioxide levels have varied between 180 parts per million by volume (ppmv) to 300 ppmv. Throughout this period, Earth's temperature closely followed the rise and fall of levels. Current estimates show that atmospheric CO_2 reached 386 ppmv in 2007 (NOAA, 2007).

Carbon dioxide is a byproduct of burning fossil fuels. Its increased presence in Earth's atmosphere began with the Industrial Revolution, and has increased since then. As previous data suggest, it is an indicator of temperature change. Figure 12 goes a step farther and compares modeled temperature fluctuations with observed temperature readings from 1860-2000.

Figure 12: Modeled and Observed Temperature Fluctuation: 1860-2000



Source: IPCC, 2001.

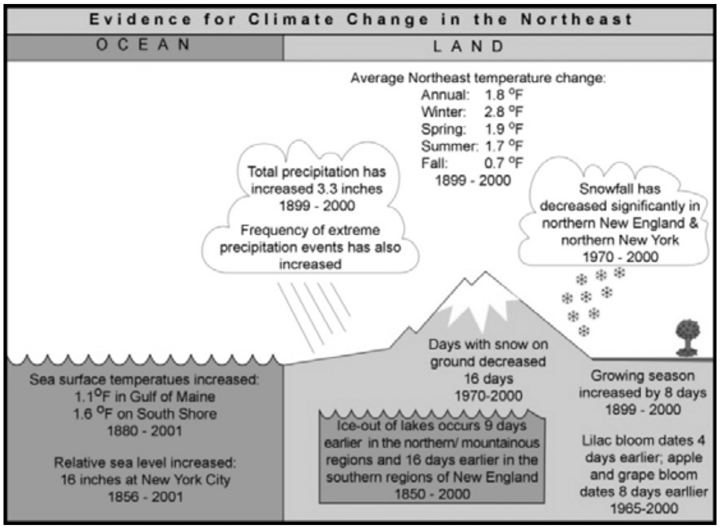
These three graphs show three models: natural forces only, anthropogenic forces only, and their combined forces. Dating approximately to 1960, the modeled trends of natural forces do not fit with the observed temperatures. A similar disparity arises when only anthropogenic forces are models; modeled trends do not fit with actual temperatures readings between 1910 and 1970. The final shows modeling based on both forces and closely matches the actual temperature readings. This suggests that the warming trends since 1860 are the result of both natural and anthropogenic causes, with anthropogenic causes having a greater affect on temperature over the past 20-30 years.

The data presented reveal that historically, global temperatures have been in sync with carbon dioxide levels of the planet. This is to say that as carbon dioxide levels increased, global temperatures followed. Current levels of carbon dioxide, 386 ppmv in 2007, are the highest levels ever experienced throughout the last 400,000 years. The increased levels of carbon dioxide result from burning of fossil fuels and are conclusively shown to have affected the global warming of the planet.

Predictable Consequences of Climate Change

Climate change is a global phenomenon, but its effects are realized locally here in New Hampshire and the Northeast. The University of New Hampshire has been a leader in researching the effects of climate change for our region. Their data, summarized below, show that the weather has become hotter, wetter, and more extreme (Wake, 2005).

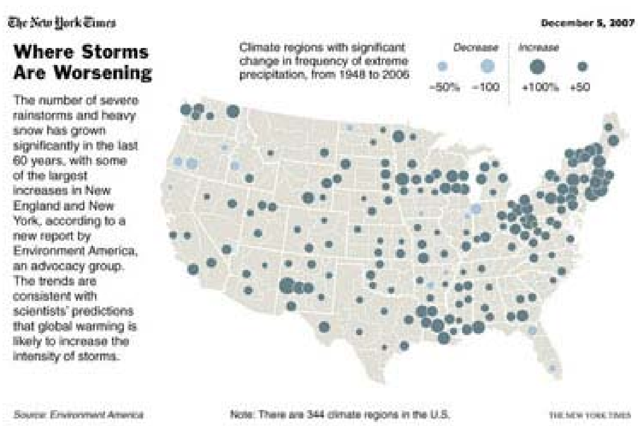
Figure 13: Evidence for Climate Change in the Northeast



Source: Wake, 2005.

Over the past 100 years the Northeast has experienced an average rise 1.8 degrees Fahrenheit. Precipitation has increased 3.3 inches and has become more severe. The average number of days with snow on the ground has decreased by 16 days per year. Sea surface temperatures have increased by 1.1 degrees Fahrenheit in the Gulf of Maine. Ice Out is occurring 9 days earlier in northern regions and 16 days earlier in southern regions of the Northeast. A recent map shows increased storm activity concentrates in the Northeast.

Figure 14: Increased Storm Activity Concentrates in the Northeast



Source: NY Times; Environment America, 2007

Their effect on the region's economy make these changes of great concern. Shorter, warmer winters will result in fewer tourism dollars for skiing, snowmobiling, and ice fishing. Agriculture will be affected by longer growing seasons and habitat changes which will affect crop output. Specifically, maple syrup production is shown to begin 10 days earlier, end 10 days later, and the syrup runs for approximately 3 fewer days than it did 40 years ago (Perkins, 2007). The Seacoast will be affected by sea level rises and increases in storm intensity, prompting insurance companies to withdraw coverage for coastal areas—a reality already for business and home owners in coastal Massachusetts. The healthcare industry will be affected by increase respiratory and heat related illnesses (Harvard, 2007). This is especially a concern for children and the elderly who are most susceptible.

APPENDIX B: PEAK OIL

Directly or indirectly, oil affects nearly every aspect of American life. Efficient, convenient, abundant and affordable, oil has fueled the construction and operation of nearly every machine and structure built in the United States during the last 80 years. In Dover, oil is also implicated in nearly every aspect of life. Fifty-eight percent of all New Hampshire homes are heated with oil (U.S. Energy Information Agency). Most people commute to work or school in a private car or a public bus that run on an oil-based fuel. Diesel-fueled trucks transport more than 90% of all goods by weight to and from New Hampshire; the remaining 10% is transported by oil-fueled ship, rail, or plane (U.S. Census Bureau). Among these goods is more than 95% of the food we eat. The plastic items we use daily are all derived from oil. The production of computers and telecommunication equipment require huge amounts of oil (and water). We need oil before we can perform virtually any activity.

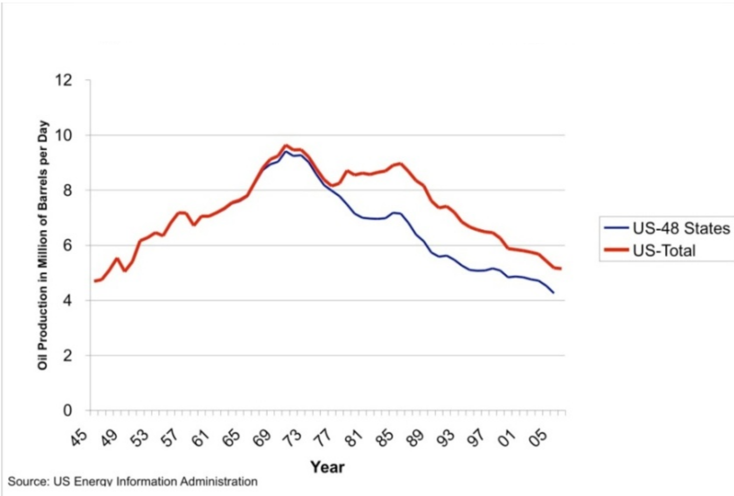
Dover and its citizens are critically dependent on an abundant oil supply in virtually all daily functions. But an important clarification must be made: we depend on the reliable, growing supply of *cheap* oil. Steady flows of *cheap* oil for the last century allowed us to build and maintain our current patterns and standard of living, and the extensive road, sewer, and building infrastructure on which we rely. It should be noted that while this appendix focuses mainly on oil supply, the situation is similar for natural gas supplies.

What is Peak Oil?

Peak oil describes the rate of oil extraction (or production) from an oil field over time. This is because when an oil field is first drilled, the oil is under high pressure and can be extracted with little energy and the production rate increases rapidly. This oil is also of the best quality and takes little money and energy to refine it into a useful product.

However, after roughly half of the oil in the field has been extracted, the pressure drops dramatically, and the rate of production begins a terminal decline. The remaining oil is thicker and of poorer quality; more energy and money are needed to extract and refine it. The graph below shows the rise and fall of oil extraction roughly follows a bell-shaped curve.

Figure 15: U.S. Oil Production, 1945-2005



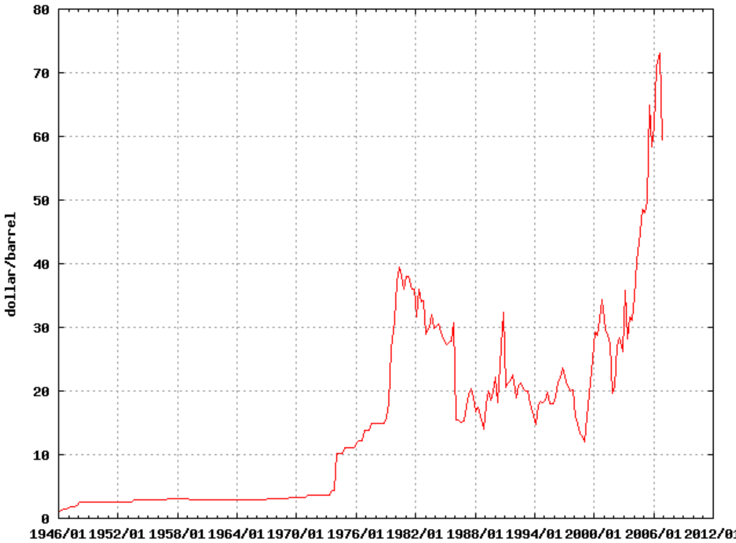
US crude oil production in the lower-48 states (blue) and including Alaska (red) from 1945 to 2005.
Source: EIA, 2006

Oil production from a whole country, oil province, or the world follows the same bell-shaped curve. Figure 1 shows the contiguous United States oil production from 1945 to 2005. The US was the first country to fully explore and extract its oil and as a result, became the first major oil province to reach its peak production (about 10 million barrels per day in 1970). US production has declined since and today stands at about half of the 1970 peak.

In 1956, petroleum geologist M. King Hubbert accurately predicted that the US oil production would peak in 1970. In 1969, he predicted that world oil production would peak in 2000. Oil demand and production declined for political reasons during the oil shocks of the 1970s, during which roughly five years of production were lost. Hubbert did not factor in such *politically* motivated decreases in oil production, so adding five years brings his prediction to 2005. As of today, the world's highest rate of oil production was in 2005 and has declined since then.

Increasing numbers of the world's petroleum experts are concluding that the global oil supplies peaked in 2005 (www.theoildrum.com). Whether that is so, or the peak remains a decade away, is immaterial compared with the impact of declining production. If oil supply begins to fall and global demand continues to rise, driven by growth in China, India, and the US, basic economic theory says oil prices will increase. The figure below shows that the price of oil more than quadrupled in the last six years as the disparity between demand and supply increases. Since these data were compiled, the price of oil reached an all-time high of more than $110 per barrel.

Figure 16: Monthly Price of One Barrel of Crude Oil, January 1946 to December 2006



Source: EIA, 2007

The immediate threat to Dover and Seacoast communities is the escalating price of oil. But as supply decreases, greater numbers of people will find oil decreasingly available. In the US, the balance between oil supply and demand is so tight that any disruption (e.g., violent weather, refinery malfunctions, geopolitical conflict) could deny thousands or millions of people access to oil and gas. In fact, diesel and gas shortages occurred during the spring, summer, and fall of 2007 in Colorado, the Dakotas, Nebraska, Iowa, and Minnesota due to two refinery fires. Some other concerns follow.

Food

The first victim of high oil prices and oil shortages is life's most fundamental need: food. Most of the food in New Hampshire grocery stores is grown and produced in California. We depend upon oil to fuel, lubricate, and pave the way for trucks to transport food more than 3,000 miles to New Hampshire from California.

But, to produce these massive quantities of food in the first place, oil is needed to run farm irrigation systems, to manufacture, distribute, and disperse herbicides and pesticides, power tractors that harvest the food, to transport the food to factories for processing and packaging, and make the packaging itself. We citizens use oil to drive to and from the grocery store to bring food home.

All in all, 90 calories of energy are burned to produce a single calorie of food in the grocery store. Of those 90 calories, 88 come from oil and natural gas (Pfieffer, 2006). As long as our agricultural system depends on farmers thousands of miles away, one constant remains: Before we can eat, we must first have oil.

Transportation

Dover's citizens rely heavily on gasoline and diesel for transportation. Most citizens commute to work and run errands by personal car. A smaller number ride the Downeaster, the various buses that serve the area, or a combination of private and public transportation and an even smaller number walk or bicycle to work. Clearly, the dominant forms of transportation used by Dover citizens depend on oil. Across the nation, even as gasoline prices rose and surpassed $3.00 per gallon for much of 2007 – nearly triple the price from 2000 – gasoline demand continued to increase over the 2006 level. This inelasticity—that gasoline demand rises regardless of cost—underlies our deep oil dependence and the potential economic and social hardship that may occur if gasoline prices become unaffordable or if gasoline shortages occur in the Seacoast region.

Public and Social Services

Nearly all emergency and social services depend on oil. Police, fire, and medical emergency response vehicles all require gasoline or diesel.

Health care costs will increase with peak oil; combined with decreasing incomes, health coverage will decline. Heating fuels for oil or natural gas burning furnaces will become less and less affordable. According to a December 2007 article in the *Nashua Telegraph*, the average household expenditure for heating oil in the Northeast is estimated to increase more than 34% this winter as the price of heating oil continues to climb. Without immediate action, vulnerable and marginalized citizens will be the hardest hit, and their numbers will grow (City of Portland, 2007). Demand for social services will likely increase as the ability to provide service declines (U.S. Department of Energy, 2005).

APPENDIX C: DOVER ENERGY ADVISORY COMMITTEE GOALS AND ACTION ITEMS

GOALS:

- Residents, businesses and the municipal government should adopt energy conservation and efficiency measures, and pursue renewable energy developments that are in the public's best interest.
- Dover households and business should have access to diverse, reliable, affordable, and environmentally responsible energy supplies.
- Encourage smart growth principles such as mixed use, centralized development, higher density and alternative transportation to help reduce energy use.
- The City should adjust economical considerations on projects to reflect the life cycle costs of the building and not just the initial capital costs of construction.
- Monitor and evaluate the city's energy costs and usage on an annual basis.
- Electricity production, transmission and distribution infrastructures in Dover should be efficient, reliable, cost-effective, and environmentally responsible.

ACTION ITEMS:

<u>Municipal</u>

- Create the Dover Energy Advisory Committee as a full committee in Dover.
- Diversify Energy Resources
    - Renewable Energy
        - Schools (wind or solar)
        - Cochecho River (small hydro)
        - Wastewater Facility (Methane Recovery)
    - Purchase Bioheat
    - BioDiesel for Municipal Fleet
- Policy
    - Green Building Ordinance
        - LEED Standards on Municipal buildings
        - Commercial Development
    - Property Tax Exemption
    - Create Revolving Green Fund
    - No Idle Campaign
- Advise City Manager and Council re: Energy Consultant, Performance Contract, and ESCO provider.
- Conduct Walk through Assessments of Municipal Buildings
    - Two Buildings per year
- Municipal Energy Savings Campaign
    - Tip Sheet for Employees
- Update Energy Data, evaluate progress and report back to City Council on a yearly basis.

- Advocate for Energy Saving measures within current committee structures.
- Establish Green Purchasing Program
- Hire Energy/Sustainability Manager

Residential

- Create Residential Energy Savings Campaign:
    - Apple Harvestfest presence
    - Quarterly Workshop session
    - Develop Website
    - NH Carbon Challenge
    - Energy Toolkit in Library

Community

- Reduce Vehicle Miles Traveled by encouraging a more walkable and bikeable community.
- Encourage and Promote Farmer's Market.
- Encourage residential and commercial growth in Dover downtown.
- Outreach to Regional Communities.
- Create School Energy Savings Campaign with Teachers.
- Create Business Energy Savings Campaign with Chamber.
- Pursue funding to develop Adaptation Program to prepare city infrastructure for climate change (increased frequency and strength of storms).

The Committee is valuable and has more to offer.