Healthy Air and Energy Fact Sheet Number 2

Maine's Potential for Healthy Energy Development

FORWARD

This is the second in a series of documents intended to provide background for policy decisions in Maine on energy and healthy air. There is a strong international consensus on the need to reduce greenhouse gas emissions from fossil fuel sources over the next three to four decades by as much as 80%. The resulting benefits to air quality and respiratory health would be considerable. This transformation of our energy system will require us to move towards a sustainable energy policy focused predominantly on conservation, efficiency, and renewable energy sources. With this document, the American Lung Association of Maine is presenting an overview of the potential from energy efficiency and renewable energy sources in Maine. Along with our first report on the uses of energy in Maine, this report will help provide a context for the nature and magnitude of the policy challenges that we must face with increasing urgency over the coming years. The summary is not intended to be comprehensive. Part of its objective is to stimulate further inquiry, which we will examine in subsequent publications.

OVERVIEW

Energy production and use is the primary source of air pollution in Maine and the United States and is a significant contributor to global warming. As such, it is a major contributor to unhealthy air and, by extension, lung disease. The American Lung Association of Maine (ALAME) is committed to reducing the physical and financial toll of asthma and other lung diseases. Our Healthy Air Campaign seeks to limit local sources of air pollution and support regional and national efforts to reduce harmful emissions. Success hinges largely on how we, as a society, respond to the challenge of changing our pattern of energy consumption in order to avert harmful and potentially disastrous consequences. In Maine, we are in the midst of a growing effort to implement climate action plans that will substantially reduce emissions of carbon dioxide and other greenhouse gases from energy consumption. This effort is taking place both at the state and community levels.

Maine has an abundance of renewable resources, including hydro, biomass, wind and solar.[1] Renewable resources, besides being available in Maine, can be much cleaner than the fossil fuels we currently rely on. When combined with aggressive strategies to reduce our overall consumption through effective energy conservation and energy efficiency programs, we have the means to address the looming challenges of air pollution and global warming in Maine, and even to serve as a model for action beyond our borders.

The American Lung Association of Maine is pleased to address "Maine's Potential for Healthy Energy Development" and urges readers to join us in the fight for healthy air.

Sign up now to become an e-advocate at http://lungaction.org/ala_maine/join.tcl

MAINE'S HEALTHY ENERGY POTENTIAL

Maine is blessed with an abundance of natural resources, from its forests to its lakes and streams and its coast. These natural resources also include renewable energy— the sun, wind, moving water, organic plant and waste material (biomass), the earth's heat (geothermal), and wave and tidal action. These energy resources are renewable, meaning they naturally replenish themselves over short periods of time so they are not depleted.

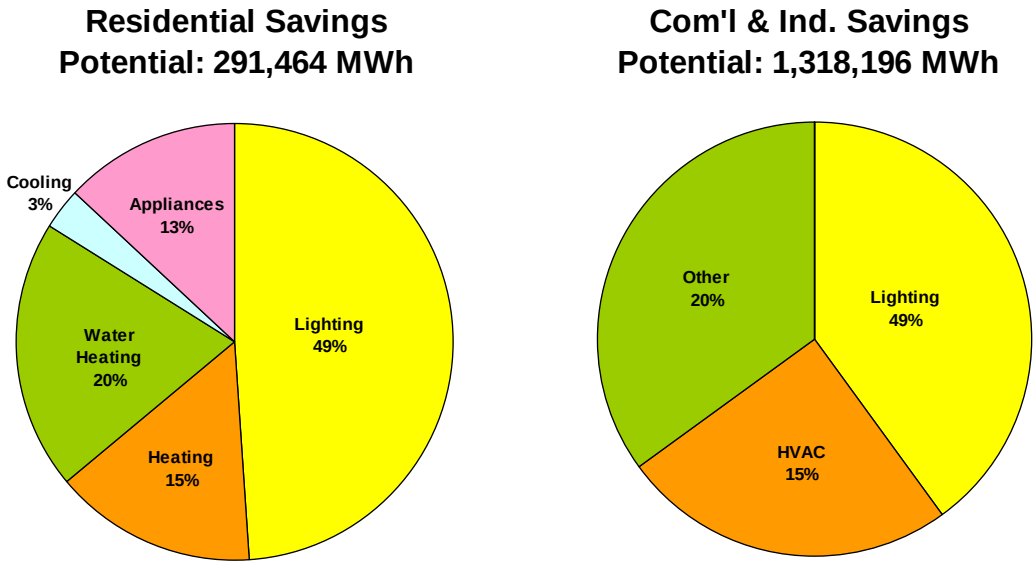
Although renewable energy resources are environmentally preferred, all energy use leaves an environmental footprint. On the other hand, using less energy through increased energy efficiency has little or no environmental impact, and that is where we begin.

ENERGY EFFICIENCY

First and foremost among Maine's healthy energy potential is the savings from energy efficiency. It is often said that "the cleanest kilowatt hour (kWh) is the one you never use," and not only is energy efficiency beneficial to healthy air, it is also by far the most cost-effective option for cleaning our energy supply.

- ELECTRICITY

There are great electric energy savings to be found if energy efficiency measures are aggressively undertaken. One study estimates that Maine's maximum achievable electric energy savings potential is 1.6 million megawatt hours (MWh) per year by the year 2012.[1] Most of the potential—about 80%--was found in the commercial and industrial sectors. Total savings would equate to 14.0% of retail electricity sales in Maine in 2002, when the study was done.[2] Savings were estimated to come from a variety of end use applications, as shown in Figure 1.



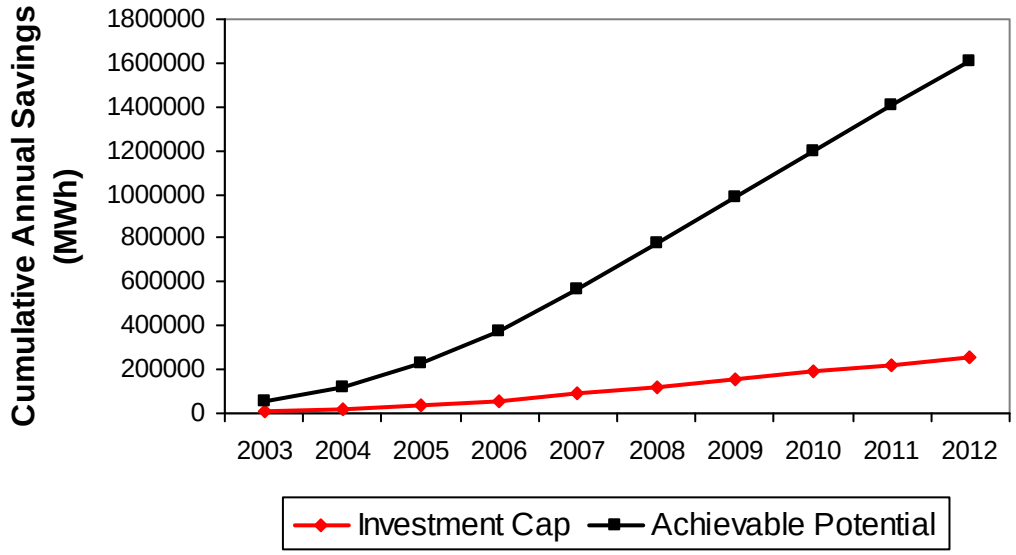
Source: Denis Bergeron, Maine PUC.

Figure 1. Maximum Achievable Electricity Savings Potential

Homes could use more efficient lighting, space heating and appliances, while businesses could find savings in more efficient lighting, air conditioning, refrigeration, motors, ventilation and cooling, and building system controls.

As shown in Figure 2., the achievable potential is estimated to be over 1.6 million MWh by the year 2012, while the path we are currently on is expected to save only about 250,000 MWh, or 16% of the achievable savings. In either case, the savings can be obtained only by investing in energy efficiency improvements. Maine currently invests $15 million per year in energy efficiency improvements (funded by a surcharge of up to $.0015 per kilowatt-hour (kWh) of electricity sales) The difference between what's actually happening and what could be happening leaves some 1.35 million MWh of healthy energy resources untapped.

Figure 2. Energy Savings Potential under Two Scenarios: Maximum Achievable Potential vs. Current Cap on Investment



Certainly, capturing the achievable potential would cost much more—an average of $79 million per year versus $15 million per year—but the net benefits are $700 million for the maximum achievable savings, compared to only $ 83 million for the current budget-constrained path.[3] Not only is the achievable potential more than six times the megawatt hour (MWh) savings that could be achieved under current funding, the true potential is likely much greater. Since this estimate was made in 2002, electricity prices have continued to rise and technology has improved, with the effect of increasing the amount of energy efficiency that is cost-effective today.

- FOSSIL FUELS

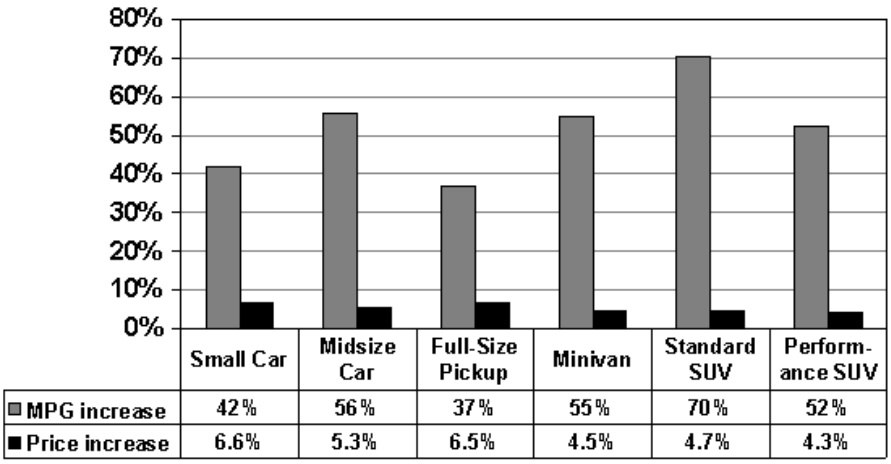
Beyond electricity, additional potential savings may be captured from the use of fuel oil and natural gas for space and water heating. There are no comprehensive estimates of natural gas or fuel oil savings available for Maine, but 80% of Maine households use fuel oil for home heating. One study has estimated that saving natural gas through increasing efficiency of use by 1% per year over the next five years would cost a little over $22 million but would return about $78 million in savings over the period, for a net benefit of $56 million.[4]

- TRANSPORTATION

Though this paper is not looking closely at non-electricity uses of energy, such as for transportation and heating, it is clear that there is significant potential for healthy energy in Maine. For example, energy used for transportation in Maine accounts for over a quarter of our total energy use. The potential for savings and energy efficiency is great if we have the will to tackle it.

The American Council for an Energy-Efficient Economy has estimated that the U.S. could achieve increases in fuel economy ranging from 37% to 70% for a very modest increase in cost of new vehicles, as shown in Figure 3.[5]

Figure 3. Fuel Economy and Price Increase Estimates for Moderate Technology Package of Design Improvements Achievable by 2010-2015



	Small Car	Midsize Car	Full-Size Pickup	Minivan	Standard SUV	Perform-ance SUV
MPG increase	42%	56%	37%	55%	70%	52%
Price increase	6.6%	5.3%	6.5%	4.5%	4.7%	4.3%

Source: ACEEE

RENEWABLE ENERGY POTENTIAL

Estimates of Maine's renewable energy potential are constantly changing. For example, a recent report delivered to the Governor's Task Force on Wind Power (c.f., Bob Grace, *Development of a Wind Power Resource Deployment Framework for Maine and New England*, October 30, 2007) indicates that the estimates presented in this document may be low relative to current projections. On the other hand, these estimates should provide a sufficient overall context from which to assess Maine's opportunities to improve our healthy energy profile.

- BIOMASS

Maine has significant raw biomass resources (wood products), but most is used to make pulp and paper, lumber and other forest products. This is the traditional use of Maine's biomass, and it is of greater value in these products than if it were used to generate electricity. Relying on bark, mill waste and sawdust, as well as purchased wood, most of the pulp and paper mills use a biomass boiler to generate process steam and electricity. There are also about 10 stand-alone biomass power plants in the state. These 10 plants together with the pulp and paper mill boilers have a combined electric generating capacity of about 660 megawatts (MW).

Maine biomass plants are currently paying about $30/green ton of biomass feedstock. At this price, Maine has enough forest residue (tree tops and branches not currently used) available to feed roughly another 100 MW of electricity generating capacity.[6] Of course, if generators would pay more, more feedstock would be made available. The price of electricity would have to rise to make this possible.

In addition, there are other potential uses for biomass. At the national level, there has been much discussion about making liquid transportation fuels, such as ethanol, from biomass. One Maine firm has announced its intention to develop a wood-to-ethanol process at a former pulp and paper mill in Old Town. The technology for making ethanol from woody biomass is still being developed, and this use would compete with traditional uses to some extent, depending on the price consumers are willing to pay for alternative fuels.

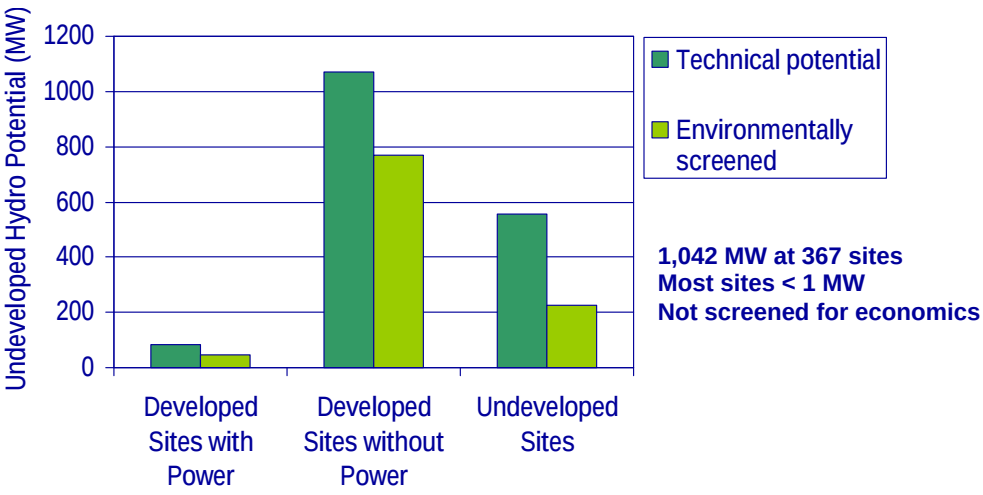
Because there are environmental considerations to the use of any natural resource, it is worth noting that some 7 million acres (about 37%) of Maine's productive forestlands are currently certified as being sustainably managed.[7]

Source: NREL 13531

- HYDRO

With its many rivers and streams, Maine also has significant hydro electric potential on top of the existing hydro capacity (over 700 MW) already operating. A national laboratory study concludes there is still potential for adding over 1,000 megawatts (MW), most of it at existing dams that have no power production facilities (see Figure 4).[8] According to the study, this potential excludes environmentally unacceptable sites. , Most of Maine's hydro potential is at sites with less than one megawatt of potential capacity, which may be too small to be economically developed. This may explain why a more recent assessment for the Regional Greenhouse Gas Initiative estimated only 174 MW of hydro potential in Maine.[9]

Figure 4. Undeveloped Hydro Potential in Maine

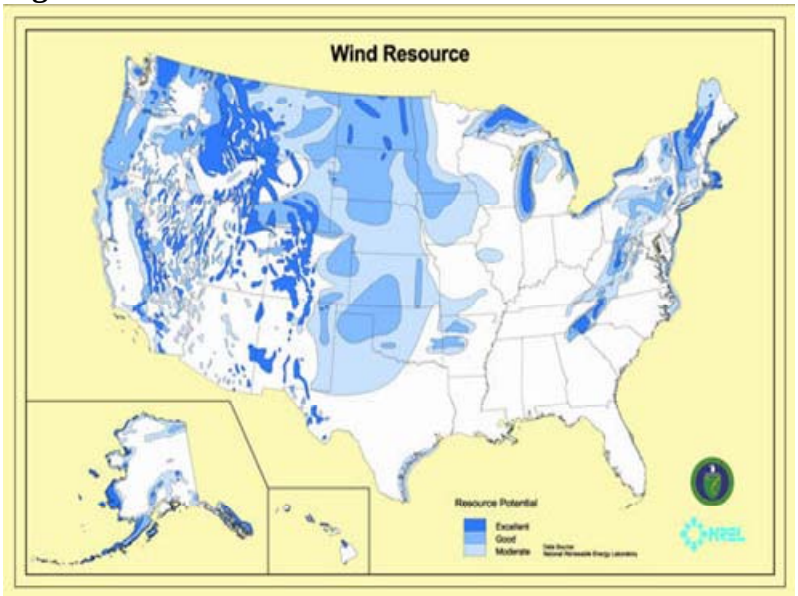


INEL, U.S. Hydropower Resource Assessment for Maine, 1995

- WIND

Wind resources in the Unites States are shown in Figure 5, where the darker the color, the stronger the wind. Based on measurement and computer modeling of wind resources, Maine has a theoretical potential of some 8,000 MW of land-based wind power. A more realistic estimate is probably somewhere between 1,000 to 2,000 MW.[10] A study for the Regional Greenhouse Gas Initiative, however, estimated Maine's onshore wind potential at a little over 4,000 MW.[11] The potential for offshore wind is generally thought to be greater, though it has not been studied carefully for the state of Maine, and may be limited by deep water. One estimate is only 154 MW,[12] and this may be because offshore wind is more expensive than land-based wind facilities. Onshore, the windiest sites are typically at higher elevations. Click here for a wind map for Maine.

Figure 5. U.S. Wind Resource



Source: NREL

- SOLAR

Despite our northern latitude, Maine has strong solar energy potential because we have many sunny days. Practical solar applications in Maine take two forms: non-electric solar energy for space and water heating, and solar photovoltaic electricity generation.

Solar heating uses the energy of the sun to heat air or a fluid, which then transfers solar heat directly to a building or a water tank. According to the U. S. Department of Energy, a typical residential solar water-heating system, for example, reduces the need for conventional water heating by about two-thirds. It minimizes the expense of electricity or fossil fuel to heat the water and reduces the associated environmental impacts. The efficiency and reliability of solar heating systems have increased dramatically, making them attractive options in the home or business.

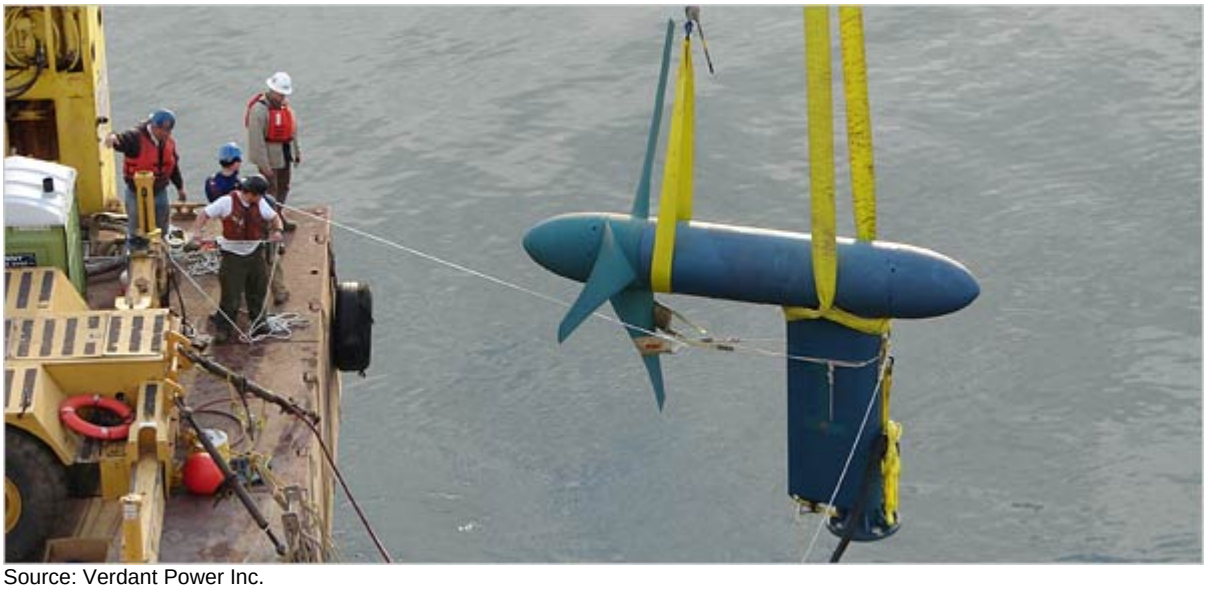
Solar electric systems generate electricity from photovoltaic cells (photovoltaic means electricity from light). When the cells are linked together, they are called solar photovoltaic (PV) modules. PV modules can be mounted on rooftops or on free-standing poles. Solar electric systems can be either connected to the grid, using utility-supplied power for backup, or supplemented with battery back-up to store energy for when the sun doesn't shine. Most projects are grid-connected, and Maine utilities are required to credit you for any excess power that is generated but not used on site.

Few power-generation technologies have as little impact on the environment as photovoltaics. As it quietly generates electricity from light, PV produces no air pollution or hazardous waste, and it doesn't require liquid or gaseous fuels to be transported or combusted. The biggest barrier to solar PV has been its cost, despite the fact that radiant energy from the sun is free. For small systems, PV energy costs are higher than those of energy bought from your local utility, but if you need power in an area not served by a utility, PV may be the most cost-effective option.

- OCEAN ENERGY

Energy from the ocean, in the form of tides and waves, is also renewable. While tides and thus tidal currents are driven primarily by the gravitational pull of the moon, waves are driven primarily by the winds. The conversion of both tidal and wave energy to electricity usually involves mechanical devices.

Tidal turbines, for example, may take different forms, but one model looks somewhat like wind turbines. They are arrayed underwater where coastal currents are strongest. The technical, environmental and economic feasibility of such tidal turbines are currently being studied at several sites along Maine's coast, but no turbines are in the water as of 2007. A small test is being conducted in New York City's East River (see photo).



Source: Verdant Power Inc.

Electricity generation from the action of ocean waves also is a developing technology, with little experience so far in the United States, though various prototypes and demonstration projects are being tested in Oregon. The wave power potential in Maine is probably greater than the tidal power potential, but the latter is likely to be deployed earlier because tides are more predictable than waves, and wave conversion technology may be more costly because it has to be able to withstand extreme weather.

SUMMARY

Maine has abundant healthy energy resources in the form of biomass, hydro and wind. Although the potential from solar and ocean energy (tidal currents and waves) is certainly large, this has not been quantified. The results are summarized in **Table 1**.

Table 1. Electric Energy Potential from Healthy Energy Sources in Maine

Resource	Incremental Potential (MWh)*	Percent of Maine Electricity Use 2005**
Energy Efficiency	1,353,904	11.0%
Biomass	569,400	4.6%
Hydro	990,756	8.0%
Wind	5,256,000	42.5%
Solar	Not available	
Ocean	Not available	
Total	8,170,060	66.1%

*Energy Efficiency is the difference between achievable potential and potential savings at the current funding cap. This amount does not estimate potential beyond 2012. Biomass assumes 100 MW with a capacity factor of 65% based on 2005 data reported to EIA. Hydro assumes 174 MW with a capacity factor of 65% based on 2005 data reported to EIA. Wind assumes 2000 MW with a capacity factor of 30%.
**Electricity use as reported by EIA was 12,362,879 MWh in 2005.

As Table 1. shows, Maine could theoretically meet two thirds of its current electricity needs if we take maximum advantage of our known energy efficiency and renewable resource potential (this estimate doesn't include potential solar or ocean energy). Since Maine is already using renewable energy resources to supply about one third of our electricity needs, the table illustrates that this untapped healthy energy potential is roughly equivalent to our total electrical energy consumption through fossil fuels.

We are living in a dynamic world. Changes in energy prices and competing demands for biomass will affect the resource potential. Interstate energy sales will also come into play, affecting the supply of healthy energy. There is also the potential for solar and ocean energy that has not yet been quantified for inclusion in this analysis. These factors and more will determine whether Maine can completely replace its electricity needs with healthy energy sources, and if additional healthy energy can be made available for our transportation and heating needs.

In sum, there can be no doubt that the potential for healthy energy production in Maine is extremely high. Currently, there is much promise for further energy efficiency and wind projects in particular, as well as for further developing emerging technologies such as wave and tidal power. Tapping that potential poses economic, environmental, and political challenges. It remains to be seen whether Maine will confront those challenges and move forward with its healthy energy potential.

Acknowledgement: *This paper was prepared for the American Lung Association of Maine by Ed Holt and Associates, Harpswell, Maine.*

FOOTNOTES

[1] Optimal Energy, Inc. and Vermont Energy Investment Corporation, The Achievable Potential for Electric Efficiency Savings in Maine. Prepared for the Maine Public Advocate, October 22, 2002. "Achievable potential" indicates the savings that could be realized if aggressive market intervention strategies are applied. It includes such factors as estimated market penetration rates and market saturation rates. Maximum achievable potential indicates the savings that could be achieved if budgetary constraints are not a factor.
[2] Total retail electricity sales in 2002 were 11,441,358 MWh.
[3] Optimal Energy and VEIC, op. cit.
[4] Environment Northeast, Climate Change Roadmap for New England and Eastern Canada. 2006.
[5] John DeCicco, Feng An, and Marc Ross, Technical Options for Improving the Fuel Economy of U.S. Cars and Light Trucks by 2010-2015. Report Number T012. American Council for an Energy-Efficient Economy, 2001.
[6] Eric Kingsley, Innovative Natural Resource Solutions LLC, email September 3, 2007.
[7] Maine Forest Service, http://www.maine.gov/doc/mfs/certification/forcert_maine.htm (accessed Sept. 25, 2007).
[8] Idaho National Engineering Laboratory, U. S. Hydropower Resource Assessment for Maine, 1995.
[9] Environment Northeast, Climate Change Roadmap for New England and Eastern Canada, Table 1.27. 2006.
[10] Maine Public Utilities Commission, Report on the Viability of Wind Power Development in Maine, January 2005.
[11] Environment Northeast, op. cit.
[12] Ibid.